# 20CE 302 Data Structures

| **Teaching Scheme** | **Examination Scheme** |
| --- | --- |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| Tutorial: 1 Hour / Week | End Semester: 50 Marks |
| | Credits: 4 |

**Course Objectives:**

To facilitate the learner to

1. Learn and understand representation, implementation and applications of data Structures
2. Choose and apply linear and non linear data structures for developing solutions for solving problems in various domains.
3. Demonstrate ability to use stack and queue data structures to solve problem
4. Understand and apply the concepts of hashing.
5. Analyze algorithms using time complexity analysis

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply appropriate data structure to construct efficient algorithms to approach the problems.
2. Distinguish between various linear data structures based on their representations and applications.
3. Apply principles of data structures- stack and queue to solve computational problems.
4. Apply non linear data structures –Trees and Graphs to solve a problem.
5. Apply the concept of Hashing techniques for solving a problem.
6. Analyze algorithms using time and space complexity

**Unit I: Introduction to Algorithms; Sorting and Searching (07)**

Introduction to Algorithms, Pseudo code, Abstract Data Types (ADT): e.g. Arrays as ADT, Introduction to Data Structures, Frequency Count, Analyzing Algorithm using Frequency count, Time complexity of an Algorithm, Asymptotic notations, Best, Worst and Average case analysis of an Algorithm. Sorting: Bubble sort, Insertion sort, Quick Sort.
Searching: Linear Search, Binary Search. Time complexity analysis of sorting and searching

Algorithms. Case study: Timsort

**Unit II: Linked List** **(07)**

Concept of Linked List, Comparison of Sequential and Linked Organizations, Linked List using Dynamic Memory Management, Linked List as an ADT, Singly Linked List , Doubly Linke List, Circular Linked List operations. Time complexity analysis of Linked List operations.
Case study: Garbage collection

**Unit III: Stack and Queue** **(07)**

Stack as an ADT, Representation and Implementation of Stack using Sequential and Linked Organization, Applications of Stack- Simulating Recursion using Stack, Arithmetic Expression Conversion and Evaluation. Queue as an ADT, Representation and implementation of Linear Queue, Circular Queue, Priority Queue .Time complexity analysis of Stack and Queue operations. Time complexity analysis of algorithms using stack and queue data structures.
Case study: Priority queue in bandwidth Management

**Unit IV: Trees** **(08)**

Introduction to Non Linear Data Structure, Binary Trees, Types of Binary Trees, Properties of Binary Trees, Binary Tree as Abstract Data Type, Representation using Sequential and Linked Organization, Binary Tree creation , Recursive and Non Recursive Tree Traversals, Binary earch Tree and its operations, B Tree, Heap as ADT.
Case study: expression tree, Heap as priority queue.

**Unit V: Graphs** **(07)**

Basic Terminologies, Storage Representation, Graph Traversals, Graph as Abstract Data Type, Spanning Trees, Minimum Spanning Trees, Kruskal's Algorithm, Prim's Algorithm, Dijkstra's Single Source Shortest Path Algorithm. Time complexity analysis of graph algorithms.
Case study: Google maps.

**Unit VI: Hashing** **(06)**

General idea of Hashing, Hash Table, Hash function, Rehashing, Issues in Hashing, Collision Resolution Strategies: Linear Probing, Open addressing and Chaining. Time complexity analysis of hashing techniques.
Case study: Telephone dictionary.

**Text Books:**

1. Sartaj Sahani, "Data Structures, Algorithms and Applications in JAVA", Universities Press (2 nd edition).

2. Robert Lafore, "Data Structures Algorithms in JAVA", Techmedia,(1 st edition).
3. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Publications ,(2 nd edition).

**Reference Books:**

1. Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, "Data Structures using C and C++" , Pearson Education, (2 nd edition).
2. A. Aho, J. Hopcroft, J. Ulman, "Data Structures and Algorithms", Pearson Education, (2 nd edition).
3. Brassard and Bratley, "Fundamentals of Algorithmics", Prentice Hall India/Pearson Education, (2 nd edition) .
4. M. Weiss, "Data Structures and Algorithm Analysis in JAVA", Pearson Education (3rd edition), (2012).
5. Goodrich, Tamassia, Goldwasser, "Data Structures and Algorithms in JAVA", Wiley publication, (6th edition).
6. R. Gillberg, B. Forouzn, "Data Structures: A Pseudocode approach with C", Cenage Learning, (2 nd edition).

**Online/Web/Other References:**

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
3. http://web.stanford.edu/class/cs166/

**Suggestive List of the Tutorial Assignments:**

Following list of tutorials can be considered as guideline for designing tutorials:
Every student should perform 12 to 14 tutorials which will cover topics of all units mentioned in the syllabus of Data Structures. Tutorial assignments will enhance the understanding of the concepts of problem solving, algorithms and data structures. Students will perform practice exercise on data representation and corresponding implementation of the data structures. Students will get opportunity to develop their logic building abilities.

Following list of tutorials can be considered as guideline for designing tutorials:

1. Demonstration of a program implementation and execution using eclipse tool.
2. Design an algorithm for simple problems like GCD calculation, power calculation etc.
3. Calculate frequency count, time complexity of sample algorithmic constructs.
4. For given algorithms of array operation, write equivalent JAVA code.
5. Practice exercise on sorting and searching algorithms for set of predefined inputs.
6. Calculate time complexity of sorting algorithms using concept of frequency count.
7. Create a linked list and write algorithms for traversal, delete a node, add a node operations on a list.
8. Create a doubly or circular linked list and write algorithms for traversal, delete a node, add a node operations on a list.
9. Solve brain teaser based on recursive code snippets.
10. Demonstration on debugging techniques.
11. Select appropriate data structures and design algorithmic solution to given application.
12. Solve puzzles based on queue data structure
13. Practice exercise on creating binary tree and perform recursive and non recursive traversal of binary tree on given data
14. Creating binary search tree for given data and perform inorder, preorder, postorder traversal.
15. Practice exercise on searching and deleting data values from given binary search tree.
16. Design a solution for "company survey" about its products in an area. Choose the appropriate algorithm to complete the survey within short period and cover all houses under that area. Give justification for your answer and also analyze your algorithm for time complexity
17. Visualize various data structures using open source tools
18. Given the input data and hash function , show the result using hashing methods .
19. Use different hashing functions to hash given values.

20. Construct a Btree of order 3 by inserting numbers of given data
21. Practice exercise on Dijkstra's algorithms.
22. Practice exercise on graph MST algorithms.
23. Practice exercise on Heap data structures.

# 20CE 302L Data Structures Laboratory

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical : 4 Hrs/Week | In Semester : 25 Marks |
| | Practical : 25 Marks |
| | Credits: 2 |

**Prerequisite:**

1. 20ES05 Fundamentals of Programming Language
2. 20ES05L Fundamentals of Programming Language Laboratory

**Course Objectives:**

To facilitate the learner to

1. Develop algorithmic foundations to solve problems.
2. Select and use appropriate data structure for a given problem statement.
3. Analyze algorithms using time complexity.
4. Implement small application using data structures.

**Course Outcomes:**

After completion of the course, students will be able to

1. Select appropriate data structure for given problem.
2. Develop the solution for the given problem using programming language.
3. Analyze solutions using time complexity.
4. Design a small application using data structure.

**Preamble:**

The laboratory assignments are designed in a set of group A, B and C such that students will be able to design and implement solution for a given problem using various data structures. Motivation here is that students should be able to code the basic algorithm and select appropriate data structure to implement the solution of given problem. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Group B assignments are designed in such a way that students will choose appropriate data structures to implement solution of a given problem. Some assignments of group A are designed to make students able to implement Abstract Data Type of a data structure and use it for a given application. Faculty members should choose the assignments from group A such a way that all the units of the syllabus of Data Structures are covered. In group C assignments students will design an algorithmic solution for selected problem using concepts covered in the subject Data Structures.

The laboratory assignments of group A and B are to be submitted by student individually using C++/JAVA object oriented programming language. Group C assignments may be performed in a group of 2 to 4 students from the same batch. For each assignment program code with sample output is to be submitted as a soft copy.

**Suggestive List of Assignments**

**Group A : (Any Six)**

1. In a group of M persons, some people can speak English and some people can speak French. Implement program to find and display-
   1. People who speak either English or French or both.
   2. People who speak both English and French.
   3. People who speak only English not French.
   4. Remove the person from the group.
2. Consider students marks of specific subject are to be stored using Array as ADT. Implement operations to summarize/ analyze the marks of the subjects.
3. Consider a mobile phone stores name and contact number in ascending order. Write program to search a contact details of specified name.
4. Consider students roll numbers and percentages of SY class are stored. Implement operations to arrange students records in ascending/ descending order based on their marks using various sorting methods.
5. Implement Doubly Linked List as ADT .Use same ADT to simulate Browser URL application.
6. Implement Singly Linked List as ADT. Use same ADT to simulate deck of cards application.
7. A 'concordance List' is an alphabetical list of words that appear in the book. Implement concordance list using ordered Linked List with insertion function that restrict duplicate value to be inserted in the list.
8. Implement Singly Linked List as ADT. Use it to simulate banking operations.
9. Student's information along with their percentage is stored in linked list for every division. Generate a combine list of students which is sorted in descending order based on their percentage.
10. Implement Stack as ADT using linked list or array. Use same ADT to check given expression is well formed parenthesized.
11. Implement Stack as ADT using linked list or array. Use same ADT to evaluate given postfix expression.
12. Implement Priority Queue as ADT using linked list or array. Use ADT to simulate pizza parlor order management.
13. Operating system stores N jobs and processing time require to complete each job in data structure. Design a program to simulate the job execution sequence

14. Implement Queue as ADT . Use Queue ADT to simulate 'waiting list' operations of railway reservation system.
15. Company wants to lease phone lines to connect its offices of different cities, with each other. Company charges different amounts of money to connect different pairs of offices. Solve the problem using graph data structures to connect all offices of a company with a minimum cost.
16. Implement graph as ADT to represent current flow in electrical circuit board.
17. An airport is developing a computer simulation of air traffic control that handles events such as landings and takeoffs. Each event has a time stamp that denotes the time when the event will occur . Develop a code for inserting an event and exacting most recent event and display all events. Use heap as ADT to implement priority queue .
18. Consider players score obtained in game are stored. Find out maximum and minimum score obtained in that game using heap data structure.
19 . Implement binary tree as ADT and use it for simulating operations on employee data.
20. Implement open hashing technique and use it to quickly look up employee's information. Provide facility to insert, display, search record .
21. Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number.
22. Implement dictionary as ADT using hashing technique.

**Group B: (Mandatory)**

1. Department of Computer Engineering has 'CSI student branch'. Students of second, third and final year can subscribe to membership. Design a system to maintain CSI student branch membership information to add, delete, and modify details of records with ease. Use appropriate data structure.
2 College Library maintains records of books. Book records contain basic information of book. Book records are to be listed in the specific order. List of books of specific author are to be searched. Use appropriate data structure to perform sorting, searching operations of book data effectively.
3. A dictionary t stores keywords and its meanings as a key value pair. Use appropriate data structure that will provide minimum comparisons to find any keyword. Provide facility to adding new keywords, deleting keywords and modifying meaning of keywords.
4. A news paper delivery boy every day drops news paper in a society having many lanes and houses. Design a program to provide different paths that he could follow. Solve the problem by suggesting appropriate data structures. Design necessary classes.

**Group C:**

1. Design a game like snake and ladder, tic-tac-toe, generating magic square.
2. Design a small application using appropriate data structures to manage library data medical shop data/ College admission data / P.M.P.M.L. bus scheduling data etc.

# 20CE 304L Digital Systems Laboratory

**Teaching Scheme**

Practical : 2 Hours / Week

**Examination Scheme**

In Semester : 25 Marks

Oral: 25 Marks
**Credits: 1**

**Prerequisite:** Basic Electrical and Electronics Engineering (20ES01)

**Course Objectives:**

To facilitate the learner to

1. Understand the basic digital circuits and logic design.
2. Apply techniques for designing combinational and sequential circuits.
3. Apply the knowledge to select different digital IC packages as per design specifications.
4. Develop minimum digital systems for simple real time applications.

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply the knowledge of basic gates to build digital circuits.
2. Make use of available circuit packages to develop combinational circuits.
3. Apply the knowledge of sequential circuits design to model digital systems.
4. Build a small digital system using an emulator tool.

The laboratory work of Digital Electronics Lab is designed to enhance problem solving in digital electronics with the help of Boolean algebra, logic gates, computer number systems, data encoding, combinational and sequential elements. The circuit optimization is introduced using K-Maps. The solution building to real world problems is aimed with the help of circuit packages. Faculty members are encouraged to expand problem assignments with variations for Group B and Group C assignments. Assignments can be framed and expanded to understand the basic concepts, design steps, logic of solution and simple digital application. The students will be also encouraged to experiment open problems with the designs using appropriate emulator tools. Faculty will ratify the assignments on similar lines as examples shown here. Majority of Group A assignments are based on combinational circuits such as code converter, multiplexer, decoder etc. and partially sequential circuits such as Asynchronous and Synchronous counters. Group B assignments are based on sequential circuits such as sequence generator, sequence detector, ASM using flip-flops as well as based on real world application level assignments. Group C assignments are based on implementation of different real time applications based on combinational and sequential circuits.

**Suggestive List of Assignments**

**Group A : (Perform minimum 6)**

1. Design and implement different logic circuits by using Basic gates and Universal gates.
2. Design and implement code converter circuits e.g. Binary to Gray, BCD to Ex-3 etc.
3. Design and implement circuits using Multiplexer and Decoder.
4. Design and implement a circuit to detect the error in the digital data communication system.
5. Design and implement Binary subtractor using 1's and 2's complement method. Use binary adder IC 7483.
6. Design and implement Asynchronous counters using a given flip flop.
7. Design and implement Synchronous counters using a given flip flop.

**Group B: (Perform any one assignment each from 1 to 4 and 5 to 8)**

1. Design and implement Sequence generator circuit. Check for the lockout condition.
2. Design and implement Sequence detector circuit using Moore and Mealy.
3. Design and implement flip flop conversion circuit.
4. Design and implement a simple ASM chart using a digital circuit.
5. Design and implement a car parking system using Entry and Exit gate, synchronized with each other. Entry gate counter will increment the count for each car entry. When all parking slots are occupied, it should indicate that parking is Full.
6. Design and implement a car parking system using Entry and Exit gate, synchronized with each other. Exit gate counter will decrease the count for each car leaving the gate. When no vehicle is present in the parking slot system, it should indicate Parking is Empty.
7. Design and implement an Ice Cream cup distribution counter based on dozens system. Counter should decrement for each sale of the cup. When a dozen of cups in the box are sold, the counter should indicate the one box is done.
8. Design and implement a packaging counter for 16 items. Counter should increment for each entry of the item in the box. When the box is full, the counter should indicate the box is full and reset itself.

**Group C (Perform any one )**

Select any open source / freeware tool and design a digital system of your choice.

1. Design a trigger circuit which will activate next circuit after 45 clocks.
2. Design a square wave generator circuit.
3. Build a random sequence generator.
4. Design a decimal adder circuit.
5. Design an octal adder circuit.
6. Design a decimal subtractor circuit.
7. Design a traffic signal controller which can show red signal for 70 sec, yellow signal for 5 sec and green signal for 40 sec.
8. Design a 2 digit traffic signal controller.
9. Design a 2 digit Bank token system.
10. Design a 3 digit Vaccine token system.
11. Design a BCD to 7-Segment display.
12. Design a character to 7-Segment display.

# 20CE 305L Programming Skills Development - I Laboratory

**Teaching Scheme**
Practical: 4 Hrs/week

**Examination Scheme**
In semester: 25 Marks
Oral: 25 Marks
Credits: 2

**Prerequisites:**
1. Fundamentals of Programming Language Lab-I (20ES02L)
2. Fundamentals of Programming Language Lab-II (20ES05L)

**Laboratory Objectives:**
To facilitate the learners to -
1. Use basics of Python, including working with functions, numbers, lists, and strings.
2. Work with file handling concepts.
3. Use numpy, matplotlib libraries for python application.
4. Apply object-oriented features to Python code.
5. Create a simple GUI using Tkinter

**Laboratory Outcomes:**
By taking this course, the learner will be able to -
1. Make use of basics of Python, including working with functions, numbers, lists, and strings.
2. Implement a python program to work with files.
3. Write basic, object-oriented Python code.
4. Create Python programs using numpy, matplotlib libraries.
5. Build a simple GUI using Tkinter

A large part of the lab would be for understanding the basic concepts of Python programming and implementation of some real world simple applications. Assignment statements are in brief and should be implemented in Python programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built in functions available in different libraries of Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are based on basics of Python and file handing. Group B assignments are based on object oriented programming, use of Matplotlib and numpy libraries and GUI using Tkinter. Group C assignment is implementation on mini project.

**Suggestive List of Assignments:**

**Group A: (Mandatory)**

1. Assignments to explore Lists, Dictionary and tuples like Create a menu drive Python program with a dictionary for words and their meanings. Write functions to add a new entry (word: meaning), search for a particular word and retrieve meaning, given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.
2. Assignments to explore String. For Example: Write a function word_lengths that takes a sentence (string), computes the length of each word in that sentence, and returns the length of each word in a list. You can assume that words are always separated by a space character " ".
3. Assignment to display a particular pattern or sequence. For example: Generate a Pascal triangle for n rows
4. Assignment to perform file operations. For example: Write a program that opens a file dialog that allows you to select a text file. The program then displays the contents of the file in a textbox.

**Group B: (Any four)**

1. Assignment based on object oriented principles. For example: Design a student data base in Python using classes and objects to perform the following operations:
   a. add b) delete c) display d) update e) search
2. Implement a Python program to perform operations on arrays and matrices. For example, Matrix multiplication
3. Read data from CSV file and plot it using matplotlib library
4. A picture or image can be represented as a NumPy array of "pixels", with dimensions H × W × C, where H is the height of the image, W is the width of the image, and C is the number of colour channels. Typically, we will use an image with channels that give the Red, Green, and Blue "level" of each pixel, which is referred to with the short form RGB. You will write Python code to load an image, and perform several array manipulations to the image and visualize their effects.
5. Use Tkinter to build a simple graphical user interface. For example: GUI to maintain a simple phone list.

**Group C: Mini Project (Any one: For example:)**

1. Devise a Python program to implement the Rock-Paper-Scissor game.
2. Devise a Python program to implement the Hangman Game.
3. Creating a Calculator with Tkinter

**References:**

**Text Books**

1. Kenneth. A. Lambert, "**Fundamentals of Python First Programs**", Cengage, 2nd Edition, 2019

2. Vamsi Kurama, "**Python Programming: A Modern Approach** ", Pearson, 1st Edition, 2017.

**Reference Books:**

1. Gowrishankar.S, Veena A, "**Introduction to Python Programming**", CRC Press, Paperback Edition, 2019.

2. Y. Daniel Liang, "**Introduction to Programming Using Python**", Pearson, Paperback Edition, 2017.

**e-Resources:**

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf

# 20CE 402 Database Management Systems

**Teaching Scheme**
Lecture: 3 Hrs/week

**Examination Scheme**
In semester: 50 marks
End semester: 50 marks
Credits: 3

**Course Objectives**
To facilitate the learners to-
1. Design database schema using an entity relationship diagram (ERD) and normalization.
2. Design queries using Structured Query Language (SQL) to retrieve the required data from the database.
3. Understand the storage systems and query processing and optimization concepts.
4. Understand Transaction management in a Database management System.
5. Understand NoSQL Databases to handle unstructured data.

**Course Outcomes:**
With successful completion of the course, the students will be able to–
1. Design the Entity Relationship diagram for the system / application considering its constraints and design issues.
2. Apply the knowledge of SQL to retrieve the required data from the database.
3. Understand the storage systems and query processing and optimization concepts.
4. Make use of various Transaction management concepts for scheduling concurrent transactions.
5. Apply the knowledge of NoSQL databases to handle unstructured data.

**Unit 1: Database Design (10)**
Introduction to database management systems, Advantages of a Database Management Systems over file processing systems. Data abstraction, Data Independence, DBMS Architecture.
Database Design - Entity Relationship Diagram (ERD), Converting Entity Relationship Diagram into tables, Extended Entity Relationship (EER) Diagram features, rules for converting EER diagram to tables, Primary key, Foreign key and other Integrity constraints.
Codd's Twelve Rules for Relational DBMS, Normalization.

**Unit 2: Relational query languages (8)**
Relational algebra, Introduction to Structured Query Language (SQL)
SQL - Data Definition Language (DDL): SQL Data Types, Null values and Literals, Creating, Modifying and Deleting tables. Views and Indexes.
SQL - Data Manipulation Language (DML): Insert, Update, Delete, Select, Set Operations, Joins, Tuple Variables, Nested sub-queries, Query Processing.
PL/SQL (Programming Language SQL): Stored Procedures and Functions, Cursors, Triggers.
SQL - Data Control Language (DCL): Grant and Revoke commands

**Unit 3: Storage and Querying (8)**
Storage and file systems: Storage and File structure, Files with Fixed / Variable Length Records, Hashed Files; Indexing: Indexed Files, Single Level and Multi Level Indexes, B+ Trees

Query Processing: Overview, measures of query cost, Selection and join operations, Evaluation of expressions, Introduction to query optimization, Estimation, Transformation of Relational expressions, Sort Operation, Impact of Indices on Query Performance;

**Unit 4: Transaction management** **(8)**
Transactions, ACID Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict serializability, View serializability, Cascaded Aborts, Recoverable and Non-recoverable Schedules. Concurrency Control: Need, Locking Methods, Deadlocks, Timestamping methods. Recovery methods: Shadow-Paging and Log-Based Recovery.

**Unit 5: Advance topics in Databases** **(8)**
NoSQL Databases
Introduction to NoSQL databases: Structured and unstructured data, NoSQL- Comparative study of SQL and NoSQL databases, Big data. BASE Properties, Types of NoSQL databases- Key-value store – JSON, Document Store – MongoDB: CRUD Operations, Indexing, Aggregation and MapReduce in MongoDB.
Special purpose databases :
Cloud, in memory, Spatial databases etc.
Introduction to data mining and machine learning

**Text Books:**

1. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, 'Database System Concepts', McGraw Hill, (6 th edition), (2013)
2. Jiawei Han, Micheline Kamber and Jian Pei, 'Data Mining – Concepts and Techniques', Morgan Kaufmann Publishers,(3 rd Edition), (2012)
3. Kristina Chodorow, Michael Dirolf, 'MongoDB: The Definitive Guide' , O'Reilly, (2 nd Edition), (2013)
4. Ramez Elmasri and Shamkant B. Navathe, 'Database Systems',Pearson, (6 th Edition), (2013)

**References:**

1. Raghu Ramakrishnan and Johannes Gehrke, 'Database Management Systems', McGraw Hill, (3 rd Edition), (2003)
2. C. J. Date, 'An Introduction to Database Systems', Pearson, (8 th Edition), (2006)
3. Thomas Connally, Carolyn Begg, 'Database Systems', Pearson, (4 th Edition), (2012)

# 20CE 404 Machine Learning

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Course Objectives:**

To facilitate the learner to

1. Introduce students to the basic concepts and techniques of Machine Learning.
2. Utilize data pre-processing techniques and dimensionality reduction techniques for given data.
3. Become familiar with supervised machine learning algorithms such as regression, classification
4. Become familiar with unsupervised machine learning algorithms such as clustering, association rule mining method
5. Become familiar with Artificial neural networks and its learning algorithms.
6. Evaluate the performance of the designed machine learning model.

**Course Outcomes:**

After completion of the course, students will be able to

1. Acquire fundamental knowledge of machine learning theory.
2. Make use of data pre-processing and dimensionality reduction technique for given data.
3. Apply supervised machine learning techniques such as classification and regression for problem solving and evaluate the designed technique using performance measures.
4. Solve the problems using various unsupervised machine learning techniques such as clustering and association rule mining
5. Apply the artificial neural network technique to solve the problem.

**Unit I: Introduction to Machine learning (6)**

Types of Learning: Rote Learning, Learning by General Problem Solving, Concept Learning, Learning by Analogy, learning problems and designing the learning systems, Machine

Learning: Types of Problems in Machine Learning, Aspects of Inputs to Training, Supervised, unsupervised, semi supervised, reinforcement learning, overfitting, underfitting, best practices in machine learning, Intelligent Agents.

**Unit II: Data Pre-processing and Dimensionality Reduction (6)**

Data cleaning, data integration, data reduction, data transformation and data discretization, curse of dimensionality, Principle Components Analysis, Bias/Variance trade-off.

**Unit III: Supervised Learning (12)**

Regression: Correlation and regression, line fitting by least square, outliers, linear and multiple regression
Classification: Logistic regression, Nearest Neighbour Classification: K-nn, Introduction to Decision tree and Bayesian Classification

Performance Measures: Confusion matrices, accuracy, sensitivity, specificity, kappa statistics, precision, recall, F-measure, Methods of cross-validation, Types of Errors: RMSE, MSE etc

**Unit IV: Unsupervised Learning (10)**

Introduction to Clustering methods, k-means clustering, Hierarchical clustering: agglomerative clustering method, decisive clustering method
Market Basket analysis, Apriori Algorithm, Association rule mining, Outlier analysis

**Unit V: Introduction to Artificial Neural networks (8)**

Supervised learning: McCulloch-Pitts model, Perceptron model, multi-layer perceptron, feed forward networks, Perceptron learning algorithm
Unsupervised learning: Self organizing maps

**Text Books:**

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that make sense of data", Cambridge University Press, 1st Edition, 2015, ISBN No.: 978-1-316-50611-0
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2nd edition, 2013, ISBN 978-0- 262-01243-0

3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

4. V. Susheela Devi, M. Narasimha Murty, "Pattern Recognition: An introduction", University Press, 2011, ISBN 978-81-7371-725-3

**Reference Books:**

**1.** Rodolfo Bonnin, "Machine learning for developers" , Packt publication, 2017, ISBN 978-1-78646-987-8

**2.** Vinod Chandra S. S., Anand Hareendran S., 'Artificial Intelligence and machine learning', PHI, (2014), ISBN 978-81-

3. Tom M. Michell, 'Machine Learning', McGraw Hill Education, Indian edition 2013, ISBN 978-1-25-909695-2.

4. John Paul Mueller, Luca Massarom, "Machine learning (in python and R) dummies", Wiley publication, 2016, ISBN 978-81-265-63050

5. Manohar Swamynathan, "Mastering Machine learning with python in six steps", Apress publication, 2018, ISBN 978-1-484-24044-1

**Online/Web/Other References:**

**1.** Nptel/coursera courses on Machine Learning

# 20CE 403L Operating Systems Laboratory

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral : 25 Marks
**Credits: 1**

**Prerequisites:**

1. Fundamentals of Programming Language Lab-II (20ES05L)
2. Data Structures and Algorithms (20CE 302)
3. Digital Systems and Computer Organization(20CE 304)

**Course Objectives:**
To facilitate the learner to

1. Understand the fundamentals of Operating Systems.
2. Understand shell scripting to automate operating system operations.
3. Apply the concepts of Operating System for Process and Memory management.
4. Understand the operations performed by the Operating System as a resource manager.
5. Understand the communication among the processes.

**Course Outcomes:**
After completion of the course, students will be able to

1. Choose UNIX/Linux Commands for Shell Programming.
2. Make use of different CPU scheduling algorithms.
3. Apply Memory Management algorithms.
4. Implement various disk scheduling algorithms.
5. Explore the Inter-Process Communication concepts.

**Preamble:**
Operating Systems Laboratory is designed to understand and implement the fundamental concepts of Operating System. Motivation here is that students should be able to code the basic shell script and make use of various Operating system services algorithms. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it enhances the concepts and logic of the solution. Students will be encouraged to solve open problems in different operating systems. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on Unix/Linux commands, shell script and process creation using system calls. Group B assignments are on simulation of schedulers, memory and I/O management algorithms and Inter-process communication problems using Semaphores. Group C assignment is on case study for different Operating Systems and its services.

## Suggestive List of Assignments

**Group A : (Mandatory)**

1. Demonstration of Installation of Linux Operating System.
2. Exploration of Unix/Linux Commands (File, Directory and Process commands).
3. Write a shell script for adding users / groups and modifying permissions of file / directory accordingly.
4. Write a program to implement operations on processes using fork and join system calls.

**Group B: (Any Four)**

5. Simulation of the scheduling algorithms. For example: First Come First Serve (FCFS), Shortest Remaining Time First (SRTF).
6. Simulation of scheduling algorithms. For example: Round-Robin (RR), Shortest Job First (SJF).
7. Simulation of memory allocation strategies. For example: First Fit, Best Fit and Worst Fit.
8. Simulation of Page replacement algorithms. For example: First-In-First-Out (FIFO), Least Recently Used (LRU), optimal page replacement.
9. Simulation of disk scheduling algorithms. For example: First Come First Serve (FCFS), SCAN, Circular – SCAN (C-SCAN), Shortest Seek Time First (SSTF).
10. Write a program to implement Banker's Algorithm for deadlock handling.
11. Write a program to implement Reader-Writer problem using semaphores.

**Group C**

Case study of various Operating systems services. (Example: Android, RTOS, Linux, IOS, Windows etc.)

# 20CE 404L Machine Learning Laboratory

**Teaching Scheme**
**Practical**: 4 Hours / Week

**Examination Scheme**
In Semester : 25 Marks
Oral : 25 Marks
**Credits: 2**

**Prerequisite:**
1) 20 CE 306 Programming Skills Development-I Laboratory

2) 20ES05 Fundamental of Programming Languages-II

**Course Objectives:**
To facilitate the learner to

1. Implement some pre-processing operations on given data.
2. Implement supervised machine learning algorithms such as regression, classification.
3. Implement unsupervised machine learning algorithms such as clustering, association rule mining method.
4. Implement artificial neural networks and its learning algorithms.
5. Implement a small machine learning application and evaluate the performance of the designed machine learning model.

**Course Outcomes:**
After completion of the course, students will be able to

1. Apply pre-processing operations on given data.
2. Apply the classification and regression machine learning techniques to solve the problem.
3. Apply various clustering and association rule mining techniques of machine learning to solve the problem.
4. Apply the artificial neural network technique to solve the problem.
5. Develop small machine learning applications using different techniques.

A large part of the lab would be for understanding the basic concepts of machine learning and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in JAVA/Python programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built-in functions available in different libraries of Java/Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on pre-processing data, supervised learning methods such as classification and regression, and simple logic gates implementation using artificial neural network. Group B assignments are on unsupervised learning and Group C assignment is on case study implementation for different application.

## Suggestive List of Assignments

**Group A : (Mandatory)**

1. Explore language used for Machine Learning Python/Java and perform the following operations: Understand the basic functionality, visualization of data. Study the different file format, explore the available data sets and its usage using programming language.

2. Suppose that the data for analysis includes the attribute age: 13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70. (a) Plot an equal-width histogram of width 10. (b) Sketch examples of each of the following sampling techniques: SRSWOR, SRSWR, cluster sampling, and stratified sampling. Use samples of size 5 and the strata "youth," "middle-aged," and "senior." (c) scale and also normalize the data. Pre-process the given data as given here.

3. BMI and body fat of persons are given. Use this BMI to predict the body fat of a person. Implement predictive modelling using regression analysis using a programming language that you are familiar with such as Java/Python. Fit the model and predict the value for given problem.

4. Data given for the SPEED and AGILITY rating of 20 college athletes and whether they were drafted by professional team. Implement k-nn classification technique of Machine learning using a programming language that you are familiar with such as Java/Python. Compare the performance of classification by changing value of k for the given data.

5. Build the logic gates AND, OR, NOT, NOR, NAND gates using ANN assuming random initialization. Write a program to implement Perceptron learning in an artificial neural network using Java/Python.

**Group B: (Any Two)**

1. You have a list of shopping items purchased by many people. Find out what are the frequently purchased combination of 2 items. Implement Apriori, a Frequent Pattern Analysis algorithm using Java/Python.

2. One of the earliest and well-known applications of the SOM is the phonetic typewriter of Kohonen. It is set in the field of speech recognition, and the problem is to classify phonemes in real time so that they could be used to drive a typewriter from dictation. The real speech signals obviously needed pre-processing before being applied to the SOM. Simulate this application where 4-dimensional input space is mapped to 2 nodes. Write a program to implement Self Organising Map (SOM) using Java/Python.

3. A Hospital Care chain wants to open a series of Emergency-Care wards within a region. We assume that the hospital knows the location of all the maximum accident-prone areas in the region. They have to decide the number of the Emergency Units to be opened and the location of these Emergency Units, so that all the accident-prone areas are covered in the vicinity of these Emergency Units.

   The challenge here is to decide the location of these Emergency Units so that the whole region is covered. Implement a K-means clustering algorithm using a programming language that you are familiar with such as Java / Python. Compare the performance of your algorithm on the dataset by changing input parameter value such as K

**Group C**

1. Machine learning case study for readily available data sets using the techniques studied, and evaluate the designed and implemented model.

# CE 501 COMPUTER NETWORKS

**Teaching Scheme**
Lectures: 3 Hours / Week
Tutorial: 1 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 4**

**Course Objectives:**

To facilitate the learner to

1. Distinguish the fundamental concepts of networking standards, protocols and technologies
2. Identify role of protocols at various layers in the protocol stack
3. Select and Compare the appropriate network and protocols by understanding the given requirements for a given system.
4. Get familiar with fundamental concepts of network security and recent trends in networking

**Course Outcomes:**

After completion of the course, students will be able to

1. Build an understanding of the fundamental concepts of computer networking and recent trends in networking
2. Identify data flow between two communicating hosts using various protocols at TCP/IP layers
3. Identify the role of various address in TCP/IP Protocol stack
4. Discover relevance of various protocols for given application

**Unit I: Introduction to Computer Networks (7)**

Definition, Types of Networks: Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Protocol, Design issues for the Network layers, Network Models: The OSI Reference Model, TCP/IP Model, Network Topologies. Types of Transmission Medium, Network Architectures: Client-Server, Peer To Peer, Hybrid. Network Devices: Bridge, Switch, Router, Gateway, Access Point, Modulation, Line Coding Schemes, Switching: Circuit switching, Packet switching, Multiplexing: FDM, TDM.

**Unit II: Data Link Layer (8)**

Introduction, functions, Design Issues, Services, Framing, Error Detection and correction, Parity Bits, Hamming Codes and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, MAC Sub layer : Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 Standards.

**Unit III: Network Layer (10)**

Functions of Network layer, Design Issues, IP Protocol: Classes of IP (Network addressing), IPv4, IPv6, Network Address Translation, Sub-netting, CIDR, Routing Algorithms: Dijkstra's, Distance vector Routing, Link State Routing, Network Layer Protocols: Address Resolution Protocol, Reverse Address Resolution Protocol, Internet Control Messaging Protocol, Routing Protocols: Routing Information Protocol, Open Shortest Path First , Border Gateway Protocol, Unicast Routing Protocols, Multicast Routing Protocol.

**Unit IV: Transport Layer (7)**

Transport layer design issues, Protocol Overview, Header Structure, Transmission Control

Protocol (TCP) functions such as Connection Management, Error control, Flow control, Congestion control, User Datagram Protocol (UDP) overview, typical applications support, TCP Vs. UDP, TCP and UDP Socket Primitives.

**Unit V: Application Layer (6)**

Hyper Text Transport Protocol (HTTP): Overview, header structure, connections, request and response messages, persistence and non-persistence HTTP. Cookies, Simple Mail Transport Protocol (SMTP): Overview and Working of MIME, POP3, File Transfer Protocol (FTP): Overview and Working, identifying protocols for given application with example, Introduction to various Types of Servers, Dynamic Host Configuration Protocol (DHCP): Header, Working, Domain Name Server (DNS): Working, Proxy Server: Need and Significance, working.

**Unit VI: Network Security & Recent Trends in Communication Networks (4)**

Introduction to Network Security, Security mechanism, need and Services, Introduction to classical cryptography and its Type, Introduction to software defined network (SDN), Characteristics, Operations and Applications. Introduction to virtualization. (Reference from Research Papers and web)

**Text Books:**


1. Andrew S Tanenbaum, David J Wetherall,**'Computer Networks'**, *Pearson*, (5th Edition), (2014)
2. Forouzan B **'Data Communication and Networking'**, *Tata McGraw Hill*, (5th Edition), (2013).


**Reference Books:**


1. Kurose, Ross **'Computer Networking a Top Down Approach Featuring the Internet'** *Pearson*, (6th Edition) , (2014).
2. Stallings W **'Data and Computer Communications'** *Prentice Hall Pvt.Ltd*. (8th Edition), (2009).
3. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff **'Unix Network Programming Volume 1'**, *Addison-Wesley Publication*, (3rd Edition), (2003).
4. Geoffrey C. Fox, Jack Dongarra, and Kai Hwang,**'Distributed and Cloud Computing'** Morgan Kaufmann, (1st Edition),(2011).
5. Stallings W, **'Cryptography and Network Security: Principles and Practice'**, *Pearson*, (6th Edition), (2014).


**Online/Web/Other References:**


1. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
2. nptel.ac.in/courses/106/105/106105183
3. nptel.ac.in/courses/106/105/106105081
4. nptel.ac.in/courses/106/106/106106091
5. nptel.ac.in/courses/106/105/106105031

## Tutorials

1. Study of various networks components, devices, and cabling
2. Problem solving on Line Coding Scheme
3. Problem solving based on error control using parity code, hamming and CRC
4. Scenario based problem solving on flow control stop and wait, go back N and Selective repeat
5. Problem solving based on IP Header
6. Problem solving based on subnetting / supernetting
7. Problems based on routing algorithm.
8. Demonstration of Routing protocols on simulator
9. Problems based on TCP and UDP header
10. Case study of college network
11. Designing network for given specification
12. Research paper reading based on SDN, Network Security, Virtualization, and Satellite Network

# 20CE 502 Design and Analysis of Algorithms

**Teaching Scheme: Examination Scheme** Lecture: 3 Hrs/Week In Semester: 50 Marks End Semester: 50 Marks
Credits: 3

**Prerequisite**:
1. Data Structures and Algorithms (20CE302)
2. Discrete Mathematics (20CE303)

**Course Objectives:**
To facilitate the learners :-
1. Understand and apply methods of analysis of algorithms.
2. Learn and apply strategies for designing the algorithms.
3. Learn and apply the concept of computational complexity classes for the given problem.
4. Get acquainted with the concept of evolutionary algorithms design.

**Course Outcomes:**
By taking this course, the learner will be able to :–
1. Apply the knowledge of analyzing the algorithm.
2. Evaluate algorithm design techniques for solution of a problem.
3. Perceive the given problem solution from computational complexity classes point of view.
4. Build knowledge to understand the design requirements of evolutionary algorithms.

**UNIT I: Introduction** [7]

Basic steps to solve the problems, Performance analysis of recursive and non-recursive algorithms, Recurrences: substitution method, recursion-tree method, master method.

**UNIT II: Computational Complexity Classes** [7] Basic Concepts of complexity classes, Non deterministic algorithms, The classes P and NP, NP Complete and NP Hard.
Decision problems: Clique Decision problem, Node cover Decision problem, Directed Hamiltonian Cycle Problem, Satisfiability problem, Travelling salesman problem, NP Hard problems

**UNIT III: Divide and Conquer and Greedy Strategy** [7] Divide and Conquer: General Strategy, Control Abstraction, min/max problem, Binary Search, Quick Sort, Randomized quick sort and Merge Sort.

Greedy Method: General strategy, control abstraction, Knapsack problem, Job sequencing with Deadlines (Scheduling Algorithm), Minimal Spanning Tree algorithms(Graph Based Algorithm).

**UNIT IV: Dynamic Programming** [7] Dynamic programming: General Strategy, Multi stage graphs, Optimal Binary Search Tree problem( OBST), 0/1 Knapsack problem, Travelling Salesperson Problem.

**UNIT V: Backtracking and Branch and Bound** [7]

Backtracking: General Strategy, Implicit and Explicit constraints, DFS State space tree formulation, Sum of subsets, Hamiltonian Cycle problem/Graph colouring problem, 4/8 Queens problem, Maze problem /Tower of Hanoi, 15-puzzle problem/Sudoku. Branch and Bound: General Strategy, BFS state space tree formulation, Traveling Salesperson Problem.

**UNIT VI: Introduction to Advanced Algorithms** [7] Introduction to Parallel Algorithms Matrix Multiplication/Sorting, Genetic Algorithms, Approximation Algorithms, Randomized Algorithms.

**Text Books:**


1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2nd edition. Galgotia publication,, 2008, ISBN: 978 81 7371 6126
2. Gilles Brassard and Paul Bartley, "Fundamental of Algorithm.", PHI, 2010, ISBN-9788120311312 New Delhi
3. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithm", 3rd edition, 2009,PHI


**Reference Books:**


1. Fayez Gebali, “Algorithms and Parallel Computing”, Willy, 2015, ISBN 9788126553891
2. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 2014, Pearson Education
3. A. V. Aho and J.D. Ullman, "Design and Analysis of Algorithms", Pearson Education, 2006, ISBN: 978 81 317 0205 5
4. Parag Himanshu Dave, Himanshu Bhalchandra Dave, “ Design And Analysis of Algorithms”, PEARSON Education, ISBN 81-7758-595-9


**MOOC Courses:**

1. https://nptel.ac.in/courses/106/101/106101060/ 12 weeks course offered by IIT B.
2. https://www.mooc-list.com/course/algorithms-design-and-analysis-part-1-coursera
3. https://www.cse.iitb.ac.in/~akshayss/courses/cs310-2019/index

# 20CE 503 Software Design and Architecture

**Teaching Scheme**
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

**Examination Scheme**
In Semester: 50 marks
End Semester: 50 marks
Credits: 4

**Prerequisite:** Data structures (20CE 302)

**Course Objectives:**
**To facilitate the learner to -**

1. Develop familiarity with the basic concepts of software architecture and quality attributes of a system.
2. Model the software requirements of a system using Unified Modeling Language (UML) to understand the architectural, structural and behavioral aspects of the system.
3. Understand and apply various design patterns in creating an object oriented design.
4. Get exposure to the various software testing techniques and methods.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Analyze the concepts of software architecture and quality attributes to realize the solution of a system.
2. Build structural and behavioral models using Unified Modeling Language (UML).
3. Apply various design patterns to understand reusability in object oriented design.
4. Apply various software testing techniques at unit level, suitable to different problem areas.

**Unit 1: Introduction to Software Architecture (06)**
Software Development Life Cycle (SDLC), SDLC Models, Software Requirements Specification (SRS), What is Software Architecture, Why Software Architecture is important, Architectural Styles.

**Unit 2: Design Using Unified Modeling Language (UML) (08)**
Importance of modeling, Introduction to UML: Object-oriented modeling language, Use case Diagrams, Activity Diagrams, Class Diagrams, Sequence Diagrams.

**Unit 3: Quality Attributes (08)**
Understanding Quality Attributes, Quality Attribute Scenarios and Tactics - Performance, Security, Usability.

**Unit 4: Creational and Structural Design Patterns** **(07)**

What is Design Pattern, Classification of Design Patterns, Elements of Design Pattern, Creational Design Patterns - Singleton, Factory Method, Structural Design Patterns - Proxy, Adapter.

**Unit 5: Behavioral Design Patterns** **(06)**

Observer, Iterator, Model View Controller (MVC), Mediator.

**Unit 6: Software Testing** **(07)**

Introduction, Verification and Validation, V-Model, White Box testing - Structural Testing – Unit / Code functional testing, Code coverage testing, Code complexity testing, Black Box testing - Equivalence Class Partitioning, Boundary Value Analysis, Use case based testing.

**Text books:**


1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education*, (3rd Edition)(2013).
2. Grady Booch, James Rumbaugh, Ivar Jacobson, **'The Unified Modeling Language User Guide'**, *Pearson Education*, (2nd edition)(2008).
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, '**Design Patterns-Elements of Reusable Object-Oriented Software',** *Pearson Education*, (2002).
4. Srinivasan Desikan, Gopalaswamy Ramesh, '**Software Testing Principles and Practices'**, *Pearson Education*, ISBN 81-7758-121-X (2013).


**Reference books:**


1. Len Bass, Paul Clements, Rick Kazman, **'Software Architecture in Practice'**, *Pearson Education*, (2nd Edition) (2006).
2. Mary Shaw and David Garlan, **'Software Architecture – Perspectives on an Emerging Discipline'**, *Prentice Hall of India*, (1996).
3. Richard N. Taylor, Nenad M. and Eric M. Dashofy, **'Software Architecture: Foundations, Theory and Practice'**, *Wiley*, (2006).
4. Jim Arlow and Ila Neustadt, **'UML 2 and the Unified Process –Practical Object-Oriented Analysis and Design',** *Pearson Education*, (2nd edition) (2006).
5. Iien Burnstein, '**Practical Software Testing',** *Springer (India) private limited*, (2005).

**Tutorials - Preamble:**

The scope of tutorials for "Software Design and Architecture" includes exercises based on requirements capturing, analysis, design and testing of sample applications. During tutorials, problem solving and system design skills of students are challenged and improved. For a chosen hypothetical system, students are expected to identify its scope, prepare SRS document, build analysis/design level UML models and identify the test cases. The students are also expected to analyze the quality attributes requirements for the chosen system and elaborate the same using quality attributes scenarios. The following is a sample list of tutorials, covering the various concepts in the course. The objective of tutorials is to provide an opportunity for students to explore as per their interests. Consequently, these tutorial statements will be further detailed during conduction, according to the scenarios under consideration.

**Example List of Tutorials:**

1. Study architectural styles and submit a report on these styles.
2. A case study of any website or any other large system and its architecture for quality attributes requirements such as Performance, Security, Usability and Availability.
3. Design a Software Requirement Specification (SRS) document for a given system.
4. Draw Use case diagrams for capturing and representing requirements of a given system.
5. Draw Activity diagrams to display the business flows for a given system.
6. Draw Class diagrams to identify and describe key concepts like classes, relationships and other classifiers like interfaces.
7. Draw Sequence diagrams to show message exchanges in a given system.
8. Identify suitable design patterns for a given application.
9. Apply various Black Box testing methods for unit testing of a sample application.
10. Apply various White Box testing methods for unit testing of a sample application.

# 20PECE 501A Digital Image Processing

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50
Marks End
Semester: 50 Marks
**Credits: 3**

**Course Objectives:**
To facilitate the learner to

1. Understand basic concepts of digital image processing.
2. Learn and apply image enhancement and Image Segmentation techniques.
3. Understand object Recognition, Image Restoration and reconstructions.
4. Learn and apply image compression techniques and Understand image processing applications.

**Course Outcomes:**
After completion of the course, students will be able to

1. Apply basic steps of digital image processing on given images
2. Select the image enhancement techniques.
3. Make use of Image Restoration, reconstructions techniques.
4. Identify the image compression techniques.
5. Choose Image Segmentation techniques for given images.

**Unit I: Introduction to Image Processing** **(07)**

Introduction to digital image processing: Origin, usage and application of image processing, Fundamental steps and component of image processing system,representation of digital images. Basic relationships between pixels, introduction to Human Visual System,Image sensing and acquisition,Basic concepts in sampling and quantization,Basic operations:Convolution,Arithmetic and Logical Operations.

**Unit II: Image Enhancement Techniques(08)**

Basic image preprocessing (contrast enhancement, simple noise reduction) some basic gray level transformations,Histogram Processing-Histogram Equalization,Histogram stretching,Spatial filtering- Smoothing and Sharpening Spatial filters. Frequency Domain: Introduction to Fourier Transform– frequency domain filters.

**Unit III: Image Compression(07)**

Introduction to Image Compression and its need, Coding Redundancy,Classification of Compression Techniques (Lossy and Losless - JPEG,RLE, Huffman, Shannon fano,Arithmetic coding), Scalar & Vector Quantization.

**Unit IV: Image Restoration & Reconstruction(06)**

Model of Image degradation, Noise Models,Classification of image restoration techniques,Order Statistics fileters-Mean,Median,Min,Max,Alpha trimmed meanfilter,Geometric and harmonic mean filter,Inverse filtering, Wiener filtering,Blind-deconvolution techniques.

**Unit V: Image Segmentation, Analysis and Object Recognition(08)**

Point detection, Lines detection,Edge detection,Classification of image segmentation techniques: Edge-based Segmentation, Region based techniques. Binarization: Global Thresholding, Adaptive thresholding. Types of Edge detector: derivative filters-Prewitt, Sobel, Canny.

Introduction to Object Recognition, Object Representation(Signatures, Boundary Skeleton), Simple Boundary Descriptors, Regional descriptors- Topological feature(Texture).

Morphological Operations:Basics of Set Theory; Dilation and Erosion - Dilation,Erosion; Structuring Element; Opening and Closing;

**Unit VI: Advances in Image processing Applications(06)**

Medical Image Processing, Remote Sensing, Synthetic-aperture radar (SAR) Image Processing,Image registration,Biometric Authentication Methods like Face detection, Iris Recognition.

**Text Books:**


1. R.C.Gonzalez,R.R.Woods, '**Digital Image Processing'**,ISBN 978-81-317-2695-2,*Person (*Third Edition) ,(2011)
2. Sridhar S.'**DigitalImage Processing',***Oxford UniversityPress, (Second Edition),(2016)*
3. S.Jayaraman, S. Esakkirajan,T. Veerakumar , **'Digital Image processing',**ISBN 978-0-07-014479-8, *Mcgraw Hills Publication (Tenth reprint), (2013)*


**Reference Books:**


1. Sonka, Hlavac, Boyle, '**Digital Image Processing and Computer Vision',** ISBN 978-81-315-0555-7,*Cenage Learning* (Sixth Indian Reprint) ,(2011)
2. B. Chanda, D.Datta Mujumdar '**Digital Image Processing And Analysis',** *PHI*, ISBN 978- 81-203- 4325-2, (Second Edition),(2013)
3. Anil Jain, '**Fundamentals of Digital Image Processing'**, *PHI*, ISBN-81-203-0929-4 (Indian Reprint) ,(1995)
4. Basudeb Bhatta **' Remote Sensing and GIS'** *Oxford University Press*, ISBN 978-0-19-807239-3 (Second Edition)(2014)


**Online/Web/Other References:**


1. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6504845
2. https://searchsecurity.techtarget.com/definition/biometric-authentication

## 20PECE 501B Java Full Stack Technologies

**Teaching Scheme**
Lectures: 3 Hrs/week

**Examination Scheme**
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

**Prerequisites:** Data Structures (20CE 302)

**Course Objectives:**
**To facilitate the learner to -**

1. Get exposure to full stack development in Java technologies.
2. Develop familiarity with the client side Java technologies.
3. Gain comprehensive knowledge about Java server side technologies for enterprise application development in practice.
4. Get familiar with the web services based approach for real-life application development.
5. Get acquainted with the database development technologies in Java.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Choose suitable client side Java technologies.
2. Analyze Java server side technologies for enterprise application development.
3. Analyze the characteristics of web services paradigm.
4. Analyze the role of Java database development technologies to realize their suitability for application development.

**Unit 1: Client Side Web Technologies (07)**

n-tier architecture, HTTP request - response, Web browser, HTML, CSS, XML, JSON, JavaScript (JS), Document Object Model (DOM), Introduction to jQuery, Asynchronous JavaScript And XML (AJAX).

**Unit 2: Server Side Java Web Technologies (07)**

Introduction to server side technology, Common Gate Interface (CGI), Java Servlets, Java Server Pages (JSP), Session tracking, JSP tags, Java Beans, MVC architecture.

**Unit 3: ReactJS (06)**

Overview of ReactJS: Introduction, Features, Advantages, Comparison with AngularJS, Introduction to Nodejs; ReactJS concepts like components, virtual DOM, JSX and APIs.

**Unit 4: Java 2 Enterprise Edition (J2EE) Technologies (08)**

Introduction to J2EE technologies, Enterprise Java Beans (EJB), Java Messaging Service (JMS), Remote Method Invocation (RMI).

**Unit 5: Java Web Services (07)**

Web Services: Overview; Service Oriented Architecture (SOA), Java Web services based on SOAP and REST, Java Web services API for SOAP and REST based web services:
JAX-WS, JAX-RS.

**Unit 6: Java Database Programming and Hibernate (07)**

Java Database Connectivity (JDBC), Java Transaction API (JTA), Java Persistence API (JPA), Hibernate: Overview, architecture, Object Relational (OR) Mapping.

**Text books:**


1. Kogent Learning Solutions Inc., **'Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX, Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-997-4, (2015).
2. Kogent Learning Solutions Inc., **'Java Sever Programming Java EE6 Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-936-3, (2013).
3. Stoyan Stefanov, **'React - Up & Running: Building Web Applications',** *O'Reilly,* ISBN: 9781491931820, (2016).
4. William Crawford, Jim Farley, **'Java Enterprise in a Nutshell'**, *O'Reilly*, ISBN-13: 978-0596101428, 3rd Edition, (2005).


**References books:**


1. Mark Tielens Thomas, **'React in Action'**, *Manning Publications*, ISBN: 978-1617293856, (2018).
2. Kevin Mukhar, Chris Zelenak, James L. Weaver and Jim Crume, **'Beginning Java EE5: From Novice to Professional'**, *Apress*, ISBN-13: 978-8181284020, (2006).
3. Kirupa Chinnathambi, **'Learning React: A Hands-on Guide to Building Web Applications Using React and Redux',** *Addison Wesley,* (2016).
4. Jim Keogh, **'The Complete Reference J2EE'**, *McGraw Hill Education*, ISBN: 978-0-07-052912-0, (2012).


**Web References:**


1. https://learn.jquery.com
2. https://docs.oracle.com/javaee/7/tutorial/
3. https://reactjs.org

## 20PECE 501LB Java Full Stack Technologies Laboratory

**Teaching Scheme**
Practical: 2 Hrs/week

**Examination Scheme**
In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

**Course Objectives:**
**To facilitate the learners to -**

1. Understand the Installation and Configuration setting related aspects of web server, integrated development environments and various frameworks, in the development of web applications.
2. Understand the role of various technologies used for real-life application development.
3. Get exposure to full stack development in Java which includes client side and server side technologies, web services and database development technologies.
4. Gain practical knowledge about the various client side and Java server side technologies for application development in practice.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Make use of suitable client side Java technologies.
2. Experiment with various Java server side technologies like Java Servlets, Java Server Pages, Web services and JPA for web application development.
3. Make use of Java Sockets library and Java RMI framework for the development of sample client-server applications.
4. Build a sample web application using suitable technologies at various tiers.

**Preamble:**

Development of web applications need technologies at various levels, which play different roles in the overall web architecture. The intent of Java Full Stack Technologies Laboratory is to enable the understanding of the role of various technologies in full stack development and implementation of some real world application scenarios using these technologies. Assignment statements are in brief and should be implemented with Java web technologies. Motivation here is that students should be able to develop the user interface, business logic and the database programming parts of a typical web application, using the APIs/libraries provided by various client side and server side Java technologies. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to build solutions for real world business scenarios in different domains, to fulfil the end-user requirements. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on applying various client side technologies and basic server side technologies. Group B assignments are on exploring the use of technologies like EJB, Web services and Hibernate. Group C assignment is on the development of sample web application.

**Suggestive List of Assignments:**

**Group A: (Mandatory)**

1. Develop dynamic and interactive web client using HTML, CSS and JavaScript technologies. Make use of these technologies to develop suitable web forms, layout and to perform validation of form data, for this web client.

   Sample application scenario:
   Consider that a student needs to register for an online course portal. For this scenario, develop an HTML form for "Course Registration", make use of CSS for layout design of this form and perform validation on various fields of this form using JavaScript.

2. Develop dynamic and interactive web client using XML and AJAX technologies, to enable rich user experience.

   Sample application scenario for AJAX:
   Consider a web form for an administrator of an "Online Shopping Application". An administrator can select the name of a customer from the drop down list box on the web form. Then on the same page, the details of the customer such as shipping address should get displayed.

3. Develop dynamic and interactive web client using jQuery as a client side JavaScript library. For this web client, implement event handling and animation effects using jQuery.
4. Develop dynamic and interactive web client using ReactJS as a client side library. Make use of various features of ReactJS such as components, APIs etc.
5. Implement an application using Java RMI to understand distributed application environment. The remote object accesses database using JDBC.
6. Implement a sample web application scenario using Java Servlets, Java Server Pages and Java Beans as the server side dynamic content generation technologies. Make use of MVC architecture for this implementation and also show the appropriate usage of the various capabilities of these technologies such as session tracking, tag library, implicit objects, directives etc.

   Sample application scenario:
   Consider a simple web form where you give Student Roll number and get back Student Profile details from the database. Make use of MVC architecture, based on Java Servlet, JSP and Java Bean to implement this web based scenario.

**Group B: (Any One)**

1. Implement a sample EJB based scenario for any application like online movie ticket booking, online college admission portal, online railway reservation etc. Make use of various types of beans such as session beans and entity beans, for the implementation of business methods and persistence of data.
2. For a sample application scenario, implement and consume the suitable web services using SOAP or REST protocol.
3. Make use of JPA with Hibernate framework for performing the create, retrieve, update and delete (CRUD) operations on the backend database.

   Sample application scenario:
   Consider "Course Information Management" as a typical Database Application. This application may have database tables like Courses, Participants etc. Make use of JPA with Hibernate framework to access the data from the Courses table in this above application.

**Group C:**

1. Design and develop a typical web application like online cab booking, online food ordering application, online tours and travel portal etc. For the development of this application, choose the appropriate technologies for the client side aspects, server side business logic and database development.

# Elective I - 20 PECE 501C Statistics for Computer Science

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**
To facilitate the learner to
1. Utilize fundamentals of statistics and descriptive statistics concepts.
2. Analyse data using correlation, regression and multivariate analysis.
3. Apply statistical inference techniques for dealing with uncertainty in decision making.
4. Apply analysis of variance technique to check how different the samples are from each other.
5. Apply statistics concepts in different applications.

**Course Outcomes:**
After completion of the course, students will be able to
1. Apply the methods of descriptive statistics on different types of data.
2. Experiment with statistical analysis and multivariate analysis using correlation and regression.
3. Make use of sample inferential statistics to draw inference.
4. Perform analysis of variance for groups of data.
5. Apply the statistics concepts in applications such as manufacturing, economics, business analysis and forecasting.

**Unit I: Basic statistics (10)**
Definition, collection and type of data, processing of data, classification, tabulation and graphical representation of data, limitation of statistics.
Types of averages: arithmetic mean, median, mode, geometric mean, harmonic mean, relationship among averages, variation, merits and limitations of variation, standard deviation.

**Unit II: Correlation and Regression (7)**
Introduction, types of correlation, methods of studying correlation: scatter diagram, graphic method, Karl Pearson's coefficient of correlation, Rank correlation coefficient
Regression analysis: Introduction, uses of regression analysis, difference between correlation and regression analysis. Regression lines, regression equations, regression coefficient and its properties.

**Unit III: Multivariate Analysis (4)**
Partial regression, partial correlation, multiple correlation, multivariate regression, principal component analysis (PCA).

**Unit IV: Statistical Inference -Test of Hypothesis (7)**
Introduction, procedure of testing hypothesis, types of hypothesis, two types of error in testing of hypothesis, two-tailed and one-tailed test
t-test, chi-square test, F-test, degrees of freedom, relation between t-test, chi-square and F-test.

**(6)**

**Unit V: Analysis of Variance**

Introduction, assumptions and techniques of analysis of variance, One-Factor analysis of variance, two factor analysis of variance: Parameter estimation and testing hypotheses.

**Unit VI: Applications of Statistics (8)**

Introduction to statistical quality control, acceptance sampling, Introduction to business forecasting, Introduction to index numbers for economic and business analysis.

**Text Books:**

1. "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2. "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.
3. "Statistics in Nutshell", Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN: 978-81-8404-568-0, SPD O'Reilly publication.

**Reference Books:**

1. "Statistical Data analytic" by Piegorsch W.W., 2017, ISBN:978-81-324-2472-4, Wiley publication
2. "Introductory statistics", Sheldon M. Ross, 2nd Edition, 2006, ISBN: 81312-00485, Elsevier publication.
3. "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning

**Online/Web/Other References:**

1. Nptel, coursera courses on probability and statistics

| Programme Elective-II |
| --- |
| 20PECE 502 (NPTEL / Swayam Course ) |

## 20PECE 502A Software Testing

**Teaching Scheme Examination Scheme** Lectures : 3 Hrs/Week In Semester : 50 Marks
End Semester: 50 Marks
Credits: 3

**Prerequisites :**
Programming Paradigms (20CE 301)

**Course Objectives:**
**To facilitate the learners to -**
1. Understand the need for Software Testing and the concept of Graphs based testing.(Unit I,II) 2. Understand Techniques and algorithms for test case design and Logic Coverage 3. Understand Input space partitioning and Syntax based testing.
4. Have the knowledge of Test case design applied to object-oriented applications and web applications .
5. Have the knowledge of Symbolic testing and Concolic testing.

**Course Outcomes:**
**By taking this course, the learner will be able to -**
1. Apply the fundamental concepts of Software Testing and the concept of Graphs based testing. (Module 1-4)
2. Make use of Techniques and algorithms for test case design and Logic Coverage for software testing (Module 5-6)
3. Make use of Input space partitioning and Syntax based testing for software testing. (Module 7-8)
4. Apply the concepts of Test case design applied to object-oriented applications and web applications .(Module 9-10)
5. Interpret the basics of Symbolic testing and Concolic testing.(Module 11-12)

**Modules To be Covered -**

**Module 1** :
- Motivation, Terminologies,
- Testing based on Models and Criteria, concept of Automation in testing,

**Module 2** :
- Basics of Graphs: As used in testing, Structural Graph Coverage Criteria,

- Elementary Graph Algorithms,

**Module 3 :**

- Algorithms: Structural Graph Coverage Criteria
- Data Flow Graphs, Algorithms:
- Data Flow Graph Coverage Criteria

- Graph Coverage Criteria: Applied to Test Code,Testing Source Code: Classical Coverage Criteria,

**Module 4 :**

- Data Flow Graph Coverage Criteria : Applied to Test Code
- Software Design and Integration Testing,
- Design Integration Testing and Graph Coverage,
- Specification Testing and Graph Coverage,
- Graph Coverage and Finite state Machines

**Module 5 :**

- Logic: Basics Needed for Software Testing,
- Logic: Coverage Criteria, Coverage Criteria,
- Contd., Logic Coverage Criteria,

**Module 6 :**

- Logic Coverage Criteria: Applied to Test Code_1, Logic Coverage Criteria: Applied to Test Code_2,
- Logic Coverage Criteria: Issues in Applying to Test Code,
- Logic Coverage Criteria: Applied to Test Specifications, Logic Coverage Criteria: Applied to Finite State Machines

**Module 7 :**

- Functional Testing, Input Space Partitioning,
- Input Space Partitioning: Coverage Criteria, Input Space Partitioning Coverage Criteria: Example,

**Module 8:**

- Syntax-Based Testing, Mutation Testing, Mutation Testing for Programs,
- Mutation Testing: Mutation Operators for Source Code,
- Mutation Testing Vs. Graphs and Logic Based Testing

**Module 9 :**

- Mutation testing, Mutation Testing:Mutation for integration,
- Mutation testing : Grammars and inputs,

**Module 10 :**

- Testing of web Applications and Web Services

**Module 11:**

- Symbolic Testing, DART: Directed Automated Random Testing,
- DART: Directed Automated Random Testing - 2,
- DART: Directed Automated Random Testing 3,

**Module 12 :**

- Testing of Object-Oriented Applications, Testing of Mobile Applications,
- Non-Functional System Testing, Regression Testing
- Concolic testing, Conclusion

**Text Book Link:**

https://drive.google.com/file/d/1yRhi4EFWhAXTSq-iPon3I5mmtbMEfTOt/view

**Course Link:**

https://onlinecourses.nptel.ac.in/noc22_cs61/preview

**Video Download link:**

https://archive.nptel.ac.in/courses/106/101/106101163/

**Transcript link:**
https://drive.google.com/drive/folders/1ZF8BbL012nj6dNoRVCAh0mNZP709-9DR

| Programme Elective-II |
|---|
| 20PECE 502 (NPTEL / Swayam Course ) |

# 20PECE 502B Reinforcement Learning

**Teaching Scheme**
Lectures : 3 Hrs/Week

**Examination Scheme**
In Semester : 50 Marks
End Semester: 50 Marks
Credits: 3

**Prerequisites :**
Machine Learning (20CE404)

**Course Objectives:**
**To facilitate the learners to -**
1. Understand the need of Reinforcement Learning.
2. Understand the full reinforcement learning concepts and its techniques
3. Understand the basic mathematical foundations of reinforcement learning.
4. Understand the concepts of function approximation in reinforcement learning.
5. Have the knowledge of hierarchical reinforcement learning and applications.
6. Explore the current developments in the reinforcement learning field.

**Course Outcomes:**
**By taking this course, the learner will be able to -**
1. Apply the basic concepts of Reinforcement Learning in various domains/fields.
2. Make use of the techniques for full reinforcement learning.
3. Apply the fundamental mathematics for solving the problems of reinforcement learning.
4. Apply the knowledge of function approximation in reinforcement learning.
5. Apply the concepts of hierarchical reinforcement learning and its applications.
6. Interpret the recent advancements in the field of reinforcement learning.

- Introduction to RL
- RL Framework and Applications
- Introduction to Immediate RL
- Bandit Optimalities
- Value function based methods

- UCB 1
- Concentration Bounds
- UCB 1 theorem
- PAC bounds
- Median Elimination
- Thompson Sampling

- Policy Search
- REINFORCE
- Contextual Bandits
- Full RL Introduction
- Returns, value functions and MDPs
- MDP modeling

- Bellman Equation
- Bellman Optimality Equation
- Cauchy sequence and Green's equation
- Banach Fixed Point equation
- convergence proofs

- Lpi Convergence
- Value Iteration
- Policy Iteration
- Dynamic Programming
- Monte Carlo
- Control in Monte Carlo

- Off Policy MC
- UCT
- TD (0)
- TD (0) control
- Q-learning
- Afterstate

- Eligibility Traces
- Backwards view of Eligibility Traces
- Eligibility Trace control
- Thompson sampling Recap

- Function Approximation
- Linear Parameterization
- State Aggregation methods
- Function Approximation and Eligibility Traces
- LSTD and LSTDQ
- LSPI and Fitted Q

- DQN and fitted Q Iteration
- Policy Gradient Approach
- Actor critic and REINFORCE
- Theorem-1
- Policy Gradient Approaches with Function Approximation

- Hierarchical Reinforcement Learning
- Types of Optimality
- Semi Markov Decision Processes
- Options
- Learning with Options
- Hierarchical Abstract Machines

- MAXQ
- MAXQ value Function Decomposition
- Option Recovery

- Solving PODMP.

**Textbook:**

R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 1998.

**Course Link:**

https://onlinecourses.nptel.ac.in/noc22_cs75/preview

**Video Download link:**

https://archive.nptel.ac.in/courses/106/106/106106143/

**Transcript link:**

https://archive.nptel.ac.in/courses/106/106/106106143/

OEHS 3101 **ENTREPRENEURSHIP DEVELOPMENT**

**Teaching Scheme**
**Lectures: 3 Hours / Week**
**Credits: 3**

**Examination Scheme**
**In Semester: 50 Mark**
**End Semester: 50 Marks**

**Course Objectives:**
Students will be able to
1. Understand the fit between individual entrepreneurial ambitions
2. Select a problem worth solving
3. Identify customers
4. Develop a solution for your customers' problems and problem solution
5. Build and demonstrate an MVP (Minimum Viable product)
6. Structure a business model around the problem, customer, and solution and present Business Model Canvas

**Course Outcomes:**
This course will give the students the foundational experience of the entire cycle of entrepreneurship, through a combination of theory and practice.

At the end of the course, the students shall be able to:
1. Describe what it takes to be an entrepreneur
2. Analyze business opportunities and the basics to create, launch and manage new businesses
3. Develop Business Model for their Idea/Problem
4. Create MVP (Minimum Viable Product)

**Module 1: Introduction** **(3)**
Discover yourself, Principles of Effectuation, Identify your entrepreneurial style

**Module 2: Problem Identification and Idea generation** **(4)**
Identify Problems worth Solving, Introduction to Design Thinking, Generate ideas that are potential solutions to the problem identified

**Module 3: Customer Segmentation** **(7)**
Customer identification, Market, Creative solution, Unique Value proposition

**Module 4: Business Model Canvas** **(4)**
Types of business models, Business Plan documentation, Risk identification

**Module 5: Validation** **(9)**
Identification of MVP, Solution development, Building products/services, Build-measure-learn loop for development, Market fit of solution

**Module 6: Money** (5)
Revenue streams, Pricing and cost, Venture financing, Investor expectations

**Module 7: Team building** (3)
Shared leadership, role of good team, Collaboration tools and techniques

**Module 8: Marketing and sales** (3)
Positioning, Channels and strategies, Sales planning

**Module 9: Support** (4)
Project management, Planning and tracking, Business Regulation

**Course contents available at: https://staging.learnwise.org/ - Through a Cloud Technology Platform – WF Learn Wise Platform**

**PDF documents can be downloaded from the website for the distribution to students.**

**Sample References:**

1) **Effectuation: https://necrophone.com/2014/01/20/effectuation-the-best-theory-of-entrepreneurship-you-actually-follow-whether-youve-heard-of-it-or-not/**

2) **Value Proposition: https://www.youtube.com/watch?v=jZN6CUieuOQ&list=PLw540Wq5kay866m6A6xI7KOwE_Ah7is4m**

3) **The Lean BMC: https://www.youtube.com/watch?v=FjB_e7UO1hc**

4) **Define your MVP: https://startups.fb.com/en-in/categories/development/**

5) **Designing Experiments: https://www.youtube.com/watch?v=WiMZWCg1Hu8&t=111s**

6) **Beating the Competition: https://www.youtube.com/watch?v=46uP6vOj5G0**

7) **Google : Think branding: https://www.youtube.com/watch?v=1l2CUjkg0ug**

## OEHS 3101 Introduction to Intellectual Property Rights

**Teaching Scheme**
Lectures : 3 Hrs/week
Credits : 3

**Examination Scheme**
In Semester : 50 Marks
End semester : 50 marks

**Prerequisite** : Nil

**Course Objectives :**

To facilitate the learners to -
1. Give overview of Intellectual Properties (IP) regime in India and International arrangements
2. Understand and compare types of IP as Patents, Copyrights, Trade Secrets etc.
3. Learn the structure, process and steps involved in filing IP applications
4. Understand intricacies involved in drafting patent applications

**Course Outcome :**

By the end of this course, the students should be able to -
1. Demonstrate the concepts of Intellectual Property Rights
2. Apply appropriate type of IP for the Intellectual property
3. Analyze the patentability of inventive step by searching patents
4. Construct the patent draft for the given Patent Specification
5. Understand the advances in patent law, in national and international scenario

**Unit-I : Introduction** **(6)**
Intellectual Property (IP) Vs. Physical property, History of IP in India, Importance of IP, Economic Importance of Intellectual Property Rights, types of IP - Patents, Copyright, Industrial Design, Trade Marks etc., IPR-ownership

**Unit-II : Patents** **(8)**
Introduction to Patents, Patentable Inventions as per the Indian Patent Act, Patent searching, types of Patent applications, Procedure for filing application (National and International), Patents offices, Register of Patents, Rights and obligations of patentee, Term of patent

**Unit-III : Drafting of patent applications** **(8)**
Fundamentals of drafting, structure of the patent specification-Field of invention, prior art, patent classifiations, technical advance, Invention Disclosure Form, problem solution statement, claims, preamble, body, summary

**Unit-IV : Transfer and Infringement of Patent Rights** **(6)**
Working of patents, compulsory licensing, Revocation of patents, Transfer of Patent Rights-Assignment, License; Concept of infringement, Infringement of Patents Rights, Infringement of Patents

**Unit-V : Introduction to other types of IPs** **(8)**
Copyright, Trade Marks, Geographical Indications, Industrial Designs, Trade Secrets,

Layout designs of Integrated Circuits -> Introduction, Work protected by, ownership and infringement, Application process.

**Unit-VI : Advances in IPR** **(6)**

International Patenting, Patent Co-operation Treaty (PCT), Commercialization of Patents, Advances in IPR

**References**

**Text Books**


1. Niraja Pandey, Khushdeep Dharni, “Intellectual Property Rights”, PHI
2. N. S. Rathore, “Intellectual Propoerty Rights: Drafting,Interpretation of Patents Specification and Claims” , New India Publishing Agency


**Reference Books**


1. Venkataraman M., “An introduction to Intellectual property Rights”, Venkataraman M.
2. Mishra, “An introduction to Intellectual property Rights”, Central Law Publications
3. R Anita, V. Bhanoji Rao, “Intellectual property Rights, - A Primer”, Eastern book Company
4. R Puri, “Practical approach to intellectual propert Rights”
5. P Ganguly, “IPR unlisting the knowlege economy”


**Web references**


1. NPTEL course material on “Patent Drafting for Biginners” - https://onlinecourses.nptel.ac.in/noc18_hs17/preview
2. IP India : www.ipindia.nic.in/
3. WIPO, World Intellectual property Organization - www.wipo.int/
4. Intellectual Property (IP) Policy | USPTO - https://www.uspto.gov/intellectual-property-ip-policy

## 20OEHS501C Introduction to Digital Marketing

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 | In Semester: 50 marks |
| | End Semester: 50 marks |
| | **Credits:3** |

**Prerequisite: ---**

**Course Objective:**

1. Interpret Digital  marketing campaign strategy
2. Explain social media and its role in marketing strategy through various channels which it operates
3. Explore  search engine optimization
4. Explain concepts related to mobile marketing

**Course Outcome:**

After successfully completing the course students will be able to

1. Explore methods to illustrate website and webhosting concepts
2. Develop a marketing plan for product or service by integrating social media platforms to generate leads
3. Examine mobile marketing strategies to connect with customers
4. Demonstrate importance of organic ranking through SEO

**Unit: I  Overview of Digital Marketing  (08)**

Introduction to Digital Marketing,Understand customer needs, Benefits of Digital marketing, Digital marketing platforms and Strategies, Comparing Digital with Traditional Marketing,Latest Digital marketing trends, What is Domain Name, Types of Domain,  Web Hosting Concepts, Domain/Hosting Business,introduction to wordpress

**Unit: II  Digital Advertising with  Google AdWords  (08)**

Introduction to Paid Marketing, Google Account setup, Account Structure, Campaigns settings, AdGroup setup, Keyword Match Types, Keyword Research Tools, Understanding Ad Auction, What is Quality Score, My Client Centre, Google

AdWords Editor Tool,
Interface Tour and BillingSettings

**Unit: III Social Media Marketing (08)**

Introduction to Social Media, Integrating Social Media with Other Disciplines, Facebook Marketing, Facebook account setup, Personal account properties, Facebook marketing strategy, Facebook business page setup, Types of Business pages, Cover photo designing, Page management options, twitter and Instagram marketing

**Unit: IV Mobile Marketing (06)**

Introduction to Mobile Marketing and m-commerce, create mobile app,case study:market potential of mobile commerce.

**Unit: V Search Engine Optimization (06)**

**I**ntroduction to Search Engines, On-Page Optimization, Off-Site Optimization, Social media monitoring Tool

**Unit: VI Case study and Future Trends in Digital marketing (06)**

Digital marketing Scenario in india and world, Digital Strategies Influence r marketing, AI in Digital Marketing

**Text Books:**

1. Seema Gupta, **"Digital Marketing**", *McGraw-Hill Publication*, (1st Edition), (2018).
2. Benjamin Mangold, **"Google Adwords and Google Analytics"**, *loves data* , (1st Edition), (2018).
3. Richard stokes, **"Pay per click",** *Entrepreneur Press*,(2nd Edition), (2014).
4. Suraj Bandyopadhyay **"Models for Social Networks with Statistical Applications"**, *Sage Publications*, (1st Edition), (2011).

**Reference Books:**

1. Ian Dodson, "**The Art of Digital Marketing",** *Wiley*, (1st Edition), (2016).
2. Sira. R Bowden , "**Beginners Guide Digital Marketing Part 2:** *Mobile Marketing", BookRix*, (1st Edition), (2016).

**Online Resources:**

NPTEL:Marketing Management: *https://nptel.ac.in/courses/110/104/110104070/*

**websites:**

1. https://www.searchenginejournal.com/seo-guide/panda-penguin-

hummingbird/

2. https://www.lynda.com/Analytics-tutorials/Online-Marketing-Fundamentals/188429-2.html

# CE 501L Computer Networks Laboratory

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
End Semester(OR): 25 Marks
In Semester (TW):25 Marks
**Credits: 2**

**Prerequisite:**

**Course Objectives:**

To facilitate the learner to

1. Learn computer network topologies and types of network
2. Use modern tools for network traffic analysis and various networking configurations.
3. To learn network programming.
4. To develop an understanding of various protocols, modern technologies and applications

**Course Outcomes:**

After completion of the course, students will be able to

1. Demonstrate error control, flow control techniques and analyze them
2. Configure switches and routers.
3. Demonstrate LAN and WAN protocol behaviour using Modern Tools
4. Develop Client-Server architectures and prototypes

**Preamble:** This Lab is to provide students with an overview of the concepts and fundamentals of computer networks. Lab include: communication concepts and techniques in a layered network architecture, routing, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

## Suggestive List of Assignments

**Group A :** **(Mandatory)**

1 Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.

2 Design an IP scheme for a WAN network (minimum 3 networks) using Cisco Packet Tracer tool (Static Routing).

3 Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN).

4 Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.

5 Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.

**Group B:** **(Any Two)**

1 Use packet Tracer tool for configuration of 3 router network using one of

the following protocol RIP/OSPF

2 Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator

3 Write a program for DNS lookup. Given an IP address as input, it should return URL and vice versa.

4 Write a program to demonstrate Sub-netting and find subnet masks.

5 Configuring Ftp server for file upload /download using Cisco Packet Tracer.

**Group C**

1 Setup a wired LAN using Layer 2 Switch. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrating the PING packets captured traces using Wire shark Packet Analyzer Tool.

2 Creation and configuration of Virtual Machines- Create 2 local virtual machines on host and ping the Virtual Machine.

Virtual Laboratory: http://vlabs.iitb.ac.in/vlab

# 20CE 504L Programming Skills Development II Laboratory

**Teaching Scheme**
Practical: 4 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral : 25 Marks
**Credits: 2**

**Prerequisite:**

1. Fundamentals of Programming Languages – II (20ES05)
2. Data Structures and Algorithms-II (20CE305)
3. Programming Skills Development-I Laboratory (20CE 306)

**Course Objectives:**

To facilitate the learner to

1. Explore the usage of mobile development tools.
2. Learn the process of development of mobile application
3. Create data-driven mobile applications
4. Create mini project using all the concepts

**Course Outcomes:**

After completion of the course, students will be able to

1. Select suitable configuration parameters, components, API's, libraries for mobile application development.
2. Design an android application using widgets, layouts, event handlers, intents etc.
3. Develop mobile application using advance features of android like database, multimedia, canvas, graphics etc.
4. Create a small mobile application.

**Preamble:**

The lab would be for understanding the syntax and semantics of Android programming and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented using android studio.

Motivation here is that students should be able learn the App development and also should be able to analyze problems and select suitable built-in tools/API.

Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, constructs and design of simple applications. Students will be encouraged to solve open ended problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Group A assignments are for learning the basics of android programming

Group B assignments are for learning advanced features like fragments, custom views, animations, Sensor capabilities to the App. .Group C assignment is open ended application development

## Suggestive List of Assignments

**Group A : (Mandatory)**

1. Download, install and configure android development tools, plugins and SDK / Studio
2. Develop a simple Applications like
   a. Calculator
   b. Unit Converter (Scale,Temperature)
   c. BMI using UI Widgets – button, textview, editview etc.
3. Develop an application that uses Spinner component
4. Develop an application that uses intent, event listener and different Layout Managers
5. Develop an application that draws basic graphical primitives on the screen
6. Develop an application that make use of Alert Dialog

**Group B: (Any Three)**

1. Develop a mobile application that makes use of database for student/employment/ Library
2. Develop a mobile application that makes use of Uri,XMlPullparser like RSS feed
3. Develop a mobile application that implements Multi threading
4. Develop a mobile application that creates an alert upon receiving a message.
5. Develop a mobile application that uses time picker,alarm,adapter like creating alarm clock
6. Develop a mobile application for multimedia Application
7. Develop a mobile application for image transformations like Translation,Scaling and rotation
8. Develop an application that reads/writes data to-from the SD card.
9. Develop an application that uses contact class and methods like send email/SMS
10. Develop a sensor based application using Motion sensors,Position sensors, Environmental sensor

**Group C**

1. Mini Project

# 20PECE 501LA Digital Image Processing Laboratory

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25
Marks Oral : 25
Marks Credits: 1

**Prerequisite:**

**Course Objectives:**

To facilitate the learner to

1. Learn Basics Image Processing operations like image Read, Write, Add, subtract
2. Understand and apply algorithms used for image enhancement, edge detection
3. Able to develop an Image Processing application using various techniques
4. Learn and use different Image Processing Tools

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply basic operations on given image
2. Apply effectively algorithms for image enhancement, edge detection
3. Develop small image processing application using various techniques
4. Make use of Image Processing Tool

**Preamble:**

The lab would be for understanding the basic concepts of image processing and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented Using Opencv in Python/JAVA programming language. Motivation here is that students should be able to code the basic algorithm and also should be able to make use of built-in functions available in different libraries of Opencv and Python/Java. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

Group A assignments are on capturing images and performing different manipulation on image data such as arithmetic and logical operations, to improve the quality of image using different enhancement techniques. Group B assignments are on filtering techniques and Group C assignment is open ended application development

## Suggestive List of Assignments

**Group A : (Mandatory)**

1. Study different file formats and Write a program to create a simple image file in .tiff format, and display it .
2. Write a program to perform Arithmetic operations/Logical operations
3. Write a program to perform Intensity Transformation technique on given image
4. Write a program for image enhancement techniques using Histogram

**Group B: (Any Three)**

1. Write a program using derivative filtering technique for Edge detection
2. Write a program to illustrate Morphological transformation
3. Write a program to illustrate Image Restoration techniques
4. Write a program using Edge detectors for Edge detection
5. Write a program for Non-Linear filtering using convolutional masks- effects of a median filter on an image corrupted with impulsive noise.

**Group C**

1. Implement a small Image processing application using MATLAB/ OpenCV

# 20PECE 501B Java Full Stack Technologies

**Teaching Scheme**
Lectures: 3 Hrs/week

**Examination Scheme**
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

**Prerequisites:** Data Structures (20CE 302)

**Course Objectives:**
**To facilitate the learner to -**

1. Get exposure to full stack development in Java technologies.
2. Develop familiarity with the client side Java technologies.
3. Gain comprehensive knowledge about Java server side technologies for enterprise application development in practice.
4. Get familiar with the web services based approach for real-life application development.
5. Get acquainted with the database development technologies in Java.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Choose suitable client side Java technologies.
2. Analyze Java server side technologies for enterprise application development.
3. Analyze the characteristics of web services paradigm.
4. Analyze the role of Java database development technologies to realize their suitability for application development.

**Unit 1: Client Side Web Technologies** **(07)**

n-tier architecture, HTTP request - response, Web browser, HTML, CSS, XML, JSON, JavaScript (JS), Document Object Model (DOM), Introduction to jQuery, Asynchronous JavaScript And XML (AJAX).

**Unit 2: Server Side Java Web Technologies** **(07)**

Introduction to server side technology, Common Gate Interface (CGI), Java Servlets, Java Server Pages (JSP), Session tracking, JSP tags, Java Beans, MVC architecture.

**Unit 3: ReactJS** **(06)**

Overview of ReactJS: Introduction, Features, Advantages, Comparison with AngularJS, Introduction to Nodejs; ReactJS concepts like components, virtual DOM, JSX and APIs.

**Unit 4: Java 2 Enterprise Edition (J2EE) Technologies (08)**

Introduction to J2EE technologies, Enterprise Java Beans (EJB), Java Messaging Service (JMS), Remote Method Invocation (RMI).

**Unit 5: Java Web Services (07)**

Web Services: Overview; Service Oriented Architecture (SOA), Java Web services based on SOAP and REST, Java Web services API for SOAP and REST based web services:
JAX-WS, JAX-RS.

**Unit 6: Java Database Programming and Hibernate (07)**

Java Database Connectivity (JDBC), Java Transaction API (JTA), Java Persistence API (JPA), Hibernate: Overview, architecture, Object Relational (OR) Mapping.

**Text books:**


1. Kogent Learning Solutions Inc., **'Web Technologies: HTML, JS, PHP, Java, JSP, ASP.NET, XML, AJAX, Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-997-4, (2015).
2. Kogent Learning Solutions Inc., **'Java Sever Programming Java EE6 Black Book'**, *DreamTech Press*, ISBN: 978-81-7722-936-3, (2013).
3. Stoyan Stefanov, **'React - Up & Running: Building Web Applications',** *O'Reilly,* ISBN: 9781491931820, (2016).
4. William Crawford, Jim Farley, **'Java Enterprise in a Nutshell'**, *O'Reilly*, ISBN-13: 978-0596101428, 3rd Edition, (2005).


**References books:**


1. Mark Tielens Thomas, **'React in Action'**, *Manning Publications*, ISBN: 978-1617293856, (2018).
2. Kevin Mukhar, Chris Zelenak, James L. Weaver and Jim Crume, **'Beginning Java EE5: From Novice to Professional'**, *Apress*, ISBN-13: 978-8181284020, (2006).
3. Kirupa Chinnathambi, **'Learning React: A Hands-on Guide to Building Web Applications Using React and Redux',** *Addison Wesley,* (2016).
4. Jim Keogh, **'The Complete Reference J2EE'**, *McGraw Hill Education*, ISBN: 978-0-07-052912-0, (2012).


**Web References:**


1. https://learn.jquery.com
2. https://docs.oracle.com/javaee/7/tutorial/
3. https://reactjs.org

# 20PECE 501LB Java Full Stack Technologies Laboratory

**Teaching Scheme**
Practical: 2 Hrs/week

**Examination Scheme**
In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

**Course Objectives:**
**To facilitate the learners to -**

1. Understand the Installation and Configuration setting related aspects of web server, integrated development environments and various frameworks, in the development of web applications.
2. Understand the role of various technologies used for real-life application development.
3. Get exposure to full stack development in Java which includes client side and server side technologies, web services and database development technologies.
4. Gain practical knowledge about the various client side and Java server side technologies for application development in practice.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Make use of suitable client side Java technologies.
2. Experiment with various Java server side technologies like Java Servlets, Java Server Pages, Web services and JPA for web application development.
3. Make use of Java Sockets library and Java RMI framework for the development of sample client-server applications.
4. Build a sample web application using suitable technologies at various tiers.

**Preamble:**

Development of web applications need technologies at various levels, which play different roles in the overall web architecture. The intent of Java Full Stack Technologies Laboratory is to enable the understanding of the role of various technologies in full stack development and implementation of some real world application scenarios using these technologies. Assignment statements are in brief and should be implemented with Java web technologies. Motivation here is that students should be able to develop the user interface, business logic and the database programming parts of a typical web application, using the APIs/libraries provided by various client side and server side Java technologies. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to build solutions for real world business scenarios in different domains, to fulfil the end-user requirements. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Group A assignments are on applying various client side technologies and basic server side technologies. Group B assignments are on exploring the use of technologies like EJB, Web services and Hibernate. Group C assignment is on the development of sample web application.

**Suggestive List of Assignments:**

**Group A: (Mandatory)**

1. Develop dynamic and interactive web client using HTML, CSS and JavaScript technologies. Make use of these technologies to develop suitable web forms, layout and to perform validation of form data, for this web client.

   Sample application scenario:
   Consider that a student needs to register for an online course portal. For this scenario, develop an HTML form for "Course Registration", make use of CSS for layout design of this form and perform validation on various fields of this form using JavaScript.

2. Develop dynamic and interactive web client using XML and AJAX technologies, to enable rich user experience.

   Sample application scenario for AJAX:
   Consider a web form for an administrator of an "Online Shopping Application". An administrator can select the name of a customer from the drop down list box on the web form. Then on the same page, the details of the customer such as shipping address should get displayed.

3. Develop dynamic and interactive web client using jQuery as a client side JavaScript library. For this web client, implement event handling and animation effects using jQuery.
4. Develop dynamic and interactive web client using ReactJS as a client side library. Make use of various features of ReactJS such as components, APIs etc.
5. Implement an application using Java RMI to understand distributed application environment. The remote object accesses database using JDBC.
6. Implement a sample web application scenario using Java Servlets, Java Server Pages and Java Beans as the server side dynamic content generation technologies. Make use of MVC architecture for this implementation and also show the appropriate usage of the various capabilities of these technologies such as session tracking, tag library, implicit objects, directives etc.

   Sample application scenario:
   Consider a simple web form where you give Student Roll number and get back Student Profile details from the database. Make use of MVC architecture, based on Java Servlet, JSP and Java Bean to implement this web based scenario.

**Group B: (Any One)**

1. Implement a sample EJB based scenario for any application like online movie ticket booking, online college admission portal, online railway reservation etc. Make use of various types of beans such as session beans and entity beans, for the implementation of business methods and persistence of data.
2. For a sample application scenario, implement and consume the suitable web services using SOAP or REST protocol.
3. Make use of JPA with Hibernate framework for performing the create, retrieve, update and delete (CRUD) operations on the backend database.

   Sample application scenario:
   Consider "Course Information Management" as a typical Database Application. This application may have database tables like Courses, Participants etc. Make use of JPA with Hibernate framework to access the data from the Courses table in this above application.

**Group C:**

1. Design and develop a typical web application like online cab booking, online food ordering application, online tours and travel portal etc. For the development of this application, choose the appropriate technologies for the client side aspects, server side business logic and database development.

# 20PECE 501LC Statistics for Computer Science Laboratory

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical : 2 Hours / Week | In Semester: 25 Marks |
| | Oral: 25 Marks<br>Credits: 1 |

**Prerequisite:** NA

**Course Objectives:**

To facilitate the learner to

1. Understand and use the basic statistical tool for statistical operations and interpretation of data.
2. Use knowledge of data representation for given data points.
3. Apply correlation, regression model and ANOVA model for given data.
4. Apply hypothesis testing to draw conclusions for given data.
5. Use concepts of statistics for real life problems.

**Course Outcomes:**

After completion of the course, students will be able to

1. Perform basic statistical operations on given data using statistical programming and tools.
2. Apply different data representation methods for interpretation of given data.
3. Apply various models of regression, correlation and ANOVA to predict and find relation between given data.
4. Apply hypothesis testing to draw inference for given data.
5. Develop small statistical applications using different statistical techniques.

**Preamble**

A large part of the lab would be for understanding the basic concepts of statistics and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in R/Python programming language. Motivation here is that students should be able to code the basic statistical techniques on given data and also should be able to make use of built-in functions available in different libraries of R/Python. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here. Assignments can be done on any data dataset. Students and faculty are advised to consider different datasets.

# Suggestive List of Assignments

**Group A: (Mandatory)**

1.Getting started with software, installation, its objects and data types
2.Graphical presentation of data in different plot forms/diagrams using software tool
3.Apply basic statistical operations, measure of location (Arithmetic mean, harmonic mean, geometric mean, median, mode)
4.Perform measure of dispersion, standard deviation, quartile deviation etc.

**Group B: (Any Four)**

1.Plot the diagram for the given data, develop the regression model that best describes the data, and also predict output for the given value.
2.Perform correlation analysis (positive, negative, zero) that describes the degree to which variables are linearly related to each other.
3.Perform test of hypothesis, one sample t-test, paired t-test on given data and see how to use them for statistical inference.
4.Perform test of hypothesis, chi-squared goodness of fit test, on given data and see how to use them for statistical inference.
5. Perform analysis of variance (ANOVA) on data for evaluating hypothesis.

**Group C**

Data analysis case study for readily available data set using the statistical techniques studied. Take a dataset freely available, apply statistical analysis technique or statistical machine learning technique on that dataset, also graphically represents the results.

Maharshi Karve Stree Shikshan Samstha's
Cummins College of Engineering for Women, Pune
(An autonomous Institute affiliated to Savitribai Phule Pune University)
**Department of Computer Engineering**

**20HDM501 Statistics for Data science and Machine learning**

**Teaching Scheme:**
**Lectures: 3 hrs/week**

**Examination Scheme:**
**In sem: 50 Marks**
**End sem: 50 Marks**
**Credit: 3**

**Course Objectives:-**
**To facilitate the learners to :-**
1. To be able to analyze univariate, bivariate and multivariate data.
2. To be able to apply feature selection, dimensionality reduction
3. To be able to perform Time series analysis, interpolation and extrapolation techniques
4. To be able to apply statistical inference techniques and statistical decision theory to draw conclusion

**Course Outcomes:-**
**Learner should be able to:-**
1. Apply univariate, bivariate data analytics techniques.
2. Apply data transformation, feature selection and dimensionality reduction techniques for given multidimensional data.
3. Analyze given time series data.
4. Apply interpolation and extrapolation techniques for data analysis.
5. Apply statistical inference techniques and statistical decision theory for given data.

**Course Contents:**

**Section 1: Univariate and Bivariate Data Analysis**

Review of descriptive statistics: Data types, Measure of central tendency, dispersion, skewness, kurtosis. Case studies for descriptive statistics using python. Association of attributes: Difference between correlation and association, consistency of data, methods of association, partial association, illusory association, Simpson's paradox.

**Section 2: Operations on Multidimensional data**

Feature selection, Dimensionality reduction, data transformation, distance measures, Time series analysis, Interpolation and Extrapolation, Significance of interpolation and extrapolation, methods of interpolation, extrapolation. Case studies using python.

**Section 3: Statistical inference and decision theory**

Statistical inference and statistical decision theory: Test of hypothesis introduction, parametric and non-parametric test such as t-test, Rank Sum test, Experimental design: randomized blocks, latin squares. Statistical decision theory: Introduction, ingredients to decision problems, optimal decisions. Examples using python.

**Text Books:**

1) “Statistical Methods”, S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2) “Basic statistics”, B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.
3) “Statistics in Nutshell”, Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN : 978-81-8404-568-0, SPD O'Reilly publication.
4) “R programming for beginners”, Sandhya Arora, Latest Malik, 1st edition, 2020, University press publication, ISBN 978-93-89211-56-6

**Reference Books:**

1) “Statistical Data analytic” by Piegorsch W.W., Wiley publication, 2017
2) “Introductory statistics”, Sheldon M. Ross, 2nd Edition, 2006, ISBN : 81312-00485, Elsevier publication.
3) "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning
4) “Data Mining: Concepts and Techniques”, Jiawei Han, Micheline Kamber, Jian Pei, , 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

## 20HDM502 Advanced Data Science

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. To be able to apply advanced data science concepts using python.
2. To be able to apply probability and probability distributions concept for given data
3. To be able to analyze and visualize data using python and other tools.

**Course Outcomes:**

Learner should be able to:-

1. Apply python programming for advanced data science concepts.
2. Apply different concepts of probability for data analysis.
3. Perform exploratory data analysis
4. Perform data visualization for univariate and multivariate data.

**Course Contents:**

**Section 1: Advanced python programming**

Quick review of basics of Python programming, data frames, data handling, data cleaning, data integration, data analysis using python, handling SciPy, Sklearn library functions. Basic case studies using these libraries.

**Section 2: Probability**

Review of basics of probability, Distributions, Conditional probability, Bayes theorem, Hidden Markov Model, Case study and demo with Python.

**Section 3: Exploratory data analysis and visualization**

Exploratory data analysis and visualization,Visualization before Analysis, Visualizing univariate and multivariate data, Multivariate Glyphs. Case study, Python based examples, Demo with tool like Tableau.

**In class hands-on / demonstrations:**

**Explore and download free data set**

**(from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/,**

**https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)**

**and perform the following**

--data handling with dataframes in python
--data cleaning
--data integration
--Exploratory data analysis
--Visualization of data in different plots using python libraries
--apply conditional probability, HMM concept on given data

**Text Books :-**

1. "Data Analytics using python", Bharti Motwani, Wiley publication,1st edition, ISBN 978-81-265-0295-0, 2020
2. "Data Science from Scratch", Joel Grus, O'Reilly Media, 2nd edition, ISBN-9781492041139, 2019
3. **"**Data science fundamentals and practical approaches", Gypsy Nandi, BPB publication, 1st edition, ISBN 978-93-89845-662, 2020

**Reference Books:-**

1. "Statistics for Machine Learning: Essential statistical concepts for exploring predictive analytics and machine learning using Python and R", Pratap Dangeti, Packt Publishing 2019, ISBN: 978-1789532678
2. "Probability and Statistics for Data Science", Carlos Fernandez-Granda, New York 2017, https://cims.nyu.edu/~cfgranda/pages/stuff/probability_stats_for_DS.pdf
3. "Think Stats: Probability and Statistics for Programmers",Allen B. Downey, Green Tea Press Needham, Massachusetts, 2011, https://greenteapress.com/thinkstats/thinkstats.pdf

# T1 Evaluation of
# 20HDM 502 Advanced Data Science 2022-23

**Rubrics for Evaluation:**

The students will be working in a group of 2-3.
The evaluation can be done on following points:

| Sr. No. | CO | Evaluation point | Marks | BL Section | |
|---|---|---|---|---|---|
| 1. | 1 | Download / create multidimensional data set and apply suitable data cleaning methods | 05 | L4 S1 | M |
| 2. | 1 | Choose and apply suitable data Integration methods using Python libraries | 05 | L4 S1 | M |
| 3. | 3 | Choose and apply suitable exploratory data analysis methods for multidimensional data | 05 | L4 S3 | M |
| 4. | 4 | Choose and apply suitable advanced multivariate data visualization using Python libraries | 05 | L4 S3 | D |
| 5. | 2 | Apply conditional probability / HMM to the selected data set | 05 | L4 S2 | M |
| | | **Total marks** | **25** | | |

- The students will select or create a data set, apply appropriate techniques to the chosen data set and justify the method selection.
- The students will submit their implementation along with a brief write-up to the course teacher on-line.

Dr. Madhuri Tasgaonkar
ADS Course Chairman

Maharshi Karve Stree Shikshan Samstha's
Cummins College of Engineering for Women, Pune
(An autonomous Institute affiliated to Savitribai Phule Pune University)
Department of Computer Engineering

**20HDM501L Statistics for Data science and Machine learning Laboratory**

**Teaching Scheme:**
**Lectures: 2 hrs/week**

**Examination Scheme:**
**In sem: 25 Marks**
**End sem: 25 Marks**
**Credit: 1**

**Course Objectives:**

**To facilitate the learners to -**

1. Implement and analyze the basic and descriptive statistical operations univariate, bivariate and multivariate data.
2. Apply correlation, regression model, principal component analysis(PCA) model.
3. Perform analysis of time series dataset.
4. Make use of statistical inference techniques such as t-test, rank sum test for the given dataset.
5. Design the solution for real life problems using the techniques of statistics.

**Course Outcome:**

**By taking this course, the learner will be able to -**

1. Implement basic and descriptive statistical operations on a given dataset.
2. Implement various models of correlation, regression, feature selection, PCA on a given two dimensional or multidimensional dataset.
3. Perform time series analysis on a given time series dataset.
4. Implement statistical inference techniques such as t-test, rank sum test for the given dataset.
5. Develop small statistical data analysis application using different statistical techniques.

**Lab Work:-**

The large part of Statistics for Data science and Machine learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used i.e. data

cleaning/transformation/integration/reduction will be done and that data will be subsequently used to perform advanced statistical operations. Students will be encouraged to publish their findings in the form of research papers. Students will be motivated to explore the existing data set, build the code for/using statistical methods.
Faculty members are encouraged to expand problems with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

## Suggestive List of Assignments

**Explore and download free data sets (from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/, https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17**

**) and perform the following on the cleaned and integrated dataset (Using R/python).**

--Descriptive data analysis for univariate data such as medical data.

--Data analysis of two dimensional data / multidimensional using correlation and regression etc and predict data value. Data set can be of nutrition, medical, real estate data etc.

--Apply data Feature selection, Dimensionality reduction, data transformation, distance measures techniques on multivariate data

--Perform time series analysis on given time series data such as sales,  daily temperature, stock data set.

--Apply statistical inference techniques such as t-test, rank sum test on given data such as cars dataset.

--Perform simpson's paradox on given data. Expenditure data set can be used as an example.

--Develop a data analysis case study for readily available dataset using the statistical techniques studied.

**Text Books:**


1) "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2) "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.

3) “Statistics in Nutshell”, Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN : 978-81-8404-568-0, SPD O'Reilly publication.
4) “R programming for beginners”, Sandhya Arora, Latest Malik, 1st edition, 2020, University press publication, ISBN 978-93-89211-56-6

**Reference Books:**

1) “Statistical Data analytic” by Piegorsch W.W., Wiley publication, 2017
2) “Introductory statistics”, Sheldon M. Ross, 2nd Edition, 2006, ISBN : 81312-00485, Elsevier publication.
3) "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning
4) “Data Mining: Concepts and Techniques”, Jiawei Han, Micheline Kamber, Jian Pei, , 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

Maharshi Karve Stree Shikshan Samstha's
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**Department of Computer Engineering**

**20HDM501L Statistics for Data science and Machine learning Laboratory**

**Teaching Scheme:**
**Lectures: 2 hrs/week**

**Examination Scheme:**
**In sem: 25 Marks**
**End sem: 25 Marks**
**Credit: 1**

**Course Objectives:**

**To facilitate the learners to -**

1. Implement and analyze the basic and descriptive statistical operations univariate, bivariate and multivariate data.
2. Apply correlation, regression model, principal component analysis(PCA) model.
3. Perform analysis of time series dataset.
4. Make use of statistical inference techniques such as t-test, rank sum test for the given dataset.
5. Design the solution for real life problems using the techniques of statistics.

**Course Outcome:**

**By taking this course, the learner will be able to -**

1. Implement basic and descriptive statistical operations on a given dataset.
2. Implement various models of correlation, regression, feature selection, PCA on a given two dimensional or multidimensional dataset.
3. Perform time series analysis on a given time series dataset.
4. Implement statistical inference techniques such as t-test, rank sum test for the given dataset.
5. Develop small statistical data analysis application using different statistical techniques.

**Lab Work:-**

The large part of Statistics for Data science and Machine learning laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used i.e. data

cleaning/transformation/integration/reduction will be done and that data will be subsequently used to perform advanced statistical operations. Students will be encouraged to publish their findings in the form of research papers. Students will be motivated to explore the existing data set, build the code for/using statistical methods.
Faculty members are encouraged to expand problems with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domains. Faculty will appropriately adopt assignments on similar lines as the examples shown here.

## Suggestive List of Assignments

**Explore and download free data sets (from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/, https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17**

**) and perform the following on the cleaned and integrated dataset (Using R/python).**

--Descriptive data analysis for univariate data such as medical data.

--Data analysis of two dimensional data / multidimensional using correlation and regression etc and predict data value. Data set can be of nutrition, medical, real estate data etc.

--Apply data Feature selection, Dimensionality reduction, data transformation, distance measures techniques on multivariate data

--Perform time series analysis on given time series data such as sales, daily temperature, stock data set.

--Apply statistical inference techniques such as t-test, rank sum test on given data such as cars dataset.

--Perform simpson's paradox on given data. Expenditure data set can be used as an example.

--Develop a data analysis case study for readily available dataset using the statistical techniques studied.

**Text Books:**

1) "Statistical Methods", S.P. Gupta, 41st Edition, 2011, ISBN :978-81-8054-862-8, Sultan Chand and Sons publication.
2) "Basic statistics", B.L. Agarwal, 9th Edition, 2011, ISBN:978-81-224-2472-0, New Age publication.

3) “Statistics in Nutshell”, Sarah Boslaugh and Paul Andrew Watters, 2008, ISBN : 978-81-8404-568-0, SPD O'Reilly publication.
4) “R programming for beginners”, Sandhya Arora, Latest Malik, 1st edition, 2020, University press publication, ISBN 978-93-89211-56-6

**Reference Books:**

1) “Statistical Data analytic” by Piegorsch W.W., Wiley publication, 2017
2) “Introductory statistics”, Sheldon M. Ross, 2nd Edition, 2006, ISBN : 81312-00485, Elsevier publication.
3) "Applied multivariate statistical analysis", Richard A. Johnson, Dean W. Wichern, 6th edition, 2012, ISBN-978-81-203-4587-4, PHI Learning
4) “Data Mining: Concepts and Techniques”, Jiawei Han, Micheline Kamber, Jian Pei, , 3rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

# 20CE 601 MICROPROCESSOR AND MICROCONTROLLER

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| Lectures: 3 hrs./Week | In-Semester: **50** Marks |
| Tutorial: 1 hr./Week | End-Semester: **50** Marks |
| | **Credits: 4** |

**Prerequisite:**

1. Digital Systems and Computer Organization (20CE 304)

**Course Objectives:**

To facilitate the learners

1. To understand basic architecture and programming of Pentium microprocessor.
2. To understand and analyze the protected mode of the Pentium processor.
3. To understand the architecture of an 8051 microcontroller.

**Course Outcomes:**

By taking this course, the learner will be able to

1. Demonstrate the knowledge of basic Pentium processor concepts.
2. Infer the advanced microprocessor architectures.
3. Make use of the 8051 microcontrollers for interfacing the devices.
4. Apply the programming concepts using x86 and 8051 assembly level language.

**Unit – 1: SUPERSCALAR ARCHITECTURE IN PENTIUM MICROPROCESSOR (07)**

Pentium Architecture, Pipeline stages, Superscalar pipeline issues, Instruction pairing rules, Branch prediction, Memory organization with Instruction and Data caches Pentium programmers' model, register set, Addressing modes and instructions.

**Unit – 2: PROTECTED MODE ARCHITECTURE IN PENTIUM (08)**

Real Mode vs. Protected mode, Memory management with segmentation and paging Protection mechanism in segmentation and paging, Virtual 8086 Mode (support registers, descriptors, privilege-level, protection, exclusive instructions, inter-privilege level, transfer control, Paging-support registers, Descriptor, linear to physical address translation, Translation Look-aside Buffer, page level protection).

**Unit – 3: MULTITASKING, INTERRUPTS, EXCEPTION AND INPUT/OUTPUT (07)**

Multitasking, support registers, Descriptors, Task switching, Nested task, I/O handling in Pentium, I/O instructions, I/O Permission bitmap, Interrupts and Exceptions structure in real, protected and virtual modes.

**Unit – 4: 8051 MICROCONTROLLER ARCHITECTURE (07)**

Features, Microcontroller MCS-51 family architecture. Programmers model-register set, register bank, Special Function Registers, addressing mode, instruction set, Memory organization on-chip data memory External data memory and program memory. Memory interfacing-external RAM/ROM interface.

**Unit – 5: 8051 AND INPUT-OUTPUT INTERFACING** **(08)**

CPU timings, Interrupt structure, Timers and their programming, Serial port and programming, Serial Data Communication using RS-232C. I/O devices-Analog to Digital (ADC) / Digital to Analog (DAC) Converters and Stepper Motor, Power saving modes in 8051.

**Unit – 6: INTRODUCTION TO ADVANCED MICROPROCESSORS AND MICROCONTROLLERS** **(06)**

Introduction to multicore architectures i3/i5/i7, Cache coherency, Features of Processor Architectures for Mobile Application, Embedded Application and Enterprise Application.
Introduction to Advanced Microcontrollers for Embedded Systems

**Text Books:**

1. 8086 and peripherals – Intel Manual
2. Pentium Architecture – Intel Manual
3. Intel 8-bit Microcontroller Manual

**Reference Books:**


1. Douglas Hall, **'Microprocessors & Interfacing'**, *McGraw Hill*, (Revised 2nd Edition), (2006)
2. James Antonakos, **'The Pentium Microprocessor'**, *Pearson Education,* (2nd Edition), (2004)
3. Sivarama P. Dandamudi, **'Introduction to Assembly Language Programming For Pentium and RISC Processors'**, *Springer*,( 2nd Edition), (2004)
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, **"The 8051 Microcontroller and embedded systems**", 2009, Pearson education. ISBN – 81-7808-574-7
5. W. Stallings, '**Computer Organization and Architecture - Designing for Performance'**, *Prentice Hall of India*,(8th edition), (2002)


**Web References:**

1. NPTEL series – nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/
2. NPTEL series for 8051 – https://nptel.ac.in/courses/108/105/108105102/
3. service.scs.carleton.ca/sivarama/org_book/org_book_web/slides/chap_1_versions/ch7_1.pdf

## List of Tutorial Assignments:

The subject Microprocessor and Microcontroller introduces the processor evolution from basic to advanced. It also signifies the use of microcontrollers in multiple real-life applications.
The tutorial is designed to develop the assembly language programming ability of an individual student.

1. & 2. Write small code snippets using arithmetic, logical and conditional jump instructions.

3. Learning how to use the DOS/LINUX system calls for program I/O.

4. Numerical examples solving logical to physical address translation for x86.

5. Write small codes using string instructions.

6. Evaluate the output of small ALP's.

7. Draw memory maps and evaluate the changes after a particular instruction.

8. & 9. Develop 8051 program snippets.

10. Design delays using 8051 timers.

Maharshi Karve Stree Shikshan Samstha's
Cummins College of Engineering for Women, Pune
(An autonomous Institute affiliated to Savitribai Phule Pune University)
Department of Computer Engineering

# 20CE 602 Software Engineering

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| **Lectures: 3 Hours/Week** | **In Semester: 50 marks** |
| **Tutorial: 1 Hour/Week** | **End Semester: 50 marks** |
| | **Credits: 4** |

**Prerequisites:** Software Design and Architecture (20CE 503)

**Course Objectives:**
To facilitate the learner to -
1. Develop familiarity with the software design and component based software engineering.
2. Get exposure to the various facets of agile software process model.
3. Learn the basic concepts of refactoring.
4. Gain knowledge about the various aspects of designing and testing of web applications.

**Course Outcomes:**
By taking this course, the learner will be able to -
1. Apply the concepts of component-level design to realize the solution of a system.
2. Analyze the agile software process model for application development.
3. Analyze the refactoring methods to restructure the classes.
4. Make use of various concepts of designing and testing for web applications.

**Unit 1: Software Design Concepts and Component-Level Design (07)**

Design within the context of Software Engineering, The design process, Design concepts, Design model.
Component-Level Design: What is a component, Designing class-based components, Steps of
component-level design, Component-based development.

**Unit 2: Introduction to Agile Software Development (07)**

Why agile software development - Limitations of traditional process models, Evaluating Agile Benefits,
Understanding the Agile Manifesto, Outlining the Four Values of the agile Manifesto, Defining the 12 Agile
Principles, Agile approaches - Lean, Scrum and Extreme Programming, Agile team.

**Unit 3: Agile Project Planning and Software Practices (07)**

Agile project inception, User stories, Estimation, Agile plan.
Agile software practices: Refactoring, Test-driven development, Continuous Integration Continuous Delivery
(CICD); DevOps: Lifecycle, Benefits, Use cases, DevOps and Deployment.

**Unit 4: Introduction to Refactoring (07)**

What is Refactoring, Why and when to refactor, Code smells, Duplicated code, Long method, Extract
method, Large class, Extract class, Alternative classes with different interfaces, Move method, Move field,
Rename method, Rename variable, Replace method with method object.

**Unit 5: Refactoring Methods (07)**

Replace data value with object, Change unidirectional association to bidirectional, Switch statements,
Replace conditional with polymorphism.

Remove control flag, Introduce assertion, Replace constructor with factory method, Replace error code with
exception.
Pull up field, Pull up method, Push down method, Push down field, Extract subclass, Extract superclass,
Extract interface, Replace inheritance with delegation.

**Unit 6: Design and Testing of Web Applications (07)**

WebApp design quality, Design goals, Design pyramid, WebApp interface design, Asthetic design, Content design, Architecture design, Navigation design, Component-level design, Object-oriented hypermedia design Method. Testing concepts for WebApps, Testing process - overview, Content testing, User interface testing,Component-level testing, Navigation testing, Configuration testing, Security testing, Performance testing.

**Text books:**

1. Roger S. Pressman, 'Software Engineering: A Practitioners Approach', Tata McGraw Hill,
(7th Edition) (2010).
2. Jonathan Rasmusson, 'The Agile Samurai: How Agile Masters Deliver Great Software', Shroff
Publishers and Distributers (SPD), ISBN: 978-93-5213-411-3, (2016).
3. Martin Fowler, Kent Beck, John Brant, William Opdyke and Don Roberts, 'Refactoring:
Improving The Design of Existing Code', Pearson Education, ISBN: 978-81-317-3466-7, (2017).
4. Mark C. Layton, Steven J. Ostermiller, 'Agile Project Management for Dummies', Wiley, (2nd
Edition), (2017).

**Reference books:**

1. Sanjeev Sharma and Bernie Coyne, 'DevOps for Dummies', IBM Limited Edition, John Wiley and
Sons, Inc. (2015).

2. Ian Sommerville, 'Software Engineering', Person Education, (8th Edition) (2008).
3. Grady Booch, James Rumbaugh, Ivar Jacobson, 'The Unified Modeling Language User Guide',
Pearson Education, (2nd Edition) (2008).

**Web References:**

1. Official website of R. S. Pressman and Associates, Inc: http://www.rspa.com/
2. Agile Software process model: https://www.agilealliance.org/
3. Basics of Scrum: https://www.scrumalliance.org/
4. https://www.bmc.com/blogs/devops-basics-introduction/

**Tutorials - Preamble:**

The scope of tutorials for "Software Engineering" includes exercises based on component-level design concepts, agile software practices, refactoring concepts and design and testing of web applications. During tutorials, problem solving and system design skills of students are challenged and improved.
For a chosen hypothetical system, students are expected to identify its scope, suitable classes, modules and build the component and deployment models. The students are also expected to apply the relevant refactoring techniques to improve the quality of the design. The following is a sample list of tutorials, covering the various concepts in the course. The objective of tutorials is to provide an opportunity for students to explore as per their interests. Consequently, these tutorial statements will be further detailed during conduction, according to the scenarios under consideration.

**Example List of Tutorials:**

1. Draw Component Diagrams to model components, interfaces and dependencies as part of an implementation view of a given system.

2. Draw Deployment Diagrams to show the configuration of run-time processing nodes and the components that reside on them, depicting the working scenario for a given application.
3. Apply CRC modeling to identify classes, their responsibilities and the collaborators for a given system.
Also for this system, identify the relevant user interface classes, business domain classes, system classes, process classes and persistent classes.
4. For a given large and complex system, create a "NOT List". Also for this system, identify the various modules and specify the responsibilities of these modules.
5. For a given system, identify the different users and write down the User Stories for the various features of this system, using the user story template.
6. Imagine that you are part of an agile team involved in the development of some software product. For this product, design a Product Box.
7. Write an Elevator Pitch in proper format for any software product of your choice.
8. For the given requirement / function, apply and describe with code/pseudo code the 3 steps of Test Driven Development.
9. Refactor the given code using "Rename method" and "Rename variable" techniques. Write the refactored code.
10. Refactor the given code using "Extract method" technique and Write the refactored code.
11. Refactor the given code using "Replace error code with exception" technique and Write the refactored code.
12. Refactor the given code using "Remove control flag" technique and Write the refactored code.
13. Refactor the given code using "Introduce Assertion" technique and Write the refactored code.
14. Refactor the given code using "Move method" and "Move field" techniques. Write the refactored code.
15. Refactor the given code using "Replace conditional with polymorphism" technique and Write the refactored code.

16. For a given an inheritance hierarchy, apply "Pull up field/method" technique and Write the refactored code.
17. For a given an inheritance hierarchy, apply "Push down field/method" technique and Write the refactored code.
18. For the given code, apply the relevant refactoring techniques from "Extract class", "Extract subclass", "Extract superclass" and Write the refactored code.
19. For any typical web application of your choice, specify the various features and write down a set of test cases to test these features/functionalities.

# 20CE 603 Cloud Computing

**Teaching Scheme**
Lecture: 3 Hrs/week

**Examination Scheme**
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

**Prerequisites:** Operating Systems (20CE 403)

**Course Objectives:**
**To facilitate the learner to -**
1. Understand the basic concepts related to cloud computing.
2. Analyze the underlying principles of different cloud service models.
3. Understand and apply the security techniques in cloud computing.
4. Get exposure to emerging trends in cloud computing.

**Course Outcomes:**
**By taking this course, the learner will be able to -**
1. Apply cloud computing concepts and the emerging trends to cloud based systems.
2. Analyze the cloud services and models.
3. Analyze various cloud platforms and tools for realization of different services.
4. Apply security concepts to the cloud environment.

**Unit 1: Introduction (06)**
Introduction to Cloud Computing, Cloud Economics, National Institute of Standards and Technology (NIST) Definition of Cloud Computing, Cloud Characteristics, Cloud Service Models, Cloud Deployment Models, Benefits, Challenges and Risks.

**Unit 2: Infrastructure-as-a-Service (IaaS) (08)**
Introduction to Infrastructure-as-a-Service (IaaS), Virtualization – Introduction, Taxonomy, Characteristics, Pros and Cons, Types of Service Level Agreement (SLA), Hypervisors - Xen, Kernel Virtual Machine (KVM), VMware, Docker Containers, Serverless computing, Microservices, Microservices architecture, Case Study- Amazon Web Services (AWS).

**Unit 3: Platform-as-a-Service (PaaS) (07)**
Introduction to Platform-as-a-Service (PaaS), Data in Cloud: Relational Databases, NoSQL Databases, Big Data, Cloud File System: Hadoop Distributed File System (HDFS), HBase, Map-Reduce Model, Case Study- Google App Engine (GAE).

**Unit 4: Software-as-a-Service (SaaS) (08)**
Introduction to Software-as-a-Service (SaaS), Multi-tenancy, Mashups, Service Oriented Architecture (SOA), Web Services based on Simple Object Access Protocol (SOAP) and REpresentational State Transfer (REST), SaaS Applications, Case Study- Salesforce.com.

**Unit 5: Cloud Security** **(07)**

Cloud Security Fundamentals, Cloud Security Challenges and Risks, Virtualization Security, Identity Management and Access Control, Secure Execution Environment and Communication.

**Unit 6: Recent Trends** **(06)**

Inter-cloud / Federated Cloud, Internet of Things (IoT) and Cloud Computing, Mobile and Cloud Computing, Data Centers- Introduction, Cloud Applications, Cloud and DevOps, Research trends in Cloud Computing.

**Text books:**


1. Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, '**Mastering Cloud computing**', *McGraw Hill Education*, (2013), ISBN 978-1-25-902995-0.
2. Gautam Shroff, '**Enterprise Cloud Computing**', *Cambridge University Press*, (2010), ISBN 978-0-521-13735-5.
3. Ronald Krutz and Russell Dean Vines, '**Cloud Security**', *Wiley India Pvt. Ltd.*, (2010), ISBN 978-81-265-2809-7.
4. Kailash Jayaswal, Jagannath Kallakurchi, Donald Houde, Dr. Deven Shah, '**Cloud Computing Black Book**', *DreamTech Press*, (2015), ISBN 978-93-5119-418-7.


**Reference books:**


1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, '**Cloud Computing Concepts, Technology and Architecture**', *Prentice Hall*, (2013), ISBN 978-01-333-8751-3.
2. Barrie Sosinsky, '**Cloud Computing Bible**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-2980-3.
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, '**Cloud Computing Principles and Paradigms**', *Wiley India Pvt. Ltd.*, (2015), ISBN 978-81-265-4125-6.
4. Dr. Kumar Saurabh, '**Cloud Computing**', *Wiley India Pvt. Ltd.*, (2011), ISBN 978-81-265-2883-7.
5. Tim Mather, Subra Kumaraswamy, Shahed Latif, '**Cloud Security and Privacy**', *O'Reilly*, (2011), ISBN 13:978-81-8404-815-5.
6. A. Srinivasan, J. Suresh, '**Cloud Computing: A Practical Approach for Learning and Implementation**', *Pearson*, (2014), ISBN 978-81-317-7651-3.


**Web References:**


1. http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf
2. https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf
3. https://docs.docker.com
4. https://www.bmc.com/blogs/devops-basics-introduction/
5. http://searchdatacenter.techtarget.com/definition/data-center
6. http://www.sapdatacenter.com/article/data_center_functionality/
7. https://www.salesforce.com

## 20HS 601 Professional And Societal Awareness For Engineers

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credits: 3 |

**Course Objectives:**

To facilitate the learner to

1. Understand professional ethics, communication and practices
2. Relate Intellectual property concepts to various documents , products
3. Study Sustainability issues and green computing in environmental context
4. Study social issues in the computing world

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply professional and computing ethics
2. Relate Intellectual property basics to information management, storage and sharing
3. Apply sustainability paradigms to various computing centric issues
4. Relate green computing basics to IT systems
5. Apply sustainability principles to new world

**Unit I: Professional Ethics and communication (08)**

Morals, values and Ethics, Integrity, Work ethic, Civic virtue, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, stress management, Senses of Engineering Ethics, Kohlberg‟s theory, Gilligan‟s theory, Models of professional roles, Uses of Ethical Theories, Communicating professionally with stakeholders

**Unit II: Intellectual Property (08)**

Philosophical foundations of intellectual property, Intellectual property rights (cross-reference IM/Information Storage and Retrieval/intellectual property and protection) ,Intangible digital intellectual property (IDIP), Copyrights, patents, trade secrets, trademarks, Plagiarism, non disclosure agreement

**Unit III: Sustainability & CSR (09)**

Basics of sustainability in IT and computing, Global social and environmental impacts of computer use and disposal, Business Ethics, Ethics Vs Social Responsibility, A view of corporate social responsibility (Legal, Ethical, Economic, Philanthropic) and its importance, ESG(Environmental, Social and Governance standards), Evolution of ESG from CSR

**Unit IV: Green Computing (09)**

Green IT Fundamentals: Business, IT, and the Environment , Green computing: carbon footprint, scoop on power, Green IT Strategies: Drivers, Dimensions, and Goals , Environmentally Responsible Business: Policies, Practices, and Metrics, Virtualization of IT systems, Role of electric utilities, Telecommuting, teleconferencing and teleporting , Materials recycling , Best ways for Green PC, Green Data center, Green Grid framework.

**Unit V: Sustainability in Healthcare (08)**

Basics, Societal expectations, Sustainability and Pharmaceutical products-Role in Human health, Sustainable Concerns All Along the Life Cycle of the Health-care Industry, Global corporate governance and IT

**Text Books**

1. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2014
2. Ming din, "Sustainable development for health care industry" , Springer
3. Niraja Pandey, Khushdeep Dharni, "Intellectual Property Rights", PHI
4. Caroline Whitbeck, "Ethics in Engineering Practice and Research", Cambridge Press, ISBN:978-1-107-66847-8

**Reference books**

1. Woody Leonhard and Katherine Murray, "Green IT for Dummies", Wiley Publications (2009),ISBN: 978-0-470-74349-2

**Online resources**

NPTEL on Professional Ethics :https://nptel.ac.in/courses/110/105/110105097/

# 20PECE 601A DevOps Fundamentals

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours/Week | In Semester: 50 marks |
| | End Semester: 50 marks |
| | Credits: 3 |

**Prerequisites:** Software Design and Architecture (20CE 503)

**Course Objectives:**
To facilitate the learner to -
1. Understand and appreciate the need for the DevOps as a state-of-art software engineering practice.
2. Learn the basic concepts related to DevOps.
3. Get acquainted with the various tools which are used in different phases of DevOps model.
4. Get exposure to emerging trends in software development related to DevOps.

**Course Outcomes:**
By taking this course, the learner will be able to -
5. Apply the fundamental concepts and emerging trends of DevOps to software development.
6. Analyze the various concepts of application development such as agile software model, microservices to understand the need of DevOps based solution of a system.
7. Compare various concepts and tools of continuous integration, continuous delivery, continuous testing and monitoring for DevOps based realization of solution of a system.
8. Analyze the various deployment platforms as part of DevOps lifecycle.

**Unit 1: Introduction to DevOps (06)**
Overview, Features, Components, Why to use DevOps - Benefits, Business need for DevOps, Using DevOps to solve new challenges like enabling mobile applications, scaling agile and managing multitier applications; DevOps lifecycle - DevOps stages: Develop, Code/build, Test, Deploy; DevOps use cases DevOps techniques: Continuous improvement, Release planning, Continuous integration, Continuous delivery, Continuous testing, Continuous monitoring and feedback; DevOps tools.

**Unit 2: Application Development (07)**
Agile software development, User stories, Automating SDLC and DevOps, DevOps team. Serverless computing. Microservices and DevOps: Monolithic to microservices Project in terms of microservices, need/applicability of DevOps Microservices - what, characteristics, how are they used, nature in continuous release, architecture, services design.

**Unit 3: Continuous Integration Continuous Delivery (CICD) Pipeline (08)**

CICD pipeline - basics, Source code repository, Version control and source code management - GitHub, Git commands. Creating Automated build, Automated build frameworks like Maven, Ant for Java. Automated configuration and automated deployment, Configuration management with tools like Puppet and Chef, Ansible; Continuous integration with Jenkins.

**Unit 4: Continuous testing and Continuous monitoring (08)**

Continuous Unit testing and Integration testing, Test Driven Development (TDD), Release testing, Testing in development, Testing in production, Selenium: Introduction, Why to use, automating test cases for testing web elements, Creating test cases in Selenium WebDriver. Testing and Bug tracking Frameworks such as JUnit, TestNG and JIRA. Continuous monitoring and logging with tools like Nagios.

**Unit 5: Deployment Platforms (07)**

Containerization and DevOps: Virtualization, Application runtime environment, Application needs/dependencies, Containerization, Containerization Tools, Benefits of containers in enabling DevOps workflow.

Dockers for DevOps: Docker - Overview, Docker lifecycle, Docker Image, Docker file, Docker registry, Docker engine, Docker runtime container, Docker installation, commands, Namespaces, Docker layered approach, Docker applications/use cases. Container Orchestration: Kubernetes.

**Unit 6: DevOps - Applications, Case studies and Trends (06)**

Cloud's benefit to DevOps, Web Applications on Cloud Platform

Automation of infrastructure: Terraforms - Infrastructure as code (IaC) software tool.

DevSecOps: Agile security, DevOps and security, Low code solutions.

**Text books:**

1. Sanjeev Sharma and Bernie Coyne, 'DevOps for Dummies', IBM Limited Edition, John Wiley and Sons, Inc., ISBN- 978-1-119-04705-6, (2015).
2. Viktor Farcic, 'The DevOps 2.0 Toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices', CreateSpace Independent Pub, (2016).
3. Katrina Clokie, 'A Practical Guide to Testing in DevOps', Leanpub, (2017).

**Reference books:**

1. Bass, L., Weber, I.M., Zhu, L., 'DevOps: a software architect's perspective'. Pearson Education, ISBN: 9789332570375, (2016).
2. Davis J., Daniels K., 'Effective DevOps: Building a Culture of Collaboration, Affinity and Tooling at Scale', O'Reilly, ISBN- 9789352133765, (2018).

3. Farooqui S. M., 'Enterprise DevOps Framework: Transforming IT Operations', CA Press / Apress, ISBN- 9781484240618, (2019).
4. Sanjeev Sharma, 'The DevOps Adoption Playbook: A Guide to Adopting DevOps in a Multi-Speed IT Enterprise', Wiley, ISBN- 9788126569083, (2017).
5. Humble, J., Farley, D.: 'Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation'. 1st edn. Addison-Wesley Professional (2010).

**Web References:**

1. https://devops.com/
2. https://docs.docker.com
3. https://www.bmc.com/blogs/devops-basics-introduction/
4. https://www.ibm.com/in-en/cloud/devops
5. https://aws.amazon.com/devops/what-is-devops/

# 20PECE 601C Deep Learning

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

**Course Objectives:**

To facilitate the learner to

1. Understand building blocks of Deep Neural Networks.
2. Understand various optimization algorithms used for training Deep Neural Networks.
3. Understand the working of CNN, RNN
4. Have knowledge of Deep Architectures for solving various applications.

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply mathematical concepts and Machine Learning Basics for understanding Deep Learning topics
2. Apply concepts of Feedforward Networks for understanding Deep Learning topics
3. Apply the basic concepts of CNN and RNN to real time problems
4. Apply available Deep Learning solutions to real time applications.

**Unit I: Machine Learning and Deep Learning (07)**

What Is Deep Learning and Machine Learning Work? Limitations of Machine Learning, History of Deep Learning, Advantages/ Challenges of Deep Learning, Bias Variance trade off, hyper- parameters, Regularization, Confusion matrix, Building a Machine Learning Algorithm, Deep Learning tools/frameworks.

**Unit II: Deep Learning Basics (07)**

Linear Algebra, Probabilities and Information theory, Linear Dependence and Span, Norms, Eigen decomposition, The Trace Operator, The Determinant, Principal Components Analysis, Activation Functions, Loss Functions, Perceptron, Sigmoid neurons.

**Unit III: Feedforward Networks for Deep Learning (07)**

Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise, Early Stopping, Parameter Tying and Parameter Sharing, Dropout, Introduction to Keras, TensorFlow, Theano, and CNTK, Setting up a deep-learning workstation.

**Unit IV: Convolution Neural Network (CNN) (08)**

Biological Inspiration and Motivation, The Convolution Operation, Pooling, Padding, Overview of CNN Architecture, Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers, Back propagation in CNN, Applications of CNNs, Introduction to convnets.

**Unit V: Recurrent Neural Network (RNN) (07)**

Working with text data, One-hot encoding of words and characters, Using word embeddings, Wrom raw text to word embeddings, Wrapping up, Recurrent Neural Network (RNN), A recurrent layer in Keras, Understanding the LSTM and GRU, Advanced use of recurrent neural networks, A temperature-forecasting

**Unit VI: Advanced Deep Learning (06)**

Introduction to Deep Learning applications in Computer Vision / NLP / Text Mining, Understanding use of CNNs for classification, Semantic Segmentation, Image denoising, Object Detection. Introduction to Generative Adversarial Networks, Deep Reinforcement Learning, AlexNet/VGG Net/ResNet etc.

**Text Books:**

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press Ltd. ISBN:9780262035613, 0262035618, 2016
2. Deep Learning with Python, FRANÇOIS CHOLLET, Manning Publications Co., ISBN 9781617294433, 2017
3. Python Deep Learning,Valentino Zocca, Gianmario Spacagna, Daniel Slater, Peter Roelants, Packt Publishing, ISBN 9781786460660, 2017

**Reference Books:**

1. Fundamentals of Deep Learning: Designing Next Generation intelligence Alogrithms, Nikhil Baduma, Nicholas Locascio, O'Reilly Publication, ISBN 10: 9352135601 , ISBN 13: 978- 9352135608, 2017

2. Deep Learning – A Practitioner's approach, Josh Patterson and Adam Gibson, O'Reilly Publication, 1st edition, ISBN : 9789352136049, 2017
3. Deep Learning with PyTorch, ELI STEVENS, LUCA ANTIGA, AND THOMAS VIEHMANN, Manning Publications Co, ISBN 9781617295263, 2020

# PECE 3201 Data Management, Protection and Governance

# PECE 3201 Data Management, Protection and Governance

**Teaching Scheme**

Lectures: 3 Hrs/Week

**Examination Scheme**

In Semester: 50 marks

End Semester: 50 marks

Credits: 3

**Course Objectives:**

**To facilitate the learner to –**

1. Get acquainted with the high-level phases of data life cycle management.
2. Acquire knowledge about the various aspects of data storage, data availability, data protection.
3. Gain exposure to various solutions/reference architectures for various use-cases.
4. Understand the technical capabilities and business benefits of data protection.

**Course Outcomes:**

**By taking this course, the learner will be able to –**

1. Understand the data management world, challenges and best practices.
2. Compare various concepts and technologies for enabling data storage and high availability.
3. Illustrate various types of data threats and approaches to ensure data center security.
4. Explain the various concepts related to data protection.
5. Outline different standards for compliance and governance of data.
6. Understand various approaches for designing data intensive enterprise applications and industry standard solutions in data management.

**Unit 1: Introduction to data life cycle management (DLM) (06)**

- Goals of data life cycle management
- Challenges involved
  - Volume of data source
  - Ubiquity of data locations
  - User demand for access
- Stages of data life cycle - creation, storage, usage, archival, destruction
- Risks involved without DLM, benefits, best practices

**Unit 2: Data storage and data availability (08)**

- Storage technology
  - Hard Disk Device (HDD), Solid State Devices (SSD), memory devices
  - Data access - block, files, object
  - Data center End to End View – overview of complete stack including storage, network, host, cluster, applications, virtual machines, cloud storage
  - Storage virtualization technologies - RAID level, storage pooling, storage provisioning
  - Advance topics in storage virtualization – storage provisioning, thin-provisioning
  - Cloud storage – S3, glacier, storage tiering
- High Availability
  - Introduction to high availability
  - clustering, failover, parallel access



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**Unit 3: Data Threats and Data center security** **(07)**

- Type of Threats
  - Denial of Service (DoS), man in the middle attacks
  - Unintentional data loss
  - Repudiation
  - Malicious attacks to steal data
- Introduction to Ransomware
- Understanding, Identification and Threat modelling tools
- Security
  - Authorization and authentication - access control, Transport Layer Security (TLS), key management, security in cloud
  - Design and architecture considerations for security

**Unit 4: Introduction to data protection** **(08)**

- Introduction
  - Need for data protection
  - basic of back-up/restore
- Snapshots for data protection, copy-data management (cloning, DevOps)
- De-duplication
- Replication
- Long Term Retention - LTR
- Archival
- Design considerations
  - System recovery
  - Solution architecture
  - Backup v/s Archival
  - media considerations and management (tapes, disks, cloud)
  - challenges with new edge technology (cloud, containers)

**Unit 5: Data regulation, compliance and governance** **(06)**

- Regulations requirements and Privacy Regulations
  - The Health Insurance Portability and Privacy Act of 1996 (HIPPA)
  - PII (Personally Identifiable Information)
  - General Data Protection Regulation (GDPR)
- Information Governance
  - Auditing
  - Legal Hold
  - Data classification and tagging (Natural Language Processing)
- India's Personal Data Protection bill

**Unit 6: Applications uninterrupted** **(07)**

- Understand data management aspects of traditional and new edge applications
- Reference architecture/best practices *(pick 2-3 case studies from below topics)*
  - Transactional Databases (Oracle, MySQL, DB2)
  - NoSQL Databases (MongoDB, Cassandra)
  - Distributed applications (micro service architectures)
  - Cloud applications – Platform as Service (PaaS), Software as Service (SaaS), Kubernetes
  - Multi-Tiered applications
  - ETL workloads
  - Data analytics (AI/ML)

**Textbooks:**


1. Robert Spalding, **'Storage Networks: The complete Reference'**.
2. Vic (J.R.) Winkler, **'Securing The Cloud: Cloud Computing Security Techniques and Tactics'**, Syngress/Elsevier - 978-1-59749-592-9


**Reference Books:**


1. Martin Kleppmann, **'Designing Data-Intensive Applications'** , O'Reilly





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**Web References:**


https://www.enterprisestorageforum.com/storage-hardware/storage-virtualization.html

https://searchstorage.techtarget.com/definition/data-life-cycle-management

https://www.hitechnectar.com/blogs/three-goals-data-lifecycle-management/

https://www.bmc.com/blogs/data-lifecycle-management/

https://www.dataworks.ie/5-stages-in-the-data-management-lifecycle-process/

https://medium.com/jagoanhosting/what-is-data-lifecycle-management-and-what-phases-would-it-pass-through-94dbd207ff54

https://www.spirion.com/data-lifecycle-management/

https://www.bloomberg.com/professional/blog/7-phases-of-a-data-life-cycle/

https://www.datacore.com/storage-virtualization/

https://www.veritas.com/content/dam/Veritas/docs/solution-overviews/V0907_SB_InfoScale-Software-Defined-Infrastructure.pdf

https://www.veritas.com/solution/digital-compliance

https://www.veritas.com/solution/data-protection

https://www.veritas.com/gdpr





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## OE 4201 : e-Business
**(Open Elective-III)**

**Teaching Scheme**
Lectures : 3 Hrs / week

**Examination Scheme**
In Semester : 50 Marks
End semester : 50 marks
Credits : 3

**Prerequisites :** No Prerequisites

**Course Objectives :**

To facilitate the learners to -

1. Understand the technological, economic and social phenomena behind rapid changes in the e-businesses
2. Have a good working knowledge of e-business concepts, applications and technologies
3. Understand the e-business models and infrastructure
4. learn how e-business concepts are applied to different fields, such as: education, banking, tourism and so on
5. Inspire with online business ideas and motivate them to apply in the real life.
6. Study the new trends in e-business, e-commerce

**Course Outcome :**

By the end of this course, students should be able to -

1. Explain the concepts of e-business and e-business models
2. Apply suitable principles and practices of designing and developing e-business website
3. Apply necessary back end system components required for successful e-business implementations
4. Outline the meaning of e-business security and how it impacts the business
5. Relate e-business, BI and KM to fulfil modern e-business trends

**Unit I: Introduction** **(07)**

E-commerce and e-business, advantages of e-business in growth of a business, Transition from traditional business to e-business, features of e-business technology, e-business models, IT Infrastructure requirements of e-business **Case Study :** Various e-business models

**Unit II : Building e-business Websites** **(7)**

Issues involved in designing a website, designing in-house websites, steps involved in website development, e-business and website development solutions, Advantages of using an e-business solution, selection of a suitable e-business solution, security issues involved in websites, tracking and analysing website traffic data. Digital Marketing **Case Study**

**Unit III : e-Business Infrastruture / Back end Systems (7)**

Back end system support requirements - security, scalability, availability, adaptability, manageability, maintainability, assurance, interoperability, load balancing; internet technology, World Wide Web, Internet software; Content management, **Case Study**

**Unit IV : e-security & online payment systems (7)**

e-Business security policy, risks and risk assessment, practice guidelines to e-security, legal framework and enforcement, ethical, social and political issues in e-business

Performance characteristics of online payment systems, online payment methods, security and risk handling in online payments, fraud detection in online payments, IT Act 2000, digital signatures, digital certificates, and PKI; **Case Study**

**Unit V : Knowledge management & BI for strategic e-business (8)**

From information processing to knowledge world, aligning knowledge with business, knowledge management platforms, state of knowledge and measuring parameters; knowledge industry, knowledge strategy, and knowledge workers

Business and Intelligence - applications and importance of business intelligence, implementation of intelligence, building BI systems, selecting BI tools, integrating BI and KM, decision-making and BI, **Case Study**

**Unit VI : Launching an e-Business and e-business trends (6)**

Launching a successful e-business – requirement analysis, managing Web site development, search engine optimization, Evaluate Web sites on design criteria.

Future and next generation of enterprise e-business, challenges and new trends, ethical and regulatory issues

**References**


| | |
|---|---|
| **Text Books** | |
| 1 | Papazoglou, Michael and Pieter Ribbers, “E-Business : Organizational and Technical Foundations”, John Wiley, 2nd Edition (Sept 2011) |
| 2 | Parag Kulkarni, Sunita Jahirabadkar, Pradeep Chande, “E-Business”, Oxford University Press (May 2012) |
| **Reference Books** | |
| 1 | Daniel Amor, “The E-business (R)evolution”, Prentice Hall PTR (2000) |
| 2 | Kenneth Laudon, Carol Guercio, “E-commerce : Business, Technology, Society”, Prentice Hall, 4th Edition (January 2008) |
| 3 | Kalakota Ravi, Marcia Robinson, “E-Business 2.0 – Roadmap for Success”, Pearson Education, 2nd Edition (2004) |

## 20OE601I GAMIFICATION

**Teaching Scheme** Lectures: 3 Hours / Week

**Examination Scheme** In Semester: 50 Marks

End Semester: 50 Marks

**Credits: 3**

**Course Objectives:**

To facilitate the learner to

1. To develop problem solving abilities using gamification.
2. To identify the various methods of Gamification.
3. To apply gamifications mechanics to solve a problem.
4. To make use of gamifications tools to solve a problem

**Course Outcomes:**

After completion of the course, students will be able to

1. To apply steps of problem solving using gamification.
2. To analyze player motivation and counter gamification.
3. To analyze games using gamification mechanics.
4. To apply tools of gamification to real life applications.

**Unit I: Gaming Foundations (6)** Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.

**Unit II: Player Motivation (7)** Powerful Human Motivators, Why People Play, Player types, Social Games, Intrinsic versus Extrinsic Motivation, Progression to Mastery, Case studies for Thinking: Tower of Hanoi,Concepts Applied to Video games and Gamification

**Unit III:Counter Moves in Gamification (8)** Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen-and App-Based Digital Futures, Remodeling design, Designing for Engagement, Case study of Maze Problem.

**Unit IV: Game Design (8)** Game Mechanics and Dynamics: Feedback and Reinforcement, Game Mechanics in depth, Putting it together, Case study of 8 queens problem.

**Unit V: Game Mechanics and Applications (6)** Gamification case Studies, Coding basic game Mechanics,Gamification Applications : Education,Healthcare,Marketing,Gamification for Machine Learning

**Unit VI: Gamification Platforms (6)** Instant Gamification Platforms, Mambo.io(Ref:http://mambi.io), Installation and use of BigDoor (Open Source http://bigdoor.com),ngageoint/gamification-server(ref: https://github.com/ngageoint/gamification-server)

**Text Books:**

1. Mathias Fuchs, Sonia Fizek,Paolo Ruffino, Niklas Schrape, Rethinking Gamification, Meson Press,2014, ISBN: 978-3-95796-000.
2. Gabe Zechermann, Christopher Cunningham, Gamification by Design, Oreilly,August 2015, ISBN: 978-1-449-397678.

**Reference Books:**

1. B. Burke, Gamify: How Gamification Motivates People to Do Extraordinary Things, Gartner 2014,ISBN:1937134857.

2. Stieglitz, S.Lattemann, C.Robra-Bissantz, S.Zarnekow, R.Brockmann,Gamification :Using Game Elements in Serious Contexts,2016,ISBN: 978-3-319-45557.

## 20CE 604 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 2 hrs./Week** | **In Semester – 25 marks** |
| | **Credit(s): 1** |

**Prerequisite:**
1. Digital Systems and Computer Organization (20CE 304)
2. Digital Electronics Laboratory (20CE 307)

**Course Objectives:**
To facilitate the learners
1. To understand and apply x86 instructions to write assembly language programs.
2. To learn, apply and analyze microprocessor and peripherals interfacing techniques.
3. To learn and use the interfacing of assembly language and higher-level language.
4. To be able to solve moderately complex problems using modular assembly language programming.
5. To understand and use privileged instructions.

**Course Outcomes:**
By taking this course, the learner will be able to
1. Apply x86 instructions to write assembly language programs.
2. Apply modular programming using assembly level language.
3. Apply 8051 instructions to develop simple microcontroller programs.
4. Build a small system using microcontroller interfacing techniques.
5. Analyze the given problem and find the solution for it.

The Microprocessor and Microcontroller laboratory assignments are designed for problem solving using assembly language programming. The laboratory work also covers the introduction to microcontroller assembly language and real-life case studies. It also aims to familiarize the concepts of use of modular programming and higher level language with ALP.

**Group A Assignments (Perform all assignments) (Demonstrations and exercises)**
1. Write x86 ALP to perform data declarations, arithmetic and logical operations and check the output in debugger.
2. Write x86 ALP to accept a signed number and check if it is positive or negative. Display appropriate messages.
3. Write x86 ALP to accept a string from user and perform following operations (select any three)
   (a) Convert a string to uppercase / lowercase
   (b) Toggle the case of the string
   (c) Concatenation of another string
   (d) Find if it is palindrome
   (e) Find a substring
   (Note - 1. Use of macros and procedures is mandatory. 2. For this assignment make a group of 3-4 students, each one performing each task and then combine all functions to apply

modular programming.)
4. 8051 Assembly language programming for addition, subtraction, multiplication and division of two 8-bit numbers.
5. 8051 Assembly language programming for block data transfer between internal and external memory including overlapping blocks.
6. 8051 Assembly language programming to configure timers and counters with polling technique.

**Group B Assignments (Structured assignments)**

**Part B-1 – Select any one assignment from the following.**

1. Using Pentium protected mode instructions display protected mode registers.
2. Write ALP to perform the following any file operations using command line arguments.
3. Write ALP to find the largest number from an array using PUBLIC/GLOBAL and EXTERN.

**Part B-2 – Select any one assignment from the following.**

1. Write 8051 ALP for timer and counter calculations using interrupts.
2. Write 8051 ALP for serial communication.
3. Write 8051 ALP to interface I/O and DAC.

**Group C Assignments (Open ended assignment)**

Select any of the following titles. Design and build the system.

1. Select any high-level language and insert assembly language code into it.
2. Interface mouse using ALP
3. Digital clock programming using 7- segment display.
4. Room temperature indicator.
5. Programming of LCD.
6. Interfacing the keyboard.
7. Programming of parallel ADC.
8. Interfacing Stepper Motor.
9. Speed Control of DC motor.
10. Interfacing Relay.

**Text Books:**

1. 8086 and peripherals – Intel Manual
2. Pentium Architecture – Intel Manual
1. Intel 8-bit Microcontroller Manual

**Reference Books:**


1. Douglas Hall, **'Microprocessors & Interfacing'**, *McGraw Hill*, (Revised 2nd Edition), (2006)
2. James Antonakos, **'The Pentium Microprocessor'**, *Pearson Education,* (2nd Edition), (2004)
3. Sivarama P. Dandamudi, **'Introduction to Assembly Language Programming For Pentium and RISC Processors'**, *Springer*,( 2nd Edition), (2004)
4. Muhammad Ali Mazidi and Janice Gillispie Mazidi, **"The 8051 Microcontroller and embedded systems**", 2009, Pearson education. ISBN – 81-7808-574-7

5. W. Stallings, '**Computer Organization and Architecture - Designing for Performance'**, *Prentice Hall of India*,(8th edition), (2002)

**Web References:**

1. NPTEL series – nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/
2. NPTEL series for 8051 – https://nptel.ac.in/courses/108/105/108105102/
3. service.scs.carleton.ca/sivarama/org_book/org_book_web/slides/chap_1_versions/ch7_1.pdf

# 20CE 605 Cloud Computing Laboratory

**Teaching Scheme**
Practical: 2 Hrs/week

**Examination Scheme**
Oral: 25 Marks
Credits: 1

**Course Objectives:**
**To facilitate the learners to -**

1. Explore the underlying principles of Infrastructure-as-a-Service (IaaS), virtualization and containers.
2. Understand the use of the Hadoop ecosystem.
3. Get exposure to the use of cloud Application Programming Interfaces (APIs) for developing sample application(s).
4. Study different cloud platforms and tools for various cloud service models.

**Course Outcomes:**
**By taking this course, the learner will be able to -**

1. Apply the hypervisor and container-based virtualization.
2. Experiment with Hadoop ecosystem by implementing sample programs for Hive/HDFS/Map-Reduce.
3. Make use of CloudSim framework for understanding cloud computing infrastructure and services.
4. Analyze the use of different cloud platforms and tools/APIs for various cloud service models.

**Preamble:**

The intent of Cloud Computing Laboratory is to enable the understanding and implementation of the basic concepts of Cloud Computing. Assignment statements are in brief and can be implemented with Java/Python programming language. Motivation here is that students should be able to experiment with different aspects of IaaS, PaaS and SaaS using various APIs/libraries. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and simple application. Students will be encouraged to explore different cloud platforms and tools. Faculty will appropriately adopt assignments on similar lines as the examples shown here. The basic and the next level experimentation with CloudSim, Docker container, virtualization and Hadoop ecosystem is covered by the assignments in Group A and those in Group B, respectively. Group B assignments are also on exploring the various cloud APIs. Group C assignments are on exploring the various cloud platforms.

**Suggestive List of Assignments:**

**Group A: (Mandatory)**

1. Explore the CloudSim platform for cloud modelling. For example: Create a data centre with one host and run one cloudlet on it using CloudSim.
2. Demonstrate the use of Docker container by exploring its related commands. Also, show the use of Fedora/Ubuntu images over the Docker engine.
3. Demonstrate the use of MySQL/Tomcat/MongoDB image over the Docker engine.
4. Demonstrate the use of Hive query language (HQL) to process the data using Hadoop ecosystem.
5. Create a virtual machine using Kernel Virtual Machine (KVM) and explore commands for virtualization.

**Group B: (Any Three)**

1. Experiment with the CloudSim platform for modelling and simulation of cloud infrastructure. For example: Create and configure the data centre and user base to show response time, request servicing time and data centre loading.
2. Frame Python scripts to perform operations (for e.g. start/pause/stop) on the Virtual Machine using Libvirt and Operating System (OS) calls for virtualization.
3. Build the Docker image from a Docker file and demonstrate the use of it over the Docker engine.
4. Using Hadoop ecosystem, implement Map-Reduce word count program on single node cluster for the given sample data.
5. Using Hadoop ecosystem, implement Map-Reduce program for the given log file data.
6. Explore and configure the Xen/VirtualBox/VMware hypervisor.
7. Execute Hadoop Distributed File System (HDFS) commands on Hadoop ecosystem.
8. Install Google App Engine. Create hello world application and other simple web applications using Python/Java.
9. Explore the use of API for cloud storage application (for e.g. DropBox API) with the Linux command line interface and Python script.
10. Create an application using Force.com API.
11. For a sample application, implement and consume web service using social networking APIs with Simple Object Access Protocol (SOAP).
12. For a sample application, implement and consume web service using cloud APIs with REpresentational State Transfer (REST).

**Group C: (Any One)**

1. Installation and configuration of an open source cloud platform.
2. Explore the use of different cloud platforms such as Google App Engine (GAE), Amazon Platform Services, Microsoft Azure services, Openstack and Rackspace.

# 20HDM601 Advanced Machine Learning

**Teaching Scheme**
**Lectures: 3 Hours / Week**

**Examination Scheme**
**In Semester: 50 Marks**
**End Semester: 50 Marks**
**Credits: 3**

**Prerequisite: 20CE404 Machine Learning**

**Course Objectives:**

1. To be familiar with Tensorflow/keras/python and advanced machine learning algorithms.
2. To gain advanced knowledge of support vector machines, naive bayes, decision tree algorithms.
3. To get exposure to applying Artificial neural networks for non linearly separable patterns.
4. To apply methods of ensemble learning.

**Course Outcomes:**

At the end of this course, students will be able to

1. Make use of basic functions of tensorflow/keras/python for machine learning algorithms and design of support vector machine
2. Apply Naive bayes classification algorithm for given problem
3. Experiment with methods of ensemble learning and advanced decision tree for given data.
4. Solve non linearly separable problems using artificial neural networks.

**Course Contents:**

**Section 1: TensorFlow, Keras and Support vector machine**

ML using TensorFlow , keras/ Basic functions. Installation of TensorFlow/keras and its features. Introduction to Support Vector Machines(SVM), Optimal Hyperplane for Linearly Separable and Nonseparable Patterns, Maximizing margin, Non linear pattern classification, Kernel trick, Design of Support Vector Machines.

**Section 2: Naive Bayes Classification**

Introduction to Naive Bayes, Bayes theorem, Bayes theorem and concept learning, ML for predicting probabilities, Naive Bayes classifier, Types of bayesian classifier, Bayesian belief networks, Expectation Maximization (EM) algorithm.

**Section 3:  Ensemble learning**

Introduction, Decision Tree, Entropy, Information gain, Gini Index , Different types of ensemble learning methods, bagging , boosting, stacking, Random Forests.

**Section 4: Advanced Artificial neural networks**

Artificial neural networks, Non linear separability, XOR problem, back propagation algorithm.

**Text Books**

1. “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Aurélien Géron, O’Reilly Media, 2nd edition, ISBN 9781492032649, 2019
2. “Machine learning”, Peter Flach, cambridge university press, 6th edition, ISBN 978-1-316-50611-0, 2018
3. “Machine learning using python”, Pradhan, U. Dinesh Kumar, Wiley publication, 1st edition, ISBN 978-81-265-7990-7, 2019
4. “Machine learning”, S. Sridhar, M.Vijayalakshmi, 1st Edition, Oxford university press, 2021, ISBN 978-0-19-012727-5

**Reference Books:**

1. “Introduction to machine learning”, Ethem Alpaydın, MIT press, 3rd edition, ISBN 978-81-203-5078-6, 2014
2. “Machine learning in python”, Michael Bowlers, Wiley publication, 1st edition, ISBN 978-81-265-5592-5, 2015
3. “Practical Machine Learning with Python”:A Problem-Solver’s Guide to Building Real-World Intelligent Systems, Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress publication, ISBN: 978-1-4842-3206-4, 2018

4. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3 rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

## 20HDM602 Data Visualization and Business Intelligence

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. Develop familiarity with Business Intelligence concepts
2. Gain knowledge about analysis of data and visualization
3. Get exposure to latest trends and case studies in BI

**Course Outcomes**: At the end of this course, students will be able to

1. Apply decision making knowledge to a application from business perspective
2. Analyze the data and generate appropriate representation
3. Visualize the given data by following ethical guidelines
4. Make use of latest trends and case studies in BI to a given scenario

**Section I: Business intelligence**

Decision making and Decision Support Systems, Business Intelligence Concepts, BI life cycle, Business Performance Management Systems, BI and data science

**Section II: Data Visualization**

Design principles of data visualization, best practices, choosing an effective visual, managing clutter, dissecting model visuals, Popular tools, data visualization using tools like R, Tableau, Importance of ethics in data visualization, ethical dimensions and general guidelines about visualization, Data visualization in business.

**Section III: Case studies and trends**

Case studies related to storytelling with data, Geographic visualizations (eg.Uber), Demographic comparison (eg. Voters and their inclinations), visualization of Urban data , self-service BI, Predictive /Advanced analytics, Mobile BI

**In class hands-on / demonstrations:**

-Hands on previously explored datasets for visualization using open source BI tools such as Jaspersoft, BIRT (Business intelligence and Reporting tools)

**Text Books:**

1. "Storytelling with data" , cole nussbaumer knaflic, Wiley Publications , 2019, ISBN 978-1119621492
2. "Data science for Business", Foster Provost et al., O'reilly Publications, 2013,ISBN 978-1449361327
3. "Decision Support And Business Intelligence Systems",Turban, Sharda, Pearson Publications, 2013, ISBN 978-8131761090

**Reference Books:**

1. "Business analytics for managers" , Laursen G.H.N. , Thorlund J., 2nd Edition, Wiley publication, 2016, ISBN: 978-1-119-29858-8
2. "Business Intelligence for Dummies" Swain Schepus, Wiley Publication, 2008, ISBN 978-0-470-12723-0
3. "Decision Support Systems in the 21st Century", George Marakas, 2002, ISBN-978-8120323766
4. "Real-World Decision Support Systems Case Studies", Jason Papathanasiou et al., Springer, 2016, ISBN 978-3-319-43916-7

# T1 Evaluation
# 20HDM 602 Data Visualization and Business Intelligence
# 2022-23

**Rubrics for Evaluation:**

The students will be working in a group of 2.
The evaluation can be done on following points:

| Sr. No. | CO | Evaluation point | Marks | BL Section | |
|---|---|---|---|---|---|
| 1. | 4 | Select a free/ open source BI tool, download it and investigate BI components present. | 06 | L4 S3 | A |
| 2. | 3 | Select a dataset and analyze the data visualization techniques available in selected tool | 06 | L4 S2 | M |
| 3. | 4 | Analyze different BI characteristics and components available in selected tool.<br>Compare it with other tools. | 08 | L4 S1, S3 | D |
| 4. | 1 | Analyze the decision making process available in selected tool | 05 | L4 S1 | M |
| | | **Total marks** | **25** | | |

- The students can select or create a data set.
- Presentation along with live demonstration of BI tool is preferred.
- The students will submit their presentation along with a brief write-up to the course teacher on-line.

Dr. Madhuri Tasgaonkar
DVBI Course Chairman

Maharshi Karve Stree Shikshan Samstha's
Cummins College of Engineering for Women, Pune
(An autonomous Institute affiliated to Savitribai Phule Pune University)
Department of Computer Engineering

**20HDM601L Advanced Machine Learning Laboratory**

**Teaching Scheme:** **Examination Scheme:**
**Practical: 2 hrs/week** **In sem: 25 Marks**
**Oral: 25 Marks**
**Credit: 1**

| | |
|---|---|
| **Course Objectives:** | |
| To facilitate the learner to | |
| 1. | Implement Support vector machine (SVM), Naive bayes algorithms on the dataset. |
| 2. | Implement decision tree algorithm, random forest algorithm of machine learning. |
| 3. | Implement Ensemble techniques such as bagging, boosting on the given dataset.. |
| 4. | Implement artificial neural networks back propagation algorithm for XOR. |
| 5. | Implement a small machine learning application and evaluate the performance of the designed machine learning model. |
| | |
| **Course Outcomes:** | |
| After completion of the course, students will be able to | |
| 1. | Implement the Support vector machine (SVM), Naive bayes algorithms of supervised machine learning on the dataset. |
| 2. | Implement the decision tree algorithm, random forest algorithm of machine learning to solve the given problem. |
| 3. | Implement various Ensemble techniques such as bagging, boosting on the given dataset. |
| 4. | Implement the artificial neural network technique for non linearly separable data. |
| 5. | Develop small machine learning applications using different techniques on the dataset. |

The large part of Advanced Machine Learning Techniques laboratory course conduction is to develop small case studies, mini projects using built in free datasets from kaggle, data.gov.in, ncbi.nlm.nih.gov, imagenet, etc, analyze and represent the results and data using different tools and technologies. Data will be used in a progressive way i.e. data cleaning/transformation/integration/reduction done in earlier lab will be subsequently used to build ML Model and model comparison/evaluation will also be done. Build models can be utilized in the decision making process through business intelligence. Students will be encouraged to publish their findings in the form of research papers. The large part of the laboratory component will be devoted to implement the advanced concepts of Machine learning and data science along with the real world applications.

Faculty members are encouraged to expand problems with variations and increased complexities. Assignments can be framed and expanded in such a way that it explores concepts, logic of solution and real life applications. Students will be encouraged to solve open problems in different domain

## Suggestive List of Assignments

**Implementation of the following Machine Learning algorithms using Tensorflow and Keras/R/python library on previously cleaned and integrated dataset and also evaluate the performance of the implemented ML Model.**

**Reference Data sets which can be used are (from Indian datasets such as https://data.gov.in/, https://www.ncbi.nlm.nih.gov/, https://dbie.rbi.org.in/, https://data.uidai.gov.in/, http://mospi.nic.in/, https://bhuvan-app3.nrsc.gov.in/, https://www.india.gov.in/, https://surveyofindia.gov.in/, https://www.meteoblue.com/en/weather/archive/export/india_el-salvador_3585481, https://www.icegate.gov.in/, https://www.gbif.org/dataset/9e7ea106-0bf8-4087-bb61-dfe4f29e0f17)**

--Support vector machine for data classification using IRIS or breast cancer dataset as example.

--Naive Bayes algorithm such as gaussian naive bayes, bernoulli naive bayes, multinomial naive bayes etc using Purchase/shopping data set as example.

--Expectation Maximization (EM) algorithm.

--Decision tree algorithm using birth weight data set as example.

--Random Forest algorithm using IRIS data set as example.

--Ensemble techniques such as bagging, boosting on breast cancer dataset as example..

--Back propagation algorithm for XOR logic gate or using any non linear separable data.

--Develop a mini project using data science and Machine learning for readily available dataset using the advanced machine learning and statistical analysis techniques studied.

**Text Books**

1. “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Aurélien Géron, O’Reilly Media, 2nd edition, ISBN 9781492032649, 2019
2. “Machine learning”, Peter Flach, cambridge university press, 6th edition, ISBN 978-1-316-50611-0, 2018
3. “Machine learning using python”, Pradhan, U. Dinesh Kumar, Wiley publication, 1st edition, ISBN 978-81-265-7990-7, 2019
4. “Machine learning”, S. Sridhar, M.Vijayalakshmi, 1st Edition, Oxford university press, 2021, ISBN 978-0-19-012727-5

**Reference Books:**

1. “Introduction to machine learning”, Ethem Alpaydın, MIT press, 3rd edition, ISBN 978-81-203-5078-6, 2014
2. “Machine learning in python”, Michael Bowlers, Wiley publication, 1st edition, ISBN 978-81-265-5592-5, 2015
3. “Practical Machine Learning with Python”:A Problem-Solver’s Guide to Building Real-World Intelligent Systems, Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress publication, ISBN: 978-1-4842-3206-4, 2018

4. Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining: Concepts and Techniques”, 3 rd Edition, 2012, Morgan Kaufmann publishing, ISBN: 978-0-12-381479-1

## Autonomous Program Structure
## Final Year B. Tech. Seventh Semester
## Computer Engineering
## Academic Year: 2023-2024 Onwards

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Practical | Oral | | |
| 20CE701 | Internship / Project | 0 | 0 | 30 | 200 | 0 | 0 | 100 | 300 | 15 |
| 20HS701 | Economics and Personal Finance | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 2 |
| | **Total** | 2 | 0 | 30 | 250 | 50 | 100 | 0 | 400 | 17 |
| | **Grand Total** | **32** | | | **250** | **50** | **100** | **0** | **400** | **17** |

**Duration of Internship / Project :**

1. Internship of 6 Months,

2. Project of 6 Months,

3. Combination: Internship of 2 to 6 Months duration + Project from 1 to 6 Months Duration.

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MKSSS's Cummins College of Engineering
For Women, Pune-411052

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Chairman Governing Body
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For Women, Pune-411052

Cummins College of Engineering
Karve Nagar,
Pune-411052

# 20CE 801 Information Security

**Teaching Scheme**
Lecture: 3 Hours. /week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

**Prerequisite(s):** Computer Networks (20CE 501)

**Course Objectives:**
**To facilitate the learners to-**
1. Understand the fundamental concepts of security.
2. Know the basics of cryptography
3. Identify the role of security protocols at various layers.
4. Understand network security threats, security services and countermeasures.

**Course Outcomes:**
**By taking this course, the learner will be able to–**
1. Make use of principles of Cryptosystem for Data Protection
2. Identify various techniques to provide Data security and Integrity over the network
3. Choose appropriate security mechanisms to mitigate various security challenges
4. Identify security mechanisms for Network Perimeter and specific Applications

**Unit 1: Introduction to Security (06)**
Need and significance of Security, Architectures, Introduction to common attacks (e. DOS, Phishing, SQL injection, Cross site scripting etc), Active Vs Passive Attacks, A model for Network and Internetwork Security, TCP/IP security Architecture (services and Mechanism),Introduction to cryptography- Classical Cryptography.

**Unit 2: Introduction to Cryptography (07)**
Introduction to secrete key cryptography, Cipher Basics, Introduction to DES, DES Analysis, DES variants, Introduction to AES and IDEA, Block cipher modes of operations.

**Unit 3: Public Key Cryptography and Key Management (08)**
Introduction to Public Key cryptography, The RSA algorithm, Analysis of RSA, Key Management Basics, Diffie- Hellman Key exchange, Key distribution of Private and Public Keys.

**Unit 4: Message Integrity and Authentication (08)**
Need and Significance of Message Digest, One way hash functions and properties of hash functions, MD5, SHA, Message authentication, Introduction and overview of Digital Signatures: Implementation, Algorithms standards(DSS),Digital Certificates and X.509, Certificate structure, Certificate revocation.

**Unit 5: Network Security** **(07)**
Introduction to Network Layer Security- Overview of Firewall, Design principles of Firewalls, Various types of firewalls and their working principles, Concept of VPN,Tunnelling protocols, working of IPSEC. Introduction to transport Layer security – SSL/ TLS protocol.

**Unit6: Application Security and Authentication Mechanisms** **(06)**
Overview of Application Security, Overview of Wireless Security. User Authentication Mechanisms, Kerberos v4 and v5.Overview of Cloud security, Overview of IOT security,

**Text Books:**

1. William Stalling **'Cryptography and Network Security, principles and practices'**, 7th *Edition. Pearson* ISBN 978-93-325-8522-5

2 William Stalling, Lawrie Brown **'Computer Security: Principles and Practice,** 4th Edition, Pearson ISBN 978-9353438869

**Reference Books:**

**1.** Atul Kahate, **'Cryptography and Network Security'**, 4*rd edition McGraw Hill Publication.2019* ISBN 9789353163310

2. Bernard Menezes, **'Network Security and Cryptography'**, *Cengage Learning*. ISBN 978-8131513491

3. *Bruce Schneier:* **'Applied Cryptography –Protocols, Algorithm and Source Code in C'**, *Second Edition, John Wiley & Sons, New York,* ISBN 978-1-119-09672-6.

4. Charlie Kaufman, Radia Perlman and Mike Speciner, **'Network security, private Communication In a Public World'** ISBN978-0130460196

## 20PECE 801A Introduction to Natural Language Processing

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credits: 3 |

**Course Objectives:**

To facilitate the learner to

1. Understand various aspects of Natural Language Processing.
2. Learn Phonological, Morphological, Syntactic and Semantic processing
3. Understand issues related to ambiguity of Natural Language.
4. Understand the advanced applications of Natural Language Processing.

**Course Outcomes:**

After completion of the course, students will be able to

1 Identify importance of Natural Language Processing.

2 Apply the fundamental concepts and techniques of Natural Language.

3 Identify ambiguous structure of Language.

4 Analyze the advanced applications of Natural Language Processing.

**Unit I: Introduction to Natural Language Processing (6)**

The Study of Language, Applications of Natural Language Understanding, Evaluating language Understanding Systems, Different levels of Language Analysis.

**Unit II: Fundamentals of Phonics (7)**

Speech Sounds and Phonetic Transcription, Articulatory Phonetics, The Vocal Organs, Place of Articulation of Consonants, Manner of Articulation of Consonants, Vowels, Syllables, Phonological Categories and Pronunciation Variation, Phonetic Features, Predicting Phonetic Variation, Factors Influencing Phonetic Variation.

**Unit III: Fundamentals of Morphology (7)**

Concept of Morphology, Survey of English Morphology, Inflectional Morphology, Derivational Morphology, Cliticization, Non-Concatenative Morphology, Agreement, Finite-State Morphological Parsing, Construction of Finite-State Lexicon, Finite-State Transducers(FST), Sequential Transducers and Determinism, Finite-State Transducers for Morphological Parsing, Transducers and Orthographic Rules, Word and Sentence Tokenization.

**Unit IV: Semantic Analysis (8)**

Part-of-Speech Tagging, POS-Tagging Perspective, POS tagging and HMM, POS-Tag Set, Parsing Algorithms,Parsing in case of Ambiguity; Probabilistic Parsing .Parser Comparison, Grammar; Constituency, Dependency , Inside Probability; Parse Tree construction,language modelling

**Unit V: Discourse and Pragmatics (7)**

Discourse Structure and Reference, Relating Discourse Structure and Inference, Discourse Structure, Tense, and Aspect, Managing the Attentional Stack, Concept of Pragmatics

**Unit VI: Applications of Natural Language Processing (7)**

Machine Translation, Sentiment Analysis, Question Answering Systems, Cross Lingual Information Retrieval,Natural Language Interface to Database, Extractive and Abstractive Summarization Systems, Indian Language WordNets.

**Text Books:**

**1.** Jurafsky, David, James H. Martin, 'Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition', Pearson Education Limited, Dorling Kindersley(India) Pvt. Ltd. (Indian Subcontinent Version)(2014), ISBN: 987-93-325-1814-4.

**2.** James Allen, 'Natural Language Understanding', Pearson Education Limited, Dorling Kindersley(India) Pvt. Ltd. (Indian Subcontinent Version)(2007), ISBN: 987-81-317.

**Reference Books:**

**1.** Manning, Christopher D., Hinrich Schütze, 'Foundations of Statistical Natural Language Processing', Cambridge Publication(1999), ISBN: 0262133601. 2. Steven Bird, ewan Klein, and Edward Loper, 'Natural Language Processing with Python', O'Reilly Media, 2009.

**2.** Flanagan, J. L. Speech Analysis, Synthesis and Perception. 2nd ed. New York, NY: Springer-Verlag,. ISBN: 9780387055619.

# 20PECE 801B User Experience Design (UX/UI)

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credits: 3 |

**Course Objectives:**

To facilitate the learner to

1. Understand the basic concepts of UI/UX Design in order to design with intention.
2. Achieve a deep understanding of the entire life-cycle of design process.
3. Provide a visual understanding of product to make user interaction as easy and efficient as possible.
4. Understand various design technologies for mobile and web to help avoid common mistakes and meet user requirements
5. Understand the advanced techniques of User Experience Design

**Course Outcomes:**

After completion of the course, students will be able to

1. Apply the concepts areas of study in UX to enhance the user experience
2. Apply the key psychological principles that underlie UX design principles
3. Construct the wireframes and prototypes for interactive products to establish the structure and flow of possible design solutions.
4. Apply the fundamental aspects of designing and evaluating the interfaces for mobile and web.
5. Compare the advanced techniques of User experienec Design

**Unit I: Introduction to User Experience** **(6)**

What is User Experience, Relationship Between UI and UX, Why is UX Design so Important, What is UX Design and Where is Used, Usability: A part of the User Experience, Understanding User Experience, Psychology of everyday actions, Concept of UX, Trends in UX, What is User Interaction, Mental Model, Cognitive Model in UX, Emerging Technologies in UX, Universal Design, User-centered design, Human Centered Design.

**Unit II: Design Thinking** **(8)**

Key elements of Design thinking, Design Thinking Skills-What are wicked problems and its solution, Good and poor design, Empathy Users- User research, Personas, Define problem, , Ideation- Identifying Customer Needs, Translate user needs into product specifications, Applied Creativity, Brainstorming, Prototyping, From Prototype to Product Development, Testing Design Solutions, Relation of Design thinking with UX, Design thinking applications, Applying design thinking to mobile and wed.

**Unit II: Interaction Styles** **(6)**

Design principles and rules, Shneiderman's golden rules, Normans seven principles, Nielsens ten heuristics with example of its use,Heauricstic evaluation.
Direct Manipulation – Windows Characteristics, Components, Presentation styles, Icons, Multimedia and colors, Menu selection, Form Fill-in and Dialog Boxes, Icons, Fitts'law and Hick-Hyman's law.

**Unit IV: UX Design Process** **(7)**

Elements of User Experience Design, Stages of UX design,
Visual Design - Vision and Memory,Visual Design Principles, Data Visualization, Wire framing & Storyboarding, Converting the wireframes into visual design, Prototyping, Various Prototyping Tools, Elements and Widgets. Gestalt Principles and Grids, Layout Expectations, Forms and Data Entry
Screen Design and Layout- Screen planning and purpose, organizing screen elements, ordering of screen data and content , screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully
UX Design Tools

**Unit V: UX Design for Mobile and Web** **(8)**

Mobile Usability Research – The Important Differences from the Desktop. Smartphone vs. Tablet, UI mobile components and patterns, Application frameworks: Types of Mobile Applications: Widgets, Applications, Mobile Design: Elements of Mobile Design
Web user Interface - The Gestalt Principles of Perceptual Organization, The Law of Similarity, Proximity, Familiarity/Meaningfulness, Symmetry, Continuity, The Principle of Closure, 'New' Grouping Laws, The Law of Element Connectedness, The Law of Common Region.
Types of Evaluation research, Usability Testing.

**Unit VI: Interaction Technologies** **(7)**

Explicit and Implicit Human Computer Interaction – Gesture interfaces, Speech Recognition, Tangible interfaces, Auditory Interfaces, Natural Language Interfaces, User Interfaces and Interaction for Four Widely Used Devices.
Hidden User Interface via Basic smart Devices, Hidden User Interface via Wearable and Implanted Devices, Virtual and Augmented Reality.

**Text Books:**

1. Interaction Design: Beyond Human-Computer Interaction: Book by Helen Sharp Jenny Preece, and Yvonne Rogers
2. Wilbert O. Galitz'Wiley The Essential Guide to User Interface Design' 3rd Edition Apr 2007

**Reference Books:**

1. Don Norman, 'The Design of Everyday Things', Basic Books, A member of the Perseus Books Group, (2013)
2. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, 'Designing the User Interface: Strategies for Effective Human-Computer Interaction', Pearson Education Limited (India),(2010)

**Online/Web/Other References:**

1. https://www.interaction-design.org/courses/user-experience-the-beginner-s-guide
2. https://www.coursera.org/learn/user-experience-design#syllabus

# 20PECE 801D Artificial Intelligence

**Teaching Scheme**

Lectures: 3 Hours / Week

**Examination Scheme**

In Semester: 50 Marks

End Semester: 50 Marks

Credits: 3

**Course Objectives:**

To facilitate the learner to

1. Learn overview and basics of classic Artificial Intelligence.
2. Understand various intelligent searches and knowledge representation.
3. Understand types of learning used in artificial intelligence.
4. Study applications in Artificial Intelligence.

**Course Outcomes:**

After completion of the course, students will be able to

1. Build fundamental knowledge of AI, its applications and solve classical AI problems using different AI Techniques
2. Apply intelligent search algorithms on AI problems.
3. Make use of Knowledge Management techniques of AI for reasoning.
4. Make use of various learning techniques to solve the given problem.
5. Examine different topics with various methods of expert system, pattern recognition, natural language processing, nature inspired computing.

**Unit I: Introduction to AI (6)**

Definitions of Artificial Intelligence, History of Artificial Intelligence, Artificial Intelligence Problems, Present state of AI, Intelligent agents, Topics of Artificial Intelligence: Learning Systems, Knowledge Representation and Reasoning, Planning, Knowledge Acquisition, Intelligent Search, Logic Programming, Soft Computing, Management of Imprecision and Uncertainty, Branches and applications of Artificial Intelligence.

**Unit II: Uninformed search and modelling a search problem (7)**

Generate-and-Test, Search Techniques: Depth First Search, Breadth First Search, Production Systems: Traveling Salesman Problem, Water-Jug Problem, State Space Representation, State Space Search, Tic-Tac-Toe as a State Space.

**Unit III: Heuristic Search Techniques (8)**

Best First Search Algorithm, Hill Climbing, Simulated Annealing, A* Algorithm, Problem Reduction, AND–OR Graphs, The AO* Algorithm, Towers of Hanoi Problem, Constraints Satisfaction: crypt-arithmetic problem, mini-max algorithm.

**Unit IV: Knowledge Management (7)**

Knowledge Management, Types of Knowledge: Declarative Knowledge, Procedural Knowledge, Knowledge Representation, Approaches to Knowledge Representation, Issues in Knowledge Representation, First-order Logic: Basic Predicate Representations, Conversion of WFF to Clause Form, Resolution, Unification, Resolution Examples, Reasoning, monotonic and non-monotonic reasoning.

**Unit V: Learning (7)**

Types of Learning: Rote Learning, Learning by General Problem Solving, Concept Learning, Learning by Analogy, learning problems and designing the learning systems, Reinforcement learning.

**Unit VI: Applications in Artificial Intelligence (7)**

Game Playing, Expert Systems, Natural Language Processing, Pattern Recognition, Recommendation system, Nature Inspired Computing.

**Text Books:**

**1.** Vinod Chandra S. S., Anand Harendra S., 'Artificial Intelligence and machine learning', PHI, (2014), ISBN 978-81-203-4934-6.

**2.** Kulkarni P., Joshi P., 'Artificial Intelligence: Building Intelligent Systems', PHI Learning, (2015), ISBN 978-81-203-5046-5.

**Reference Books:**

**1.** Peter, Norvig, 'Artificial Intelligence: A Modern Approach', Pearson, (3rd edition), (2014), ISBN-0-13-103805-2.

**2.** Elaine Rich, Kevin Knight and Nair, 'Artificial Intelligence', Tata McGraw – Hill, (3rd edition), (2012), ISBN-978-0-07-008770-5.

3. Bratko I., 'Prolog Programming for Artificial Intelligence', Pearson Education, (3rd edition), (2004).

4. Tom M. Michell, 'Machine Learning', McGraw Hill Education, Indian edition (2013), ISBN-13: 978-1-25-909695-2.

5. Ethem Alpaydin, 'Introduction to Machine Learning', PHI, (2006), ISBN-81-203-2791-8.

**Online/Web/Other References:**

**1.** https://nptel.ac.in/courses/106/105/106105077/
**2.** https://nptel.ac.in/courses/106/106/106106126/
**3.** https://onlinecourses.nptel.ac.in/noc19_me71/preview
**4.** https://onlinecourses.nptel.ac.in/noc20_cs42/preview

## 20PECE 802C Information Retrieval

| Teaching Scheme | Examination Scheme |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credits: 3 |

**Course Objectives:**

To facilitate the learner with

1. Concepts of information retrieval
2. Indexing techniques and information retrieval system
3. Text classification and vector space classification
4. The latest trends in information retrieval

**Course Outcomes:**

After completion of the course, students will be able to

1. Model the working of information retrieval search system
2. Analyze search strategies used in Information retrieval system
3. Design techniques for information retrieval system
4. Understand the latest trends in information retrieval

**Unit I: Introduction to Information Retrieval (7)**

Information retrieval process, Indexing, Processing Boolean queries, Term vocabulary and postings lists, document delineation and character sequence decoding, determining vocabulary of terms.

**Unit II: Scoring, term weighting and vector space model (7)**

Parametric and zone indexes, Term frequency and weighting, Vector space model for scoring, variant tf-idf functions, Components of an Information retrieval system.

**Unit III: Text classification -Naive Bayes and Vector space classification (7)**

Naive Bayes text classification, Bernoulli model, Properties of Naive Bayes, Feature selection, document representation and measures of relatedness in vector spaces, Rocchio classification, KNN, Linear vs Non linear classifiers, Classification with more than two classes, the bias variance tradeoff

**Unit IV: Evaluation in Information Retrieval** **(7)**

Information retrieval system evaluation, standard test collections, Evaluation of unranked retrieval sets, evaluation of ranked retrieval sets, Assessing relevance, System quality and user
utility, results snippets.

**Unit V: Web search basics and Link Analysis** **(7)**

Web characteristics, advertising as the economic model, The search user experience, Index size and estimation, Near duplicates and shingling, Web crawling and indexes, distributing indexes, connectivity servers. The web as a graph, Page rank, Hubs and authorities

**Unit VI: Trends in Information Retrieval** **(7)**

Case study: Google analytics, Search engine optimization, Ranking algorithms,Recommendation systems, Collaborative Filtering

**Text Books:**

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, Introduction to Information Retrieval, Cambridge University Press. 2008.

**Reference Books:**

1. Grigoris Antoniou and Frank van Harmelen, A semantic Web Primer, Massachusetts

**Online/Web/Other References:**

1. http://nlp.stanford.edu/IR-book/information-retrieval-book.html

## 20PECE 802E Introduction to Blockchain

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

**Course Objectives:**
To facilitate the learner to
1. Learn the underlying blockchain technology.
2. Learn and Explore blockchain platforms such as Ethereum, Hyperledger to build blockchain applications.
3. Understand use of cryptocurrency and smart contract.
4. Understand use of blockchain in various domains like supply chain management, healthcare, IoT etc.

**Course Outcomes:**
After completion of the course, students will be able to
1. Apply fundamental concepts of blockchain to understand the working of blockchain.
2. Make use of blockchain platforms such as Ethereum, Hyperledger to build blockchain applications.
3. Make use of Cryptocurrency and Smart Contract in real world applications.
4. Explore applications of Blockchain in domains like supply chain management, healthcare, IoT etc.

**Unit I: BLOCKCHAIN FUNDAMENTALS (6)**

Basics of Blockchain-Architecture, features, Types (Public, Private, Hybrid), working of blockchain, distributed ledger, wallets, Hash, Consensus mechanism and Mining, Smart contract, cryptocurrency.
Blockchain Technology: Applications, opportunity & challenges.

**Unit II: CRYPTOGRAPHY and CONSENSUS MECHANISM (7)**

Use of Cryptography in Blockchain, symmetric key and asymmetric-key cryptography algorithms, hash functions, SHA-256, digital signature,merkel trees.

Importance of consensus in transactions. Consensus Mechanisms ex. Proof of Work (PoW), Proof of Stake (PoS), PBFT(Practical Byzantine Fault Tolerance), DBFT(Delegated Byzantine Fault Tolerance).

**Unit III: BLOCKCHAIN FRAMEWORKS** **(7)**

Blockchain Platforms like Ethereum and Hyperledger. Demo of Blockchain Tools.
Create nodes on your personal Ethereum blockchain, create accounts, unlock accounts, mine, transact, transfer Ethers, and check balances.

**Unit IV: SMART CONTRACT** **(7)**

Introduction, what is smart contract,Working of Smart contract,Challenges. Types of smart contracts, Smart Contracts in Ethereum Blockchain, EVM in relation with Smart Contracts and Gas Price, Demo of Running and Debugging Smart Contracts in Remix (Detailed), Writing smart contracts using Solidity & JavaScript, Deploy and Debug Smart Contract using appropriate tool.

**Unit V: CRYPTOCURRENCY** **(8)**

Introduction, Cryptocurrency Basics, wallets, Types of Cryptocurrency. Crypto-economics and Cryptocurrency Transactions, Valid and Invalid Transactions, Cryptocurrency Wallets, Buying Cryptocurrency Wallets , Withdrawal Cryptocurrency Wallets. Mining Blockchain.

Bitcoin, Ethereum basic crypto primitives: Hash, Digital Signatures, Hashchain to Blockchain, Basic consensus mechanisms Ethereum Vs Bitcoin. working of Bitcoin System, Decentralized Cryptocurrency and its use cases. Bitcoin Wallets. Cryptocurrency safety issues.

**Unit VI: BLOCKCHAIN APPLICATIONS AND TRENDS** **(7)**

Community, Politics, and Regulation. Stakeholders, Roots of Bitcoin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Technical, Business, Cultural, Ethical, and Regulatory Challenges, Regulating and mitigating illegal behaviour(s).
Blockchain Applications like healthcare, Supply Chain Management, Finance, Digital ID's. Real Time Use Cases and Applications in Blockchain.

Blockchain in Financial Service(Payments and Secure Trading, Compliance and Mortgage, Financial Trade).
Blockchain in Government: Advantages, Use Cases. Future trends in blockchain, industry impact. Impact of blockchain on Business.

**Text Books:**

1. Chandramouli Subramanian, Asha A George, Abhilash K A, Meena Karthikeyan, "Blockchain Technology", Universities Press 2020, ISBN 9789389211634
2. Melanie Swa, "Blockchain", O'Reilly, 2015, ISBN: 9781491920497
3. Bikramaditya Singhal, Gautam Dhameja, Priyanshu Sekhar Panda, "Beginning Blockchain", Apress, First South Asian Edition 2018, ISBN 978-1-4842-3444-0.

**Reference Books:**

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press, 2016 ISBN: 9780691171692
2. Thompson, 'Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017, ISBN: 1546772804
3. Tiana Laurence, Blockchain For Dummies, 2nd edition, Wiley, 2019, ISBN: 978-1-119-55513-1
4. Primavera De Filippi, Aaron Wright, "Blockchain and the Law", Harvard University Press, ISBN-13: 978-0674976429

**Online/Web/Other References:**

1. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
2. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
3. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design And Use Cases"[MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

# 20CE 801L Information Security Laboratory

**Teaching Scheme**
Practical: 4 Hours/week

**Examination Scheme**
In Semester : 25 Marks
Oral : 25 Marks
Credits: 2

**Course Objectives:**

**To Facilitate the Learners to:-**

1.Understand Basic CryptographyAlgorithms
2.Learn various techniques for secure data transmission
3.Recognize the need of Network Perimeter Security
4.4.Learn various techniques used for common attacks

**Course Outcomes:**

**By taking this course the learner will be able to**:-

1. Implement Standard CryptographyAlgorithms
2. Apply the digital signature for authentication
3. Apply packet filtering concept to configure Firewall
4. Demonstrate common attacks

**Sample /Suggested List of Assignments:**

1. Implement DES algorithm

2. Implement RSAalgorithms

3. Implement Message Digest Algorithm and demonstrate the collision resistance property

4. Implementation of Diffie Hellman Key exchange for sharing the secret key.

5. 2 users are doing business online. Develop and demonstrate suitable solutions which will take care of user authentication along with Non repudiation.

6. Simulation of packet Filtering concepts.

7. Create a small application to demonstrate attacks (e.g SQL injection ,Cross Site scripting)

8. Develop and demonstrate how the contents of the web site will be made secure against the common attacks.

9. Case Study - Enterprise network Security/ Wireless Security / Security Information and Event Management

## 20PECE 801LA Introduction to Natural Language Processing Laboratory

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral : 25 Marks
Credits: 1

**Prerequisite:**

**Course Objectives:**

To facilitate the learner to

1. develop problem solving abilities for natural language processing
2. apply algorithmic strategies while solving problems
3. develop time and space efficient algorithms

**Course Outcomes:**

After completion of the course, students will be able to

1. Develop programs for natural language processing applications.
2. Design test cases to solve problems for pervasiveness,embedded security and NLP applications.

## Suggestive List of Assignments

**Group A**

1. Write a program using Scala/ Python/ C++ using Eclipse to correct the spelling of English paragraphs.

**Group B (Any two)**

Using Programming language Python and Natural Language Tool Kit (NLTK) perform following

1. Apply Simple language processing for 10 phonetics Indian languages (Marathi or mother-tongue)
2. Lab on sentiment analysis
3. Lab on Cross Lingual information retrieval
4. Lab on document summarization

**Group C**

1. Study and implementation of research paper in Multidisciplinary NLP using open source tool.

# 20PECE 801LB User Experience Design Laboratory

**Teaching Scheme**

Practical: 2 Hours / Week

**Examination Scheme**

In Semester: 25 Marks

Oral : 25 Marks

Credits: 1

**Prerequisite:**

**Course Objectives:**

To facilitate the learner to

1. Understand users' needs, experiences, behaviours and goals.
2. Learn how visual perception affects the viewing experience
3. Explain Why you made design decisions, through presentations of assignments

**Course Outcomes:**

After completion of the course, students will be able to

1. Discover the techniques used for understanding of users, what they need, what they value, their abilities, and also their limitations
2. Design innovative and user friendly interfaces for mobile and web applications.
3. Criticize existing interface designs, identify areas of improvement and then create better services and products to make user experience better.
4. Discover the industry-standard tools and specific project deliverables in UI/UX

## Suggestive List of Assignments

1. Design user persona for the users of selected product / system and Conduct a contextual inquiry for selected product / system.
2. Heuristic evaluation on a computer prototype developed by your classmates.
3. Design of User interface for the system using various interaction styles.
4. Design appropriate icons pertaining to a given domain. (Eg. Greeting cards)
5. Design a Mobile App/Website that can help people to sell their handmade products in metro cities

6. Improve Instagram with a new, innovative feature, which stands out from other image apps.
7. Redesign a page from the job portal you like (preferably a complex screen). Justify your selection and the changes/design you made. Document your design process on Notion.
8. ATM machine/KIOSK screen design for rural people
9. Tool exploration Adobe XD, Figma

# 20PECE 801LD Artificial Intelligence Laboratory

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Practical: 2 Hours / Week | In Semester: 25 Marks |
| | Oral: 25 Marks |
| | Credits: 1 |

**Prerequisite:**

**Course Objectives:**

To facilitate the learner to

1. Experiment Artificial Intelligence concepts from syllabus.
2. Experiment AI searches like A*, Min-max algorithm.
3. Understand monotonic and non-monotonic knowledge representation.
4. Experiment classification and clustering algorithms.

**Course Outcomes:**

After completion of the course, students will be able to

1. Implement various uninformed searching techniques.
2. Implement various Heuristic searching techniques.
3. Apply Knowledge Management techniques to implement Expert system.
4. Implement unification for the given expression.

## Suggestive List of Assignments

**Group A : (Mandatory)**

1. Implement DFS/BFS for graph problem.
2. Implement simple water jug problem using DFS or BFS.
3. Implement Best first search algorithm
4. Implement A* algorithm for graph problem

**Group B: (Any Two)**

1. Implement A* algorithm for 8 puzzle problem
2. Write a program to implement Min-max algorithm for game playing
3. Implement Unification algorithm

**Group C**

1. Represent knowledge using AIML/Prolog by implementing small expert system

## 20HDM801 Deep Learning and Applications

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

Prerequisite: 20CE404 Machine Learning

**Course Objectives:**
1. To be familiar with Deep learning algorithms and applications.
2. To get exposure to Convolutional Neural Networks
3. To gain advanced knowledge of Recurrent Neural Networks and LSTM for given data.
4. To get exposure to Deep learning algorithms in NLP Applications .
5. To gain advanced knowledge of Pretrained networks and advanced deep neural networks.

**Course Outcomes:**
At the end of this course, students will be able to:-
1. Make use of deep learning concepts and Popular open source libraries
2. Apply Convolutional Neural Networks algorithm for given problem
3. Experiment with concepts of Recurrent Neural Networks and LSTM for given data.
4. Experiment with Deep learning algorithms in NLP Applications .
5. Experiment with Pretrained networks and advanced deep neural networks

**Course Contents:**

**Section 1: Basics of Deep learning and Convolutional Neural Networks**

Linear Algebra, Artificial intelligence, machine learning, and deep learning, mathematical building blocks of neural networks, binary classification, a multiclass classification, Confusion Matrix for multi class classifiers. Understanding convolutional neural networks (convnets), Using a pre trained convnet, Visualizing what convnets learn

**Section 2: Deep learning for sequential data and Recurrent Neural Networks**

Working with text data, One-hot encoding of words and characters, Using word embeddings, Understanding recurrent neural networks, Understanding the LSTM and GRU layers, Deep Learning in Question Answering over Knowledge Base, Deep Learning in Machine Comprehension, Deep Learning in Sentiment Analysis

**Section 3: Deep Learning for Complex Problems and Aututoencoders**

Text generation with Long short term memory (LSTM) , Generative Adversarial Networks Generative recurrent networks, Text processing with LSTM, Generating images with autoencoders, Deep Learning for Board Games

**Text Books:**

1. "Deep Learning: A Practical Approach Using Python", François Chollet, ISBN : 13-9781617294433, MANNING publishing, Ist edition, 2021

2. "Python Deep Learning, Next generation techniques to revolutionize computer vision, AI, speech and data analysis", Valentino Zocca, Gianmario Spacagna, Daniel Slater, Peter Roelants, , Packt Publishing, Ist edition, 2017, ISBN: 13- 978-1786464453

3. "Deep Learning for Natural Language Processing", Jason Brownlee, 2017 Jason Brownlee. All Rights Reserved. Edition: v1.1 (eBook), ISBN : 9789352136094

4. "Deep Learning in Natural Language Processing", Li Deng , Yang Liu, Springer Nature, 2018, ISBN 978-981-10-5208-8 (eBook)

**Reference Books**:

1. "Deep Learning Using Python", S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka, Wiley Publisher, 2019, ISBN: 13- 978-812657991
2. "Deep Learning", Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press Ltd., 2017, ISBN: 9780262035613
3. "Deep Learning – A Practitioner's approach", Josh Patterson and Adam Gibson, O'Reilly Publication, 1st edition , 2017 ISBN : 9789352136049

**Web resources:**

https://d2l.ai/d2l-en.pdf: Dive into Deep Learning Release 0.16.5, Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola Jun,

http://ling.snu.ac.kr/class/AI_Agent/deep_learning_for_nlp.pdf: Deep Learning for Natural Language Processing, Jason Brownlee.

**20HDM801L Deep Learning and Applications Laboratory**

| Teaching Scheme | Examination Scheme |
|---|---|
| Practical: 2 Hours / Week | In Semester: 25 Marks |
| | Oral: 25 Marks |
| | **Credit: 1** |

The laboratory work for the Deep Learning and Applications (DLA) course includes implementation of deep neural network models for various applications. Students will work on image data and sequential data in the assignment. Students are encouraged to do variation in data for the assignments. Students will experiment with values of parameters/ hyper parameters and parameters in models for better accuracy. DLA aspirants will select a deep neural network model and data of their interest implemented in earlier assignments to write one paper as a part of the last assignment. In this assignment they are expected to do literature study from similar domains and compare their results with already existing research done by other researchers.

## Suggestive List of Assignments

**Benchmark Datasets for Research:**
**https://www.kaggle.com/sudalairajkumar/novel-corona-virus-2019-dataset**
**• https://www.kaggle.com/imdevskp/corona-virus-report**
**• https://data.humdata.org/dataset**
**• https://ieee-dataport.org/open-access/corona-virus-covid-19-tweets-dataset**
**• https://data.world/datasets/covid-19Datasets**
**• https://github.com/datasets/covid-19**
**• https://www.dimensions.ai/news/dimensions-is-facilitating-access-to-covid-19-research/**
**• https://www.sirm.org/category/senza-categoria/covid-19/**
**•https://dev.to/anujgupta/google-s-25-million-datasets-a-perfect-gift-for-aspiring-datascientists-3ekh**
**• https://github.com/CSSEGISandData/COVID-19**
**• https://www.kaggle.com/manoj9april/imbd-sentiment-classification-dataset**
**• https://www.kaggle.com/c/digit-recognizer/data**

--Experiment with Data representations for neural networks:Manipulating tensors, tensor operations
--Training a convnet from scratch on a small dataset
--Experiment with pre trained convnet to visualizing what convnets learn: Implement CNN for given data : Classification of characters
–Implement model for word embeddings using IMDB data, train and evaluate
--Implement RNN for given data: Speech recognition or similar application
--Experiment with Pretrained networks/ autoencoders
--Prepare paper for: work with online/ real time data and any DL technique

20OE801 Open Elective-III

| 20OE801 Open Elective-III | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Course Title** | **EnTC** | **Comp** | **IT** | **Mech** | **Instru** |
| 1 | 20OE801A | Big Data and Analytics | Y | Y | Y | Y | Y |
| 2 | 20OE801B | Cyber Physical Systems | Y | Y | Y | N | Y |
| 3 | 20OE801C | Digital Control | Y | N | N | Y | Y |
| 4 | 20OE801D | Industrial Engineering and Management | Y | Y | Y | Y | Y |
| 5 | 20OE801E | Introduction to Cyber-crime and Forensics | Y | Y | Y | Y | Y |
| 6 | 20OE801F | Instrumentation in Food and Agriculture | Y | Y | Y | Y | Y |
| 7 | 20OE801G | Medical IoT | Y | Y | Y | N | Y |
| 8 | 20OE801H | Quantum Computing | Y | Y | Y | N | Y |
| 9 | 20OE801I | Renewable Energy Sources | Y | Y | Y | Y | Y |
| 10 | 20OE801J | Soft Computing | Y | Y | Y | Y | Y |
| 11 | 20OE801K | Software Testing and Quality Assurance | Y | Y | Y | Y | Y |

20OE802 Open Elective-IV

| 20OE802 Open Elective-IV | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Course Title** | **EnTC** | **Comp** | **IT** | **Mech** | **Instru** |
| 1 | 20OE802A | Applied statistics with R Programming | Y | N | N | Y | Y |
| 2 | 20OE802B | Automobile Engineering | Y | Y | Y | N | Y |
| 3 | 20OE802C | Autonomous Robots | N | Y | Y | Y | N |
| 4 | 20OE802D | Building Automation and Energy Audit | Y | Y | Y | Y | N |
| 5 | 20OE802E | Data Analysis and Visualization | Y | N | N | Y | Y |
| 6 | 20OE802F | Data Science using Python | Y | N | N | Y | Y |
| 7 | 20OE802G | Industrial Drives and Control | Y | Y | Y | Y | N |
| 8 | 20OE802H | Smart Sensors and Structures | Y | Y | Y | Y | N |
| 9 | 20OE802I | Wireless Networks | N | Y | Y | N | Y |

## 20OE 801A Big Data And Analytics

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**
To facilitate the learner to
1 Understand the concepts, challenges and techniques of Big data and Big data analytics
2 Understand the concepts of Hadoop, Map Reduce framework , Spark for Big data analytics
3 Apply skills and tools to manage and analyze the big data
4 Understand latest big data trends and applications.

**Course Outcomes:**
After completion of the course, students will be able to
1 Apply basic concepts of big data for the various applications.
2 Apply data analytics life cycle to real-world big data applications
3 Choose Hadoop ecosystem components based on requirement of application
4 Compare Spark and Hadoop architecture
5 Compare various methods used in data Analytics and big data trends.

**Unit I: Introduction (6)**
Database Management Systems, Structured Data, SQL. Unstructured data, NOSQL, Advantages of NOSQL, Comparative study of SQL and NOSQL. Big data overview, characteristics of Big Data, Case study- SAP HANA.

**Unit II: Data Analytic Life Cycle (6)**
Data Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Discovery, Data preparation, Model Planning, Model Building, Communicate Results, Opearationalize. Case Study: GINA

**Unit III: Big Data Architectures, Hadoop (8)**
Introduction to Big Data and Hadoop, Building blocks of hadoop: Ecosystem, HDFS, HBASE, YARN, Map Reduce working.

**Unit IV: Introduction to Spark (7)**
Spark Framework, Architecture of Spark, Resilient Distributed Datasets, Data Sharing using Spark RDD, Operations in Spark;
Introduction to Kafka: need, use cases, components.

**Unit V: Machine learning (8)**

Supervised, unsupervised learning; Classification, Clustering; Time series analysis, basic data analysis using python: libraries,functions.

Text Analysis: Text Pre-processing, Topic modelling algorithms, Text Similarity measure.

**Unit VI: Big Data Trends and applications (7)**

Exploratory data analysis, Big data Visualization using python;

IoT and big data, Edge computing, Hybrid cloud.

Applications of Big data, Case study: E-commerce, healthcare.

**Text Books:**

1 "Data Science and Big Data Analytics", Wiley, 1stEdition (January 2015)
2 "Big Data, Black Book" ,Dreamtech Press (27 May 2015),ISBN-13-978-9351197577

**Reference Books:**

1 Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game",MC Press(November 2012)
2 J.Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big Data for Dummies", 1st Edition (April 2013)
3 Tom White, "Hadoop: The Definitive Guide", O′Reilly, 3rdedition (June 2012)
4 Abraham Silberschatz, Henry Korth, S. Sudarshan, "Database System concepts",McGraw Hill Education, 6th Edition (December 2013).
5 Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing (November 2013)
6 Shiva Achari ,"Hadoop Essentials - Tackling the Challenges of Big Data with Hadoop" ,Packt Publishing(April 2015), ISBN:978-1-78439-668-8

**Online/Web/Other References:**

1 https://nptel.ac.in/courses/106/104/106104189/
2 https://hadoop.apache.org/docs/stable/
3 https://kafka.apache.org/documentation/
4 https://spark.apache.org/

## 20OE 801E Introduction to Cyber Crime and Forensics

**Teaching Scheme Examination scheme:**
**Lectures: 3 Hours / Week In Semester: 50 Marks**
**End Semester: 50 Marks**
**Credits: 3**

**Course Objectives:**

To facilitate the learners to-
1 Learn fundamental concepts of cyber security

2 Understand Security challenges presented by mobile devices and information system access in cybercrime world
3 Learn tools used in Computer forensics and Cyber Applications
4 Understand risks associated with social media networking
Course Outcomes:

**By taking this course the learner will be able to-**

1 Classify Cyber Crimes
2 Identify threats and risks within context of Cyber Security
3 Outline Relevant laws and Acts in Cyber Security
4 Appraise various roles and tools used in Cyber Security/ Digital forensics

**Unit I: Introduction to Cybercrime: (7)**
Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, Ethical dimensions of cybercrime,Ethics and Morality,Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective
on Cybercrimes

**Unit II: Cyber Offenses: (7)**
How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Typical Cyber Crimes like Social Engineering, Cyber stalking, Cyber Defamation, Intellectual property Infringement Botnets: The Fuel for Cybercrime, Dark net

**Unit III: Cybercrime:Mobile and Wireless Devices : (8)**
Introduction, Trends in Mobility, Financial Frauds in Mobile and Wireless Computing, Security Challenges Posed by Mobile Devices, structure of Sim card, Sim card forensics, Sim card cloning,
Organizational Measures for Handling Mobile,Mobile Apps and cybercrime, Whats app forward frauds, End point detection systems, End point detection systems in devices in organization



**Unit IV: Methods Used in Cybercrime: (8)**
Introduction, Proxy Servers and Anonymizers,Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow

**Unit V: Digital Forensics- (6)**
Introduction to Digital Forensics, Forensics Software and Hardware, Evaluating computer forensic
tools , Software tools and Hardware Tools, New Trends, Mobile forensics for android, Sample Case studies.

**Unit VI: Cyber Security Tools- (6)**
wireshark, Nmap, Nessus, Ncat, Burp Suite, Snort, Nikto Career Opportunities and trends in Cyber
Security.
Text Books:
1 Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA. ISBN 978-81-265-2179-1
2 Information Security & Cyber Laws By Sarika Gupta, Gaurav Gupta,Khanna Publication ISBN: 978-93-810-6824-3 2019
3 Computer Forensics and Investigations Bill Nelson, Amelia Phillips and Christopher Stuart Cengage learning. ISBN 978-81-315-1946-2

Reference Books:
1 Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group
2 Eoghan Casey,”Digital evidence and computer crime Forensic Science,Computers and the Internet , ELSVIER,2011 ISBN 978-0-12-374268-1

# 20OE 802E Data Analysis and Visualization

**Teaching Scheme**
Lectures**:** 3 Hours / Week

**Examination scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

**Prerequisites:**

1 Basic Mathematics
2 Basics of Python Programming

**Course Objectives:**
To facilitate the learners
1 To understand the data analytics and visualization as well as the statistics behind it.
2 To understand and analyze the machine learning methods used in data analysis
3 To understand the modern tools used for data analytics and visualization.

**Course Outcomes:**
By taking this course, the learner will be able to
1 Develop the knowledge of data analysis and the statistical tools used for analysis
2 Identify the relevant data analysis method for a real time application
3 Select the appropriate data visualization method for the application in hand
4 Understand recent trends in data analysis and visualization

**Unit 1: INTRODUCTION TO DATA ANALYTICS (06)**
Introduction to Data, Data types and their relationships, Data Analytics workflow, Types of analysis Applications.

**Unit 2: BASIC DATA ANALYTICS (08)**
Statistical analysis, Attribute correlation, Regression analysis, Dimensionality reduction, Feature extraction and selection, Time series prediction, Hypothesis Analysis
Case study, Python based examples

**Unit 3: MACHINE LEARNING FOR DATA ANALYTICS (10)**
Data analysis methods used for Clustering, Classification, Regression, Outlier Detection, Time Series Prediction, Anomaly Detection, Association, Recommendation Systems
Case study, Python based examples

**Unit 4: DATA VISUALIZATION (10)**
Purpose and types of Visualization, Graphical Representation, Multidimensional Visualization, Handling data Cleaning, data reduction for visualization, Sorting and Scaling, Multivariate Glyphs
Case study, Python based examples

**Unit 5: RENDS IN DATA ANALYSIS AND VISUALIZATION (08)**

Deep Learning for Data Analysis, handling of small and Big Data,
Storytelling and Data Visualization Dashboards
Case study, Python based examples, Demo with tool like Tableau.

**Text Books:**

1 Dr. Anil Maheshwari, '**Data Analytics'**, McGraw Hill Education (India) Pvt. Ltd. (2017)
2 Dr. Ossama Embarak, **'Data Analysis and Visualization Using Python'**, aPress (2018)

**Reference Books:**

1 Wes McKenny, **'Python for Data Analysis'**, O'Reilly (2013)
2 Han and Kamber, **'Data Mining: Concepts and Techniques'**, The Morgan Kaufmann Series in Data Management Systems (2011)
3 Christopher Bishop, **'Pattern Recognition and Machine Learning'**, Springer (2010)
4 Edited by Chun-houh Chen, Wolfgang Härdle and Antony Unwin, **'Handbook of Data Visualization'**, Springer (2008)

**Web References:**

1 Academic use of Tableau - https://www.tableau.com/academic/teaching
2 NPTEL Courses
   a Introduction to Data Analytics https://nptel.ac.in/courses/110/106/110106064/
   b Data Analytics with Python https://nptel.ac.in/courses/106/107/106107220/
   c Python for Data Science https://nptel.ac.in/courses/106/106/106106212/
   d Introduction to Learning Analytics https://nptel.ac.in/courses/127/101/127101012/
   e Data Analytics with Python https://onlinecourses.nptel.ac.in/noc20_cs46/preview

## 20OE 802F Data Science Using Python

**Teaching Scheme**
Lectures**:** 3 Hours / Week

**Examination scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

**Prerequisites:**

1 Basic Mathematics
2 Basics of Python Programming

**Course Objectives:**
To facilitate the learners
1 To understand the data analytics and visualization as well as the statistics behind it.
2 To understand and analyze the machine learning methods used in data analysis
3 To understand the modern tools used for data analytics and visualization.

**Course Outcomes:**
By taking this course, the learner will be able to
1 Develop the knowledge of data science.
2 Identify the relevant Python method used in data science.
3 Select the appropriate data operation method for the application in hand.
4 Understand recent trends in data science and analysis.

**Unit 1: INTRODUCTION TO DATA (06)**
Introduction to Data, Data types and their relationships, Handling different types of data using Python, Handling numeric and categorical data using Python

**Unit 2: BASIC DATA Processing using NumPy, Pandas (08)**
Statistical operations, data cleaning, missing data, indexing, slicing, iterating, attribute selection, dimensionality reduction, Handling tabular data, time series
Case study, Python based examples

**Unit 3: MACHINE LEARNING using Sci-Kit, Tensorflow - I (08)**
Clustering, Classification, Regression, Outlier Detection
Case study, Python based examples

**Unit 4: MACHINE LEARNING using Sci-Kit, Tensorflow- II (08)**
Time Series Prediction, Anomaly Detection, Association, Recommendation Systems
Case study, Python based examples

**Unit 5: REGRESSION ANALYSIS AND PREDICTIVE ANALYSIS (06)**

Introduction to types of analysis - Predictive, descriptive and decision based, Regression analysis, types - linear, logistic, ridge, lasso

**Unit 6: DATA VISUALIZATION AND GRAPHICS USING Matplotlib / Seaborn (06)**

Basic visualization plots - Area, histogram, bar, Specialized plots - pie, box, scatter, bibble, Waffle, Word clouds, Seaborn, Regression plots
Introduction to Folium, maps with markers, choropleth maps, dashboards

**Text Books:**

1 Aurélien Géron, '**Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems'**, O'Reilly Media (2017)
2 Samir Madhavan, '**Mastering Python for data science'**, Packt (2015)
3 David Beazley, '**Python CookBook**', O'reilly (2013)
4 Dr. Ossama Embarak, **'Data Analysis and Visualization Using Python'**, aPress (2018)

**Reference Books:**

1 Wes McKenny, **'Python for Data Analysis'**, O'Reilly (2013)
2 Han and Kamber, **'Data Mining: Concepts and Techniques'**, The Morgan Kaufmann Series in Data Management Systems (2011)
3 Christopher Bishop, **'Pattern Recognition and Machine Learning'**, Springer (2010)
4 Edited by Chun-houh Chen, Wolfgang Härdle and Antony Unwin, **'Handbook of Data Visualization'**, Springer (2008)

**Web References:**

1 Academic use of Tableau - https://www.tableau.com/academic/teaching
2 NPTEL Courses
   a Python for Data Science https://nptel.ac.in/courses/106/106/106106212/
   b Introduction to Data Analytics https://nptel.ac.in/courses/110/106/110106064/

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

**Autonomous Program Structure of**
**Second Year B. Tech. Third Semester**
**(Information Technology)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Oral | Practical | | |
| 20IT 301 | Data Structures | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 302 | Discrete Mathematics | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IT 303 | Digital Electronics and Computer Architecture | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 304 | Network Fundamentals | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20HS 301 | Universal Human Values - 2 | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 301L | Data Structures Lab | 0 | 0 | 4 | 25 | 0 | 0 | 25 | 50 | 2 |
| 20IT 303L | Digital Electronics and Computer Architecture Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20IT 305L | Object Oriented Analysis and Design Lab | 0 | 0 | 4 | 25 | 0 | 0 | 25 | 50 | 2 |
| 20AC 301 | Audit Course | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | No Credit |
| | **Total** | **14** | **3** | **11** | **325** | **250** | **25** | **50** | **650** | **22** |
| | **Grand Total** | | **28** | | | **650** | | **650** | | |

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# 20IT 301 Data Structures

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures:** 3 hours/week | **In-Semester :** 50 Marks |
| **Tutorial : --** | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Fundamentals of Programming Language

**Course Objectives:**
Familiarize students with
1. Linear & non-linear data structures
2. Iterative & recursive function implementations
3. Symbol table & hashing techniques
4. Algorithm analysis using time & space complexity

**Course Outcomes:**
Students should be able to
1. Apply appropriate programming language constructs to develop logical steps for solving a real world problem.
2. Analyze algorithmic complexities of an algorithm.
3. Select appropriate linear & nonlinear data structure to solve a given problem.
4. Apply different hashing techniques.

**Unit – I Introduction to Data Structures 5 Hours**
Concept of problem solving, Revision: Concept of data types, operators, control structures, functions, arrays and collections.
Introduction to Data Structures: Types of data structures, Abstract Data Types

**Unit – II Introduction to Analysis of Algorithms 7 Hours**
Concept of algorithm, characteristics of algorithms, pseudo code. Analysis of algorithm: frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm, Best, Worst and Average case analysis of algorithm.
Sorting algorithm : Bubble sort, Searching algorithm : Linear search, Binary search

**Unit – III Linked List 7 Hours**
Concept of linked organization, singly linked list, doubly linked list, circular linked list. Linked list as an ADT. Representation and manipulations of polynomials using linked lists, comparison of a sequential and linked memory organization, concept of Generalized Linked List, polynomial representation using GLL.

**Unit – IV Stack & Queue 8 Hours**
Concept of stack, stack as ADT, Implementation of stack using array and linked organization, stack as data structure, use of stack- Recursion, expression conversion & evaluation
Concept of queues as ADT, Implementation using array and linked organization. Priority queue.

**Unit – V Trees** **8 Hours**

Concept of non-linear data structure, Trees and binary trees-concept and terminology. Binary tree as an ADT., Expression tree. Conversion of general tree to binary tree. Recursive and non-recursive algorithms for binary tree traversals, Binary search trees, Threaded binary tree.

**Unit – VI Hash Tables** **7 Hours**

**Symbol Table:** Symbol Table, Huffman's algorithm
**Hash table:** hashing function, collision resolution techniques- linear probing, rehashing, chaining without replacement and chaining with replacement.

**Text Books**

1. R. Gilberg, B. Forouzan, "Data Structures: A pseudo code approach with C", Cenage Learning
2. Cay S. Horstmann, "Big Java: Early Objects", John Wiley

**Reference Books**

1. E. Horowitz, S. Sahani, "Fundamentals of Data Structures", Computer Science Press
2. Alfred Aho, John Hopcroft, Jeffrey Ullman, "Data Structures & Algorithms", Pearson Publication
3. Robert Lafore, "Data Structures and Algorithms in Java", Sams Publication

# 20IT 302 Discrete Mathematics

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** 1 hours/week

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 4

**Prerequisites:** Basic Mathematics
**Course Objectives:**
Familiarize students with
1. Sets and propositions to gain knowledge to formulate and solve problems.
2. The concept of relations and functions.
3. Graph and Tree terminologies and models to be applied in real life problems.
4. The basics of algebraic structures and its applications along with number theory.

**Course Outcomes:**
Students should be able to
1. Analyze logical propositions.
2. Prove mathematical theorems
3. Apply algebraic techniques on discrete mathematics and algorithms
4. Evaluate the combinatorial problems

**Unit I: Sets and Propositional logic** **7 Hours**
Sets: Sets, Combinations of Sets, Venn diagram, Finite and Infinite Sets, Countable Sets, Multisets, Principle of Inclusion and Exclusion, Mathematical Induction.
Propositions: Propositions, Logical Connectives, Conditional and Bi-conditional Propositions, Logical Equivalence, Validity of Arguments by using Truth Tables, Predicates and Quantifiers, Normal forms. Applications of Sets and Propositions

**Unit II: Relations and Functions** **7 Hours**
Relations: Relations and their properties, n-ary relations and their applications, representing relations, closures of relations, equivalence relations, partial orderings, Lattices, Chains and AntiChains.
Functions: Functions: Functions, Composition of Functions, Invertible Functions, and Pigeonhole Principle.

**Unit III: Graphs** **7 Hours**
Graphs and Graph Models, Graph Terminology and Special Types of graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.

**Unit IV: Trees** **7 Hours**
Introduction to Trees, Applications of Trees: Introduction, Binary search trees, Prefix codes, Tree Traversal: Preorder, in-order and post-order traversals, Minimum Spanning Trees: Introduction, Prim's algorithm, Kruskal's algorithm.

**Unit V: Groups and Rings** **7 Hours**

Group Theory: Groups, subgroups, generators and evaluation of powers, cosets and lagrange's theorem, permutation groups and burnside's theorem, isomorphism and automorphisms, homomorphisms and normal subgroups, rings, integral, domain and fields.

**Unit VI: Counting** **7 Hours**

Combinatorics: Rules of Sum and Product, Permutations, Combinations. Discrete Probability: Discrete Probability, Conditional Probability, Bayes Theorem, Information and Mutual Information, Applications of Combinatorics and Discrete Probability.

**Text Books:**

1. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", 4th Edition, McGraw-Hill
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", & 7th edition, McGraw-Hill

**Reference Books:**

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete mathematical structures", 6th edition, Prentice Hall of India
2. Edgar G. Goodaire, Michael M. Parmenter, "Discrete Mathematics with Graph Theory", 3rd Edition, Pearson Education
3. Tremblay J. S., "Discrete mathematical structures with application", 3rdEdition, Tata McGraw Hill 4. Lipschutz Seymour, "Discrete mathematics", 4th Edition, Tata McGraw-Hill

# 20IT 303 Digital Electronics and Computer Architecture

**Teaching Scheme:**
**Lectures:** 3 hours/week

**Examination Scheme:**
**In-Semester**: 50 marks
**End-Semester**: 50 marks
**Credits:** 3

**Prerequisites:** Basic Electrical and Electronics Engineering
**Course Objectives:**
Familiarize students with
1. Basic digital design techniques
2. Design and implement of combinational and sequential logic circuits
3. Fundamental working of Computer Systems
4. Architecture and features of a microprocessor

**Course Outcomes:**
Students should be able to
1. Comprehend basic binary arithmetic and codes
2. Design simple combinational logic circuits using reduction techniques
3. Design simple Sequential logic circuits
4. Explain Architectural details of a microprocessor
5. Explain Memory management and Interrupts of a microprocessor

**Unit – I: Number System** **7 Hours**

Introduction to Boolean algebra and Number Systems. Signed Binary number representation and Arithmetic: Signed & True Magnitude, 1's complement, 2's complement representation and arithmetic.

Codes: BCD, Excess-3, Gray code, Binary Code and their conversion.

Logic minimization: Representation of truth-table, Simplification of logical functions, Minimization of SOP and POS forms, don't care Conditions, K-Maps.

**7 Hours**
**Unit – II: Combinational Logic Design**
CLC design using SSI chips – Code converters, Adder, Subtractor, n bit Binary adder, Introduction to MSI functions & chips - Multiplexers, Decoder / Demultiplexer, Encoder, Binary adder.

CLC design using MSI chips – BCD & Excess 3 Adder and Subtractor

**Unit – III: Sequential Logic Design** **7 Hours**

Introduction to sequential circuits. Difference between combinational circuits and sequential circuits, memory element – latch.

Flip- Flops: Design, truth table, excitation table of SR, JK, D, T flip flops. Study of flip flops with asynchronous and synchronous Preset & Clear, conversion from one type to another type of flip flop.

Application of flip-flops – Counters- asynchronous, synchronous and modulo counters. Study of modulus n counter ICs & their applications to implement mod counters.

**Unit – IV: Sequential Logic Design** **7 Hours**

Registers- Buffer register, shift register types - SISO, SIPO, PISO & PIPO, applications of shift registers - ring counter, twisted ring counter, Sequence generators using counters & shift register, Sequence Detectors using Mealy and Moore model

**Unit – V: Processor Architecture** **7 Hours**

Introduction to 8086: internal Architecture, generation of physical address, minimum/maximum mode, study of 8086 supporting chips 8288(Latch), 8284(Clock Generator), 8286(trans receiver), 8288(Bus controller), Timing diagram read Write machine cycle.

**Unit – VI: Assembly Language Programming and Interrupt Structure** **7 Hours**

Introduction to assembly language programming- Instruction Descriptions, Assembler Directives addressing modes, Examples of programming, Procedures and Macros. Interrupt Structure, Interrupt service routine, Interrupt vector table, hardware and software interrupts, INTR, NMI, Interrupt response, Execution of ISR, Priorities of interrupt

**Text Books:**

1. R.P. Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, ISBN: 0–07–049492–4
2. Douglas Hall, "Microprocessors and Interfacing, Programming and Hardware", McGraw-Hill, ISBN: 0–07–100462–9Book 2

**Reference Books:**

1. Malvino Leach, "Digital Principles and Applications", Tata Mc-Graw Hill, ($5^{th}$ Edition)
2. 8086 Intel Manual

**Web References:**

1. NPTEL Series: Digital Systems Design, Prof. Roychoudhary, IIT Kharagpur
2. NPTEL NOC:Microprocessors and Microcontroller, Prof. Santanu Chattopadhyay, IIT Kharagpur
3. NPTEL NOC:Microprocessors and Interfacing, Prof. Shaik Rafi Ahamed, IIT Guwahati

# 20IT 304 Network Fundamentals

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures:** 3 hours/week | **In-Semester :** 50 Marks |
| **Tutorial :** 1 | **End-Semester :** 50 Marks |
| | **Credit :** 4 |

**Prerequisites:** NA

**Course Objectives:**
Familiarize students with
1. OSI and TCP/IP models
2. Various media access schemes
3. Error detection and control mechanisms
4. IP addressing

**Course Outcomes:**
Students should be able to
1. Differentiate between OSI and TCP/IP models
2. Analyze the different types of network delays in packet-switched networks
3. Differentiate between data link layer services and multiple access techniques.
4. Design the IP addressing scheme for a small network.

**Unit – I Introduction 7 Hours**
The Architecture of the Internet, Layering and encapsulation, LAN, WAN, MAN, Networking Devices, Network Topologies Point to Point, Point to Multipoint Topologies.

**Unit – II Communicating over the Network 7 Hours**
The platform for communications, Protocols, OSI Model, TCP/IP Model, Protocol Data Units and Encapsulation, Comparison between OSI and TCP/IP Model, Network Addressing.

**Unit – III Network Layer 7 Hours**
IP Addressing, Network Layer Protocol, IPv4, Subnetting, Static Routing, Dynamic Routing and IPv6

**Unit – IV Ethernet 7 Hours**
Transmission media (Guided and Unguided), Performance (Bandwidth, Throughput, latency and BDP), Digital Modulation and Multiplexing.

**Unit – V Physical layer 7 Hours**
The Role of Physical Layer, Theoretical Basis for data communication, Digital Modulation and Multiplexing, The Public Switched Telephone Network and Cable Television, Internet over Cable

**Unit – VI Data Link Layer 7 Hours**
Data Link Layer Design Issues, Sliding Window Protocol, Error Correction and Detection, Medium Access Control Sublayer, Carrier Sense Multiple Access Protocols.

**Text Books**

1. Mark A. Dye, Rick McDonald, Antoon W. Rufi, 'Network Fundamentals, Cisco Press (2008)
2. Behrouz Forozoun , 'Data Communications and networking' McGraw Hill Education (5E)

**Reference Books**

1. Andrew S. Tannenbaum, David J. Weatherall 'Computer Networks', Pearson (5thedition), (2011)
2. Jim Kurose, Keith Ross "Computer Networking: A Top Down Approach " Pearson (7th edition) (2016)

# 20IT 301L Data Structures Laboratory

**Teaching Scheme:**
**Practical :** 4 hours/week

**Examination Scheme:**
**In-Semester :** 25 Marks
**Practical :** 25 Marks
**Credit :** 2

**Prerequisites:** Fundamentals of Programming Language
**Course Objectives:**
Familiarize students with
1. Linear data structures to solve real world problems
2. Non-Linear data structures to solve real world problems
3. Hashing techniques
4. Debugging of different codes & detect logical errors

**Course Outcomes:**
Students should be able to
1. Make use of linear data structures to solve a given problem
2. Make use of nonlinear data structures to solve a given problem
3. Utilize appropriate hashing techniques to solve a given problem
4. Test the program for multiple inputs

**Suggested List of Laboratory Assignments**
The laboratory assignments are designed in a set of group A, B and C such that students will be able to design and implement solution for a given problem. The laboratory assignments of group A, B and C are to be implemented using JAVA object-oriented programming language. Group A assignments are mandatory. Group B assignment is mandatory & may be performed in a group of 2 to 4 students. Group C assignments are extra assignments.

**Group A**
1. Operations on set
   a) Use Java Collection Framework - Set - addAll (union), retainAll(intersection), removeAll(symmetric difference)
   b) Without using Java Collection Framework - union, intersection, difference, symmetric difference

2. Operations on linked list
   a) Use Java Collection Framework - LinkedList - add, add(index, element), addFirst, addLast, clear, get, getFirst, getLast, remove, removeFirst, removeLast
   b) SLL - Without using Java Collection Framework - add, add(index, element), addFirst, addLast, clear, get, getFirst, getLast, remove, removeFirst, removeLast, reverse
   c) DLL - Without using Java Collection Framework - add, add(index, element), addFirst, addLast, clear, get, getFirst, getLast, remove, removeFirst, removeLast, reverse

3. Operation on stack
   a) Use Java Collection Framework - Stack - push, pop, peek, empty
   b) Without using Java Collection Framework - Stack - push, pop, peek, empty - implement stack as ADT
   c) Using the stack ADT - implement expression conversion algorithms - infix_to_postfix,

infix_to_prefix, postfix_to_infix, prefix_to_infix

4. Operations on queue
   a) Use Java Collection Framework - LinkedList - add, remove, poll, peek, element
   b) Use Java Collection Framework - PriorityQueue - add, remove, poll, peek, element
   c) Without using Java Collection Framework - add, remove, peek - implement queue as ADT
   d) Using the queue ADT - implement priority queue - patient treatment, vehicle traffic management

5. Operations on binary search tree
   a) Use Java Collection Framework - TreeMap
   b) Implement binary search tree and perform the following operations - Insert, Delete, Search, Display, mirror image, display level-wise

6. Construct an expression tree from a postfix expression and perform recursive and non-recursive traversals – inorder, preorder and postorder

7. Operation on hash table
   a) Use Java Collection Framework - HashMap
   b) Implementation of Hash table using array and handle collisions using Linear probing, without replacement without chaining, without replacement with chaining, with replacement without chaining, with replacement with chaining, chaining using linked list

**Group B (Any 1)**

Design a mini project which uses the different data structures with or without Java Collection Framework. Few suggested assignments:

1. Library management system
2. Blood bank management system
3. Student Attendance management system

**Group C (Extra)**

1. Implement Huffman coding
2. Implement Heap sort
3. Implement optimal binary search tree
4. Implement threaded binary tree

**Text Books**

1. R. Gilberg, B. Forouzan, "Data Structures: A pseudocode approach with C", Cenage Learning
2. Cay S. Horstmann, "Big Java: Early Objects", John Wiley

**Reference Books**

1. E. Horowitz, S. Sahani, "Fundamentals of Data Structures", Computer Science Press
2. Robert Lafore, "Data Structures and Algorithms in Java", Sams Publication
3. William J. Collins , "Data Structures and the Java Collections Framework", John Wiley

## 20IT 303L Digital Electronics and Computer Architecture Laboratory

**Teaching Scheme**:
**Practical**: 2 hours/week

**Examination Scheme**:
**In-Semester**: 25 marks
**Oral**: 25 marks
**Credits:** 1

**Prerequisites:** Basic Electrical and Electronics Engineering
**Course Objectives:**
Familiarize students with
1. Basic digital Integrated Circuits (IC)
2. Analyze and Test basic digital circuits
3. Writing Assembly Language Program
4. Executing Assembly Language Program

**Course Outcomes:**
Students should be able to
1. Use appropriate IC's for designing simple digital circuits
2. Implement and test simple digital circuits for various inputs.
3. Use the processor instructions to write basic assembly language programs
4. Apply modular programming using assembly level language

**Suggested List of Laboratory Assignments**
1. Design (truth table, K-map) and implementation of 4 bit BCD & Excess 3 Adder using IC7483.
2. Implementation of logic functions using multiplexer IC 74153 & decoder IC 74138. (Verification, cascading & logic function implementation)
3. Design (State diagram, state table & K map) and implementation of 3 bit Up and Down synchronous Counter using master slave JK flip-flop IC 7476
4. Design and implementation of Mod 'n' counter with IC7490
5. Design (State Diagram, State Table, K Map) and implementation of Sequence Generator.
6. Write Assembly Language Program for addition and subtraction of two 8 bit numbers
7. Write Assembly Language Program for converting two digit BCD number to its equivalent HEX and vice- versa.
8. Write ALP to perform string operations like
    1. Find length of string
    2. Compare two strings
    3. Concatenation of two strings
    4. Reverse string

**Text Books:**
1. R.P. Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, ISBN: 0–07–049492–4
2. Douglas Hall, "Microprocessors and Interfacing, Programming and Hardware", McGraw-Hill, ISBN: 0–07–100462–9Book 2

**Reference Books:**

1. Malvino Leach, "Digital Principles and Applications", Tata Mc-Graw Hill,(5th Edition)
2. 8086 Intel Manual

**Web References:**

1. NPTEL Series: Digital Systems Design, Prof. Roychoudhary, IIT Kharagpur
2. NPTEL NOC:Microprocessors and Microcontroller, Prof. Santanu Chattopadhyay, IIT Kharagpur
3. NPTEL NOC:Microprocessors and Interfacing, Prof. Shaik Rafi Ahamed, IIT Guwahati

# 20IT 305L Object Oriented Analysis and Design Laboratory

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Practical:** 4 hours/week | **In-Semester: --** 25 Marks |
| | **Practical:** 25 Marks |
| | **Credits:** 2 |

**Prerequisites: Fundamentals of Programming Language 2**

**Course Objectives:**

Familiarize students with

1. Introduction of UML 2.0 diagrams
2. Class modeling of a system
3. State modeling of a system
4. Interaction modeling of a system

**Course Outcomes:**

Students should be able to

1. Construct class model from a given description of the system
2. Organize the class model in the form of class relationships
3. Build a state model from a given description of the system
4. Develop the code for the state model in an object oriented language
5. Interpret the given problem description as UML diagrams

**Implement a mini project using the following steps as guidelines**

1. Identify the classes, their attributes and methods for a given system
2. Convert the identified classes in the system to java code.
3. Identify the relationships among the classes, represent those relationships in a class diagram and code the class diagram into a java code
4. Inspect all the classes and identify whether an object of a class changes its state during its lifecycle, draw the state transition using the state diagram for that object
5. Convert the state transitions into java code
6. Inspect the methods of all the classes and show sequence of method calls to achieve a functionality in a sequence diagram
7. Convert the sequence diagram into a java code
8. Save the persistent data into a file and refine your code

**Text Books**

1. Michael Blaha, James Rumbaugh Object oriented modeling and Design with UML second edition, Pearson

**Reference Books**

1. Grady Booch, Object Oriented Analysis and Design with applications third edition, Adison Wesley Object Technology Series

**Autonomous Program Structure of**
**Second Year B. Tech. Fourth Semester**
**(Information Technology)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours/ Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Oral | Practical | | |
| BSIT 401 | Calculus and Statistics | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IT 401 | Computer Network | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 402 | Operating Systems | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT403 | Database Management System | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 404 | Human Computer Interaction | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IT 401L | Computer Network Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IT 402L | Operating Systems Lab | 0 | 0 | 4 | 25 | 0 | 0 | 25 | 50 | 2 |
| 20IT 403L | Database Management System Lab | 0 | 0 | 4 | 25 | 0 | 25 | 0 | 50 | 2 |
| 20AC 401 | Audit Course | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | No Credit |
| | **Total** | **15** | **2** | **12** | **325** | **250** | **25** | **50** | **650** | **22** |
| | **Grand Total** | **29** | | | **650** | | | | | |

**APPROVED BY**
**Secretary Governing Body**
MKSSS's Cummins College of Engineering
For Women, Pune-411052

Karvenagar, Pune-411052

APPROVED BY
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MKSSS's Cummins College of Engineering
For Women, Pune-411052

# BSIT 401 Calculus and Statistics

**Teaching Scheme:**
**Lectures :** 3 hours/week
**Tutorial :** 1 hours/week

**Examination Scheme:**
**In-Semester : **50 Marks
**End-Semester :** 50 Marks
**Credit :** 4

**Prerequisites:** Permutation and Combination, Complex numbers - Properties, Argand Diagram, Basic properties of integration, Partial Fractions, Basic properties of integration, Beta and Gamma Functions, First order linear ordinary differential equations.

**Course Objectives:**
Mathematics is a necessary path to scientific knowledge which opens new perspective of mental activity. Our aim is to provide sound knowledge of Engineering Mathematics to make the students think mathematically and strengthen their thinking power to analyze and solve engineering problems in their respective areas.

**Course Outcomes:**
Students should be able to
1. Apply concepts of descriptive and inferential Statistics to interpret the data.
2. Calculate probabilities of random events using probability distributions.
3. Apply basic concepts of complex analysis to differentiate and integrate functions of complex variables.
4. Obtain Fourier transform and Z transform of simple functions and discrete sequences.
5. Obtain the solution of higher order Linear Differential Equations, simple electrical circuits.

**Unit – I Statistics 7 Hours**

Measures of central tendency, Standard deviation, Coefficient of Variation, Moments, Skewness & Kurtosis, Testing a statistical hypothesis, Type-I and Type-II error

**Unit – II Probability Distributions 8 Hours**

Random Variables – Discrete & continuous, Mathematical expectations, Probability density functions, Standard Distributions – Binomial, Poisson, Normal, Lognormal.

**Unit – III Complex Analysis 8 Hours**

Functions of Complex variables, Analytic Functions, Cauchy Riemann-Equations, Cauchy's Integral Theorem, Cauchy's Integral Formula, Laurent's series, Residue theorem, Conformal mapping, Bilinear Transformation

**Unit – IV Z-Transforms 5 Hours**

Definition, standard properties, Z- Transform of standard sequences and their inverses, solution of difference equation

**Unit – V Fourier Transforms 6 Hours**

Complex exponential form of Fourier series, Fourier integral theorem, sine and cosine integrals, Fourier transform, Fourier Sine and Cosine transform and their inverses

**Unit – VI Higher Order Linear Differential equation and application 8 Hours**

Higher order Linear differential equation with constant coefficients, Method of Variation of parameters, Cauchy's and Legendre's DE, Simultaneous DE, Modelling of electrical circuits.

**Text Books**

1. B.S. Grewal, 'Higher engineering Mathematics', Khanna publishers, Delhi (40th edition),(2008)
2. B. V. Ramana, 'Higher Engineering Mathematics', Tata McGraw Hill Publications (2007)
3. S.C. Gupta, V. K. Kapoor, 'Fundamental of Mathematical Statistics' , S. Chand & Sons (10th revised edition). 2002

**Reference Books**

1. Peter V. O'neil,'Advanced Engineering Mathematics', Thomson Brooks / Cole, Singapore (5th edition) (2007).
2. Erwin Kreyszig,'Advanced Engineering Mathematics' Wiley Eastern Ltd.(8th Student Edition), (2004).
3. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi.(6th edition)(2003)

# 20IT 401 Computer Networks

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures:** 3 hours/week | **In-Semester:** 50 Marks |
| **Tutorial:** -- | **End-Semester:**50 Marks |
| | **Credits:** 3 |

**Prerequisite:** Network Fundamentals
**Course Objectives:**
Familiarize students with
1. Routing at the network layer.
2. TCP and UDP key functions at transport layer.
3. Congestion control, fairness and stability of the Internet.
4. Wireless Technologies.

**Course Outcomes:**
Students will be able to
1. Analyze with different routing protocols.
2. Analyze the usage of various protocols at transport layer
3. Recognize usage of various protocols at application layer
4. Design a LAN with a switch and router.

**Unit – I: Internetworking** **7 Hours**

Internetworking Basics, OSI Model, Data Encapsulation, Introduction to TCP/IP, the process/Application layer Protocols, The Host-to Host Layer Protocols. The Internet Layer Protocols, Internet Protocol.

**Unit – II: Introduction to Routing and Packet Forwarding** **7 Hours**

Inside the Router, CPU, NVRAM, Router Interfaces, Routers and the Network Layer, Command Line Interface Configuration and Addressing, Basic Router Configuration, Building the Routing Table, IP Routing, Path Determination and Switching Functions Protocols.

**Unit – III: IP Routing** **7 Hours**

Routing Basics, Distance vector routing Protocols, Link state routing protocols. Routing Information protocol, Enhanced Interior Gateway Routing Protocol, Open Shortest Path First. Virtual Local area Networks, Network address translation.

**Unit – IV: Transport Layer** **7 Hours**

Transport layer duties and functionalities, application expectations and IP delivery semantics.
**UDP**: UDP functionality, UDP Header.
**TCP**: TCP Features, byte-stream, Connection-oriented, TCP Header Format, 2-way, 3-way Handshake, TCP State Diagram, TCP Sliding Window, Congestion Control Algorithms: Leaky Bucket, Token Bucket, Congestion Avoidance. UNIX Sockets, M/M/1 queue analysis.

**Unit – V: Application Layer** **7 Hours**

Client/Server Model, Telnet, Domain Name System, File Transfer protocol: FTP, TFTP, HyperText Transfer Protocol, POP3, IMAP, SMTP, E-mail, MIME, Simple Network Management Protocol.

**Unit – VI: Wireless Technologies** **7 Hours**

Introduction to wireless internetwork, IEEE 802.11, Cellular Technology, WLAN, Internet of Things, Bring Your Own Device. Introduction to android OS.

**Text Books:**

1. Andrew S. Tennabaum, David J. Weatherall Computer Networks‟**,** Pearson (5th edition), (2011)
2. Behrouz Forouzan ,‟TCP/IP Protocol Suite‟, Mc-Graw Hill, (4th Edition) (2010)

**Reference Books:**

1. Theodore S. Rappaport, “Wireless Communications**”,** Prentice Hall (2nd Edition) (2002)
2. Rick Graziani, Allan Johnson, Routing Protocols and Concepts **,** Cisco Press (2011)

# 20IT 402 Operating Systems

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** --

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Data Structures
**Course Objectives:**
Familiarize students with
1. Basic functions and concepts of operating systems.
2. Mechanisms to handle processes and threads.
3. Principles of concurrency and deadlock.
4. Systems Programming Concepts

**Course Outcomes:**
Students should be able to
1. Explain concepts of operating system and basic shell scripting.
2. Apply concepts of memory management and file management techniques to solve different Operating Systems problems.
3. Apply appropriate process management and Inter Process Communication techniques to resolve various problems.
4. Explain basic concepts of Systems Programming.

**Unit – I Introduction to Operating Systems** **7 Hours**
Evolution of Operating Systems, Operating Systems Overview, OS structure, Functions of an OS: Program management, resource management, Protection and Security, PC Hardware and Booting, Shell Scripting, AWK, Sed

**Unit – II Memory Management** **7 Hours**
Logical Versus Physical Address Space, Swapping, Contiguous memory allocation, Non-contiguous memory allocation, Internal and external fragmentation, Segmentation, Paging, Structure of the Page Table
Virtual Memory: Demand paging, Prepaging, Thrashing, Page replacement algorithms, Translation look-aside buffer (TLB)

**Unit – III Process Management** **7 Hours**
Process concept, forking and exec, zombies, orphans, demons, context switching, wait, exit system calls, Scheduling: threads and scheduling algorithms, scheduling algorithms (FCFS, SJF, SRTF, Round robin, multilevel queues, feedback queues)
Linux schedulers – CFS

**Unit – IV Inter Process Communication and Synchronization** **7 Hours**
IPC, Critical Section, Race Condition, context switching, process related system calls, Critical Sections, Peterson's Solution, Bakery Algorithm, Test & Set, Spinlocks, Mutex, semaphores, producer consumer, dining philosophers. Deadlocks: Ostrich algorithm, banker's algorithm, deadlock prevention, deadlock detection and recovery

**Unit – V Input/output and File Management** **7 Hours**

I/O Devices, Organization of the I/O Function, polling, Disk structure, Disk scheduling and Disk management, files, protection, access methods, directory and disk structure, File-system mounting, File-system structure and File-system implementation, allocation methods

**Unit – VI System Software and its importance** **7 Hours**

Need of System Software, Assemblers: Pass structure of Assemblers, Macro Processor: Macro. Definition and call, Macro Expansion. Loaders: Loader Schemes, Compile and Go, General Loader Scheme, Subroutine Linkages, Relocation and linking

**Text Books**

1. Abraham Silberschatz, Pert B. Galvin, and Greg Gagne, "Operating System Concepts", 9th edition, by Wiley-India edition
2. "Modern Operating Systems", 4th edition, by Andrew S. Tanenbaum, PHI Learning Private limited, New Delhi

**Reference Books:**

1. "Operating Systems: Internals and Design Principles", 8th edition, William Stallings, Pearson Education Limited.
2. "The Design of the UNIX Operating System", Maurice J. Bach, Pearson.
3. "UNIX, concepts and applications", 4th edition, Sumitabha Das, Tata McGraw-Hill Education.
4. "Operating Systems Security", Trent Jaeger, Morgan and Claypool Publishers.
5. "Linux System Programming", 2nd Edition, Robert Love, O"Reilly
6. "Systems Programming and Operating Systems", 2nd Edition, D. M. Dhamdhere, Tata McGraw Hill.
7. "Systems Programming", Indian Edition, J. J. Donovan, McGraw-Hill

# 20IT 403 Database Management Systems

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** -

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Data structures

**Course Objectives:**
Familiarize students with
1. Concepts and applications of database management.
2. Different models and normalization used for database design.
3. Query languages in databases.
4. Basic issues of database design and utilization.

**Course Outcomes:**
Students should be able to
1. Build appropriate database schema for the given application.
2. Apply normalization to database design.
3. Make use of query commands and concurrency control protocols.
4. Analyze business decisions related to Database information systems.

**Unit – I: Introduction to DBMS** **7 Hours**
Database Concepts, Database System Architecture, Data Models, entity, attributes, relationships, constraints, keys, E-R Model, conventions, EER Model, converting ER/EER diagram into tables. Relational Model, Attributes and Domains, Referential Integrities. Relational Algebra: Basic Operations

**Unit – II: Relational Algebra and Calculus** **7 Hours**
Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison

**Unit – III: Database Design and SQL** **7 Hours**
Database Design, Functional Dependency, Purpose of Normalization, Data Redundancy, Anomalies. Normal forms 1NF, 2NF, 3NF, BCNF, 4NF and 5NF. Introduction to SQL, SQL Data Types, DDL, DML and DCL queries, Views, Indexes, Null handling, Nested Queries. PLSQL. Query optimization

**Unit – IV: Database Transactions** **7 Hours**
Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability, Conflict and View, Cascaded Aborts, Recoverable and Non recoverable Schedules.

**Unit – V: Advanced Database Architectures and Concurrency Control** **7 Hours**
Database Architectures, Centralized and Client-Server Architectures, 2 Tier and 3 Tier Architecture, Indexing and hashing, Parallel Databases, and Distributed Databases. Concurrency Control, Locking Methods, Deadlocks, Protocols, Recovery Methods

**Unit – VI: Data Warehousing and Data Mining** **7 Hours**

Data Warehousing, Architecture and features of Data Warehouse, ETL Process, OLAP. Data Mining, Knowledge Discovery, Data Mining techniques, Applications of data mining.

**Text Books:**

1. Silberschatz A., Korth H., Sudarshan S, Database System Concepts, McGraw Hill Publication, ISBN- 0-07-120413-X, Sixth Edition.
2. Ramez Elmasri, Shamkant B. Navathe**,** Fundamentals of Database Systems, Pearson Publication, ISBN-13: 978-0-136-08620-8

**Reference Books:**

1. S. K. Singh, Database Systems: Concepts, Design and Application, Pearson Publication, ISBN-978-81- 317-6092-5.
2. C J Date, An introduction to Database Systems, Addition-Wesley.
3. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill, 3rd Edition, 2003.
4. Reema Thareja, Data warehousing, Oxford University Press. ISBN 0195699610.

# 20IT 404 Human Computer Interaction

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** 1 hours/week

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 4

**Prerequisites:** Object Oriented Technology.
**Course Objectives:**
Familiarize students with
1. Basic field of human-computer-interaction study
2. The concept of User centric approach.
3. Applications of human-computer-interaction to real life use cases.
4. Design of effective human-computer-interactions.

**Course Outcomes:**
Students should be able to
1. Identify the importance of HCI study and principles of User-Centered Design (UCD) approach.
2. Apply interaction design guidelines to a given application.
3. Analyze user interfaces for suggesting improvements.
4. Design prototypes for effective user-interfaces.

**Unit – I Introduction 7 Hours**
What is HCI? A discipline involved in HCI, Why is HCI study important? The psychology of everyday things, Principles of HCI, User-centered Design and Conceptual Models, Usability, Examples of good and bad HCI.

**Unit – II Users and the Interaction 7 Hours**
Human perception and memory, Thinking: Reasoning and Problem Solving, Human emotions and Psychology, Individual differences, Stages of action, Models of interaction, Ergonomics, Interaction styles, WIMP Interface, Interactivity, Context of interaction, Paradigms of Interactions.

**Unit –III HCI Models 7 Hours**
Cognitive models: GOMS Model, Hierarchical task analysis (HTA) model, Linguistic model, Physical and device models, Communication and collaboration models, Knowledge-based analysis.

**Unit –IV HCI - Design Rules, Guidelines And Evaluation Techniques 7 Hours**
Principles that support usability, Design standards, Design Guidelines, Golden rules, Using toolkits, User interface management System (UIMS), Goals of evaluation, Evaluation Criteria, Evaluation through expert analysis, Heuristics Evaluation through user participation, Choosing an Evaluation Method.

**Unit – V HCI - Design Process 7 Hours**

The process of design, Goal Directed Design Process, User focus, Scenarios, Navigation Design, Screen Design and Layout, Prototyping techniques, Wire-Framing, Model-View-Controller (MVC) Framework, Visual Interface Design.

**Unit – VI Design of Applications 7 Hours**

Multi-modal interaction, Website designing, Navigation design for websites, Evaluating a website, Designing for Mobiles, Evaluation for mobile computing, Socio-organizational issues and stakeholder requirements, Ubiquitous Computing with a case study like smart home.

**Text Books**

1. David Benyon "Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design", Pearson Education Limited, Third Edition.
2. Alan Dix, "Human Computer Interaction", Pearson Education. ISBN 978-81-317-1703-5.

**Reference Books**

1. Ben Shneiderman; Catherine Plaisant; Maxine Cohen; Steven Jacobs, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Pearson Education Limited, ISBN 978-1-292-03701-1.
2. Donald A. Norman, "The Design of Everyday Things Basic Books", ISBN 978-0-465-07299-6.
3. Jeff Johnson, "Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines" Elsevier. ISBN 978-0-12-411556-9.
4. Alan Cooper, Robert Reimann, and Dave Cronin, " About Face 3: The Essentials of Interaction Design", Wiley Publishing, Inc.
5. Gerard Jounghyun Kim, "Human–Computer Interaction: Fundamentals and Practice" CRC Press. ISBN 978-1-4822-3390-2.
6. Helen Sharp, Jenny Preece, and Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction".

# 20IT 401L Computer Network Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In Semester :** 25 marks
**Practical :** 25 marks
**Credit :** 1

**Prerequisites:** Network Fundamentals.

**Course Objectives:**
Familiarize students with
1. Routing at the network layer and VLANS.
2. TCP and UDP key functions at transport layer.
3. Congestion control, fairness and stability of the Internet.
4. Wireless Technologies.

**Course Outcomes:**
Students will be able to
1. Configure router with different routing protocols (static and dynamic).
2. Implement a LAN with a switch and router.
3. Implement a VLAN.
4. Build a network.

**Group A: Suggested List of Laboratory Assignments (any 5)**
1. Build a small network and verify connectivity.
    a. Configure router.
    b. Configure Switch
2. Install Wireshark and view live network traffic with different filters.
3. Configure VLANs and Trunking
4. Configure DHCPv4
5. Socket program
6. Implement a wireless network.

**Group B: Implement a mini project on any one of the following topics**
1. Implement router-on-a-stick inter VLAN routing
2. Implement Ether channel
3. Implement DHCPv6 or IPv6 on a small network
4. Implement switch security configurations in VLANS.
5. Configure network devices with SSH.
6. Evaluate QoS of a network using NS2 simulation

**Text Books**
1. Rick Graziani, Allan Johnson, Routing Protocols and Concepts, Cisco Press (2011)

**Reference Books**

1. Andrew S. Tennabaum, David J. Weatherall, "Computer Networks", Pearson (5th edition), (2011)
2. Behrouz Forouzan , "TCP/IP Protocol Suite", Mc-Graw Hill, (4th Edition) (2010)

# 20IT 402L Operating Systems Laboratory

**Teaching Scheme:**
**Practical:** 4 hours/week

**Examination Scheme:**
**In-Semester:** 25 marks
**Practical:** 25 marks
**Credits:** 2

**Prerequisites:** Data Structures
**Course Objectives:**
Familiarize students with
1. Shell scripting and its importance.
2. Concepts of processes and threads.
3. Concurrency, Synchronization and deadlocks.
4. Basics of Unix commands.

**Course Outcomes:**
Students should be able to
1. Implement shell program.
2. Implement synchronized processes using multithreading concepts.
3. Apply the concept of deadlock in operating systems in implementation of multiprocessing environment.
4. Design solutions using IPC and synchronization.

**Suggested List of Laboratory Assignments**
1. Create two virtual machines using Type-2 hypervisor to understand basic virtualization concept.
2. Shell programming.
3. Write C programs to simulate UNIX commands like ls, grep, etc.
4. Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir
5. Write a C program to implement multithreading.
6. Implement producer-consumer problem using semaphores.
7. Write a C program to simulate the concept of Deadlock using Dining-Philosophers/ Banker's algorithm.
8. Write a C program to implement Inter Process Communication (shared memory or pipes or message queues).

**Reference Books:**
1. Neil Matthew, Richard Stones,"Beginning Linux Programming", 4th Edition, by Wrox Publication
2. Sumitabha Das, "UNIX, concepts and applications", 4th Edition, Tata McGraw-Hill Education
3. Robert Love, "Linux System Programming", 2nd Edition, O"Reilly
4. Robert Love, "Linux Kernel Development", 3rd Edition, Pearson
5. Abraham Silberschatz, Pert B. Galvin, and Greg Gagne, "Operating System Concepts", 9th edition, Wiley-India edition
6. Andrew S. Tanenbaum, "Modern Operating Systems", 4th edition, PHI Learning Private Limited, New Delhi
7. William Stallings, "Operating Systems: Internals and Design Principles", 8th edition, Pearson Education Limited

**Other Resources:**

1. https://www.vmware.com/support/ace/doc/setpol_vmconfig_ace.html
2. https://www.virtualbox.org/manual/ch01.html
3. https://homepages.uc.edu/~thomam/Intro_Unix_Text/Shell_Prog.html

# 20IT 403L Database Management Systems Laboratory

**Teaching Scheme:**
**Laboratory:** 4 hours/week

**Examination Scheme:**
**In-Semester:** 25 marks
**Oral:** 25 marks
**Credits:** 2

**Prerequisites:** Data structures
**Course Objectives:**
Familiarize students with
1. Implementation of fundamental concepts of database management
2. Use of database management systems.
3. SQL database system and PL/SQL
4. Accessing database using web application..

**Course Outcomes:**
Students should be able to
1. Make use of database language commands to create a database
2. Manipulate information using sql queries to retrieve useful information.
3. Apply PL/SQL for processing database
4. Use front end tools to design forms, reports and menus

**Group A: Introduction to Databases (Study assignment)**
1. Study of MySQL Open source software.
2. Discuss the characteristics like efficiency, scalability, performance and transactional properties
3. Install and configure client and server of MySQL.(Show all commands and necessary steps for installation and configuration)
4. Study of SQLite: What is SQLite? Uses of SQLite. Building and installing SQLite

**Group B: SQL and PL/SQL (Minimum 6)**
1. Design any database with at least 3 entities and relationships between them. Apply DCL and DDL commands. Draw suitable ER/EER diagrams for the system.
2. Execute DDL statements which demonstrate the use of views. Try to update the base table using its corresponding view. Also consider restrictions on updatable views and perform view creation from multiple tables.
3. Design and implement a database and apply at least 10 different DML queries for the following task. For a given input string display only those records which match the given pattern or a phrase in the search string.
4. Execute the aggregate functions like count, sum, avg etc. on the suitable database. Use group by and having clauses. Retrieve the data from the database based on time and date functions.
5. Implement nested sub queries. Perform a test for set membership (in, not in), set comparison (=some, >=some, <all etc.) and set cardinality (unique, not unique).
6. Write and execute suitable database triggers.
7. Write and execute PL/SQL stored procedure and cursor to perform a suitable task on the database.

**Group C: Mini Project / Database Application Development**

Student group preferably of size 4 students should decide the statement and scope of the project which will be refined and validated by the faculty. Choose database as per the requirement of the mini project. Draw and normalize the design up to an ER Diagram with normalization in case of back end as RDBMS. Design front end using any open source technology and perform connectivity to the database. Implement suitable database operations along with business logic, validations, reports etc.

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

**Autonomous Program Structure of**
**Third Year B. Tech. Fifth Semester**
**(Information Technology)**
**Academic Year: 2022-2023 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Oral | Practical | | |
| 20IT 501 | Theory of Computation | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IT 502 | Design and Analysis of Algorithms | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IT 503 | Machine Learning | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20PEIT 501 | Programme Elective-I | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIT 502 | Programme Elective-II* | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OEHS 501 | Open HS Elective –I | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 502L | Design and Analysis of Algorithms Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IT 503L | Machine Learning Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20PEIT 501L | Programme Elective Lab- I | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| | **Total** | **18** | **3** | **6** | **375** | **300** | **50** | **25** | **750** | **24** |
| | **Grand Total** | 27 | | | 750 | | | | | |

***NPTEL / Swayam Course**

| **Programme Elective – I** | **Programme Elective – I Lab** |
|---|---|
| 20PEIT 501 A Artificial Intelligence<br>20PEIT 501 B Business Intelligence<br>20PEIT 501 C Computer Graphics and Animation | 20PEIT 501L A Artificial Intelligence<br>20PEIT 501L B Business Intelligence<br>20PEIT 501L C Computer Graphics and Animation |
| **Programme Elective – II**<br>20PEIT 502 A Blockchain Architecture Design and Use Cases<br>20PEIT 502 B Internet of Things | |

Department of Information Technology

APPROVED BY
Secretary Governing Body
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For Women, Pune-411052

Karvenagar, Pune-411052

APPROVED BY
Chairman Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

20OEHS 501 Open Elective I (Humanities)

| Sr. No. | Course Code | Course Title |
|---|---|---|
| 1 | 20OEHS501A | Entrepreneurship Development |
| 2 | 20OEHS501B | Intellectual Property Rights |
| 3 | 20OEHS501C | Introduction to Digital Marketing |
| 4 | 20OEHS501D | Law for Engineers |
| 5 | 20OEHS501E | Organizational Behaviour |
| 6 | 20OEHS501F | Project Management |

# 20IT 501 Theory of Computation

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** 1 hour/week

**Examination Scheme:**
**In-Semester:**50 Marks
**End-Semester:** 50 marks
**Credits:** 4

**Prerequisites:** Discrete structures

**Course Objectives:**
Familiarize students with
1. Abstract computing models.
2. Types and applications of formal grammars
3. Application of Theory of Computation in System Programming
4. Concept of Turing Machine

**Course Outcomes:**
Students will be able to:
1. Construct abstract computing models
2. Apply the concepts of formal grammars
3. Apply the Turing Machine concepts
4. Compare various abstract computing models

**Unit – I Fundamentals 7 Hours**
Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers. NFA to DFA conversion

**Unit – II Finite Automata with application 7 Hours**
NFA with e transitions - Significance, acceptance of languages, Equivalence between NFA with and without e transitions, minimization of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Mealy machines.
**Lexical analyzer** as an application of Finite Automaton. Introduction to Lex tool

**Unit – III Regular Expression and Grammar Formalism 7 Hours**
**Regular expressions:** Identity rules, Constructing finite Automata for a given regular expression, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets
**Introduction to Grammar:** derivation trees, sentential forms. Right most and leftmost derivation of strings, Chomsky hierarchy

**Unit – IV Regular Grammar with application 7 Hours**
Regular grammars-right linear and left linear grammars, equivalence between regular grammar and FA, inter conversion, Parsing techniques, Top-down parsing, Bottom-up parsing
**Recursive descent parser** as an application of Regular Grammar. . Introduction to YACC tool

**Unit – V Context free grammars and Push down automata 7 Hours**

Context Free Grammars-Ambiguity in context free grammars. Minimization of Context Free Grammars. Normal Forms Chomsky Normal Form, Greibach Normal Form, conversion to CNF and GNF

**Push down automata-** definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, inter conversion,

**Unit – VI Turing Machine 7 Hours**

Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines, Universal Turing Machine, decidability/undecidability of problems, Halting problem Correspondence problem, Turing reducibility

**Modularized programming concept** as an application of Turing machines

**Text Books**

1. Daniel I.A. Cohen, "Introduction to Computer Theory" Wiley-India, ISBN: 978-81-265-1334-5
2. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN-13: 978-0-19-808458-7.

**Reference Books**

1. John C. Martin, "Introduction to language and theory of computation", Tata McGraw Hill, Third edition, ISBN 0-07-049939-X
2. Hopcroft Ulman, "Introduction To Automata Theory, Languages And Computations", Pearson Education Asia, 2nd Edition
3. E V Krishnamurthy, "Introduction to Theory of Computer Science", EWP Second 2nd Edition.
4. Michael Sipser, Introduction to the Theory of Computation, Course Technology Inc; 3rd edition, 1133187790-978

# 20IT 502 Design and Analysis of Algorithms

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** 1 hour

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 4

**Prerequisites:** Data structures

**Course Objectives:**
Familiarize students with
1. Algorithmic approaches for problem solving
2. Basics of computational complexity analysis
3. Various algorithm design strategies.
4. Different classes and solutions to problems such as P, NP etc.

**Course Outcomes:**
Students should be able to
1. Apply various algorithmic techniques to solve problems.
2. Make use of appropriate algorithmic strategy for a given problem.
3. Analyze the class of the algorithm for a given problem.
4. Interpret computational complexity for various algorithms.

**Unit – I: Introduction** **7 Hours**
Analysis of Algorithm, Efficiency- Analysis framework, asymptotic notations. Proof Techniques: Proof by induction, contradiction, direct proof, contraposition and so on, Introduction to Brute Force method & Exhaustive search, Analysis of Non-recursive and recursive algorithms: Solving Recurrences

**Unit – II: Divide and conquer method and Greedy strategy** **7 Hours**
Divide & Conquer method: Merge sort, Quick Sort. Binary search, Finding Max-Min, Large integer Multiplication, TOH. Greedy Method: MST for graph, Single-Source Shortest Paths: Dijkstra's Algorithm, Fractional Knapsack problem, Job Sequencing.

**Unit – III: Dynamic Programming** **7 Hours**
General strategy, optimal substructure, 0/1 knapsack Problem, Chain matrix multiplication, Bellman-Ford Algorithm, Multistage Graph problem, Optimal Binary Search Trees, Travelling Salesman Problem.

**Unit – IV: Backtracking** **7Hours**
General method, Recursive backtracking algorithm, Iterative backtracking method. 8-Queen problem, Sum of subsets, Graph coloring, Hamiltonian Cycle, 0/1 Knapsack Problem.

**Unit – V: Branch and bound** **7 Hours**
The method, Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem – LC branch and bound and FIFO branch and bound solution, Traveling sales person problem

**Unit – VI: Classes of algorithms** **7 Hours**

Computational Complexity: Non Deterministic algorithms, The classes: P, NP, NP Complete, NP Hard, Satisfiability problem, NP Complete Problems, Parallel Algorithms, Optimizing Parallel Algorithms, Randomized and approximation algorithms, GProf

**Text Books:**

1. Thomas H Cormen and Charles E.L Leiserson, Introduction to Algorithm, PHI, ISBN: 81-203-2141-3.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN 10 : 0-19-809369-1

**Reference Books:**

1. Horowitz and Sahani, Fundamentals of computer Algorithms, Galgotia, ISBN 81-7371-612-9.
2. R. C. T. Lee, SS Tseng, R C Chang, Y T Tsai, Introduction to Design and Analysis of Algorithms, A Strategic approach, Tata McGraw Hill, ISBN-13: 978-1-25-902582-2. ISBN-10: 1-25-902582-9.
3. Anany Levitin, Introduction to the Design & Analysis of Algorithm, Pearson, ISBN 81- 7758-835-4.
4. Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3.

# 20IT 503 Machine Learning

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** 1 hour/week

**Examination Scheme:**
**In-Semester:** 50 Marks
**End-Semester:** 50 marks
**Credits:** 4

**Prerequisites:** Linear Algebra, Probability Basics

**Course Objectives:**
Familiarize students with
1. Concept of dataset
2. Applications of Machine Learning
3. Machine Learning algorithms
4. Evaluation metrics applicable to Machine Learning techniques

**Course Outcomes:**
Students will be able to:
1. Choose appropriate Machine Learning technique for solving real-world problems
2. Explain wide variety of Machine Learning algorithms and techniques
3. Solve problems using Machine Learning algorithms
4. Evaluate various Machine Learning models

**Unit – I Introduction to Machine Learning 6 Hours**
Introduction: What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross validation
Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning, Reinforcement Learning, Incremental Learning
Dataset: Preparing dataset for Machine Learning

**Unit – II Linear Models: Classification 7 Hours**
Binary and Multi-class Classification: Concept, evaluating Classification models using Contingency Table/Confusion Matrix
Perceptron: Neurons, learning rate, threshold
Support Vector Machine: Hard margin, soft margin, kernel trick for non-linear data

**Unit – III Linear Models: Regression 8 Hours**
Regression: Concept, evaluating Regression models
Univariate Regression: Linear model, constructing line of Regression
Polynomial Curve Fitting: Test-Train Curves, degree of polynomial
Theory of Generalization: Overfitting and Underfitting, Bias-Variance Dilemma, Regularization

**Unit – IV Distance based Models 8 Hours**
Distance based Models: Concept, Distance Measures: Euclidian, Manhattan, Minkowski, Hamming, Chebyshev.
Distance based Classification: Neighbors, exemplers, Nearest Neighbor algorithm
Distance based Clustering: Evaluating clustering algorithms, k-means, soft k-means, DBScan, Hierarchical Clustering

**Unit – V Rule based and Tree based Models 8 Hours**

Rule based Models: Frequent itemsets, confidence and support, Association Rule mining
Tree based Models: Building Decision Tree using impurity measures: Gini Index, Minority Class Index, Entropy. ID3.

**Unit – VI Probabilistic Models 5 Hours**

Generative and Discriminative Models, Bayes' Theorem, Independence assumption, Naïve Bayes Classification algorithm, Logistic Regression

**Text Books**

1. Etham Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition – 2013.
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press – 2012.

**Reference Books**

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer 1st Edition – 2013.
2. Jiawei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd Edition – 2011.
3. Kevin Murphy, "Machine Learning – A Probabilistic Perspective", MIT Press – 2012.

**Other Resources**

1. UCI Machine Learning Repository https://archive.ics.uci.edu
2. WEKA Collection of datasets https://waikato.github.io/weka-wiki/datasets/
3. Kaggle datasets https://www.kaggle.com/datasets

# 20PEIT 501A Artificial Intelligence

**Teaching Scheme:**
**Lectures:** 3 hours/week

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits: 3**

**Prerequisites:** Discrete Mathematics, Basic Probability Theory and Statistics
Knowledge of Data Structures

**Course Objectives:**
Familiarize students with
1. The basic principles and applications of Artificial Intelligence.
2. Concepts of problem solving and knowledge representation
3. Concepts of planning and learning
4. Concepts of Uncertainty

**Course Outcomes:**
Students will be able to:
1. Assess underlying AI concepts and their usage.
2. Implement classical Artificial Intelligence techniques
3. Represent knowledge using logic and infer new facts from it.
4. Apply Artificial Intelligence techniques for problem solving.

**Unit – I: Artificial Intelligence** **7 hours**
Introduction -What is AI? The Foundations of Artificial Intelligence,
Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

**Unit – II: Problem Solving by uninformed search** **7 hours**
Problem Solving: Solving Problems by Searching, formulation of real world problems, Breadth first search, depth first search, Iterative deepening Depth First Search, Bidirectional Search, Comparison of Uninformed search Strategies, Searching with partial information.

**Unit – III: Problem Solving by informed search** **7 hours**
Generate& test, Hill Climbing, Best First Search, A* and AO* Algorithm, Constraint satisfaction, Game playing: Minimax Search, Alpha-Beta pruning, Waiting for Quiescence

**Unit – IV: Knowledge Representation** **7 hours**
Knowledge based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.

**Unit – V: Planning and Uncertainty** **7 hours**
Definition of Classical Planning, Algorithm for Planning as State-Space Search, Planning Graphs, Blocks world, STRIPS.
Quantifying Uncertainty: Acting under uncertainty, Basic probability notations, Bayesian probability, belief network, probabilistic reasoning.

**Unit – VI: Artificial Neural Network** **7 hours**

Introduction to Neural networks: basic, comparison of human brain and machine, biological neuron, general neuron model, activation functions, Perceptron learning rule, applications and advantages of neural networks. Brief introduction to single layer and multilayer networks.

**Text Books:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall.

**Reference Books:**

1. E. Rich and K.Knight, Artificial Intelligence, Tata McGraw Hill
2. Charniack and D. Mcdermott, Artificial Intelligence, Addison Wesley
3. George F. Luger , "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Pearson
4. N.P. Padhy, "Artificial Intelligence And Intelligent Systems", Oxford University Publishers
5. Parag Kulkarni, Prachi Joshi: Artificial Intelligence: Building Intelligent Systems, Prentice Hall of India.
6. Toby Segaran, Programming Collective Intelligence, O"Reilly

**Web References:**

1. NPTEL Series: Artificial Intelligence, Prof. Anupam Basu and Prof. S. Sarkar, IIT Kharagpur

# 20PEIT 501B Business Intelligence

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:-**

**Examination Scheme:**
**In-Semester:** 50 Marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Database Systems, probability basics

**Course Objectives:**
Familiarize students with
1. The role of Business Intelligence in various business applications
2. Methods of data processing and modeling
3. Importance of visualization and reporting in business
4. Decision making process using Business Intelligence

**Course Outcomes:**
Students will be able to:
1. Solve various business problems using BI concepts
2. Choose data transformation and modeling techniques for designing data warehouse
3. Apply business analytics and visualization concepts for business reporting.
4. Explain different BI trends and their applications.

**Unit – I Introduction 6 Hours**
Concepts of Data, Information, and Knowledge, Design and implementation aspect of OLTP and OLAP/Data Warehouse, Business Intelligence (BI) Concepts and definitions, BI architectural models (Top-down and bottom-Up), Business Applications of BI, Role of Data warehouse in BI, BI system components

**Unit – II Dimensional Modeling And Data Warehouse Design 8 Hours**
Star schema, Snowflake schema, and Fact Constellation schema, Grain of dimensional model, transactions, Recurring Snapshots, Accumulating Snapshots, Dimensions (SCD types, conformed dimensions), Facts (additive, semi-additive, non-additive), Junk dimensions, conformed dimensions, Bridge tables

**Unit – III ETL 8 Hours**
Data Quality, Data profiling, Data enrichment, data duplication, Data cleaning, ETL Architecture and what is ETL, Extraction concept and Change data capture, Transformation concept, loading concept, Initial and Incremental loading, Full loading, late arriving facts, data staging, Data marts, Smart change data capture using log-based techniques

**Unit – IV Business Analytics 6 Hours**
What is business analytics (BA)? Difference between BA and BI. Types of analytics, Market-Basket Analysis, clustering, classification, regression, In-Memory Analytics and In-DB Analytics, Applications of Business Analysis

**Unit – V Reporting And Data Visualization 8 Hours**
Metadata Layer, Presentation Layer, Data Layer, Use of different layers and overall Reporting architecture, Various report elements such as Charts, Tables, Materialized views, Query rewrite,

Ad-hoc reports, Security: report level, data level (row, column), Scheduling.
**Data visualization:** Types of data, Types of data visualization, Techniques for visual data representations, data Visualization tools- Tableau, Dashboards

**Unit – VI Recent Trends 6 Hours**
Introduction to Big Data, DW appliances, Types of BI: Real time BI, Operational BI, Embedded BI, Agile BI, Mobile BI, collaborative BI, BI for real world applications such as Real estate, Share market

**Text Books**

1. Ralph Kimball, Joe Caserta, "The Data warehouse ETL Toolkit", Publisher: Wiley
2. Jiawei Han, Micheline Kamber, Jian Pei "Data Mining: concepts and techniques", 2nd Edition, Publisher: Elsevier/Morgan Kaufmann.

**Reference Books**

1. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit", 3rd edition, Publisher: Wiley
2. Reema Thareja, "Data Warehouse", Publisher: Oxford University Press.
3. William Inmon, "Building the Data Warehouse", Wiley publication 4th edition.

# 20PEIT 501C Computer Graphics and Animation

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 hours/week | **In-Semester:** 50 marks |
| | **End-Semester:** 50 marks |
| | **Credits:** 3 |

**Prerequisites:** Geometry and trigonometry, Vectors and Matrices

**Course Objectives:**
Familiarize students with
1. Basic concepts of computer graphics
2. Basic primitives and objects in computer graphics
3. Various methods and techniques used in computer graphics
4. Applications of computer graphics in animation and gaming

**Course Outcomes:**
Students should be able to
1. Select appropriate algorithm to draw computer graphics primitives
2. Apply transformations to computer graphics objects
3. Identify appropriate techniques to achieve desired image manipulation.
4. Design algorithmic logic for real life applications

**Unit – I Basic Concepts 7 Hours**

**Introduction:** Basics of graphics systems, raster scan & random scan displays, basic display processor.
**Display Files**: display file structure, algorithms and display file interpreter. Primitive operations.
**Plotting Primitives:** Scan conversions, line segments, vectors, pixels and frame buffers, vector generation.
**Introduction to OpenGL:** Basic OpenGL syntax, display-window management using GLUT, functions.

**Unit – II Graphics Primitives for Drawing and Filling 7 Hours**

**Line and Circle drawing Algorithms:** DDA, Bresenham's, Midpoint.
**Character Generation:** Stroke Principle, Starburst Principle, Bit map method, aliasing and anti-aliasing
**Polygon:** Polygon and its types, inside test, polygon filling methods: Seed fill, Scan Line, Flood fill and Boundary fill

**Unit – III Geometric Transformations 7 Hours**

**2D Geometric Transformations:** Translation, scaling, rotation, reflection, shearing, matrix representation and homogeneous coordinate system, composite transformations
**3D Geometric Transformations:** Translation, scaling, rotation, rotation about X, Y, Z and arbitrary axis reflection about XY, YZ, XZ and arbitrary plane.

**Unit – IV** **Segments, Windowing and Clipping** **7 Hours**

**Segment:** Introduction, segment table, segment creation, closing, deleting and renaming, visibility
**Windowing:** Concept of window and viewport, viewing transformations
**Line Clipping: C**ohen sutherland method, midpoint subdivision method
**Polygon Clipping: S**utherland hodgman method for clipping convex and concave polygon

**Unit – V** **Shading and Animation** **7 Hours**

**Shading**: Halftoning, Gouraud and Phong Shading
**Computer Animation:** Design of animation sequences, general computer animation functions, computer animation languages, key-frame systems, motion specifications.

**Unit – VI** **Gaming** **7 Hours**

**Gaming platforms**: Graphics memory pipeline, block diagram of nvidia workstation and i860 introduction to opengl es
**Interactive Graphics & usage of the tools of computer graphics:** 3D studio and maya
**2D games:** Snake game

**Textbooks**

1. D. Hearn, M. Baker, "Computer Graphics with OpenGL", 4th Edition, Pearson Education, 2014, ISBN 978-93-325-1871-1
2. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.

**Reference Books**

1. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition,Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
3. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.
4. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum‟s Series outlines.
5. F.S. Hill JR, "Computer Graphics Using Open GL", Pearson Education
6. Samuel R. Buss, "3D Computer Graphics", Cambridge University Press

## 20PEIT 502A Blockchain Architecture Design and Use Cases

**Teaching Scheme:**
Lectures: 3 hours/week

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Basics of programming, software engineering

**Course Objectives:**
Familiarize students with
1. Blockchain technology landscape
2. Bitcoin blockchain
3. Ethereum and smart contract
4. Hyperledger

**Course Outcomes:**
Students should be able to
1. Explain Blockchain technology landscape
2. Apply applications and implementation strategies of Blockchain
3. Make use of Blockchain in real life applications.
4. Evaluate security, privacy, and efficiency of a given blockchain system

**Description:**

The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way. The concept and applications of Blockchain have now spread from cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on. This course will cover both the conceptual as well as application aspects of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains. us other domains, including business process management, smart contracts, IoT and so on.

**The course will cover following topics:**

Introduction to Blockchain, Basic Crypto Primitives, Bitcoin Basics Distributed Consensus, Consensus in Bitcoin, Permissioned Blockchain (Basics, Consensus, RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance), Blockchain for Enterprise – Overview, Blockchain Components and Concepts, Hyperledger Fabric – Transaction Flow, Hyperledger Fabric Details, Fabric – Membership and Identity Management, Hyperledger Fabric Network Setup, Fabric Demo on IBM Blockchain Cloud, Hyperledger Composer – Application Development, Network Administration, Blockchain in Financial Service, Revolutionizing Global Trade, Blockchain in Supply Chain, Blockchain in Government Blockchain Security, Comparing Ecosystems – Ethereum development tools and Quorum

**Suggested Swayam Course:**
"Blockchain Architecture Design and Use Cases", by Prof. Sandip Chakraborty, IIT, Guwahati
https://onlinecourses.nptel.ac.in/noc19_cs63/course

**Reference Books:**

1. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", 1st Edition
2. Melanie Swa, "Blockchain", O'Reilly
3. Bob Dill, David Smits, "Zero to Blockchain - An IBM Redbooks course"

# 20PEIT 502B Internet of Things

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:-**

**Examination Scheme:**
**In-Semester:** 50 Marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Basic programming knowledge, Network Fundamentals

**Course Objectives:**

Familiarize students with

1. Core concepts of Internet of Things (IoT)
2. Communication protocols and different types of networks in IoT
3. Programming of various exemplary devices like Arduino, Raspberry Pi
4. State of art IoT technologies and application areas

**Course Outcomes:**

Students will be able to:

1. Explain core concepts of IoT
2. Compare different communication protocols and networks
3. Program exemplary devices like Arduino, Raspberry Pi
4. Design IoT applications with IoT technologies

**Description:**

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. Today it is possible to envision pervasive connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. IoT-based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems, are gradually relying on IoT based systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

**The course will cover following topics:**

Introduction to IoT, Basics of Networking, Communication Protocols, Sensor Networks, Interoperability in IoT, Introduction to Arduino Programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi, SDN for IoT, Data Handling and Analytics, Cloud Computing, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT

**Suggested Swayam Course:**

"Introduction to Internet of Things", By Prof. Sudip Misra, IIT, Kharagpur
https://onlinecourses.nptel.ac.in/noc21_cs17/preview

**Reference Books**

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

# 20IT 502L Design and Analysis of Algorithm Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In Semester**: 25 Marks
**Practical**: 25 marks
**Credits**: 1

**Prerequisites:** Data Structures

**Course Objectives:**
Familiarize students with
1. Basics of computational complexities.
2. The space and time requirements of the algorithms.
3. The various algorithmic design techniques.
4. The categorization of the given problem for finding an appropriate solution.

**Course Outcomes:**
Students should be able to
1. Apply algorithmic strategy for solving a given problem.
2. Develop the code for the algorithm such as sorting, minimum spanning tree, etc.
3. Analyze computational complexity of the algorithms.
4. Test the code for multiple inputs.

**List of Laboratory Assignments (**Minimum 4 assignments**)**

1. Write a program to implement an algorithm using Brute Force method or Exhaustive search approach.(For e.g Sorting techniques or Password cracking)
2. Write a program to implement a program using the Divide and Conquer approach (for e.g, Quick, Merge sort, Binary search, Strassen's method).
3. Write a program to implement an algorithm using Greedy method. (for e.g Prims, kruskals, knapsack problem).
4. Write a program to implement an algorithm using Dynamic Programming also verify the complexity. (for e.g Chain matrix multiplication, Bellman-Ford Algorithm, Multistage Graph problem, Optimal Binary Search Trees, Travelling Salesman Problem)
5. Write a recursive program to find the solution using Backtracking approach. (n queens, Graph coloring, Hamiltonian Cycle, 0/1 Knapsack Problem).
6. Write a program to find the solution using Branch and Bound approach (0/1 Knapsack problem – LC branch and bound and FIFO branch and bound solution, Traveling sales person problem, Job scheduling Problem).

**Text Books:**

1. Thomas H Cormen and Charles E.L Leiserson, Introduction to Algorithm, PHI, ISBN: 81-203-2141-3.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford, ISBN 10: 0-19-809369-1.

**Reference Books:**

1. Horowitz and Sahani, Fundamentals of computer Algorithms, Galgotia, ISBN 81-7371-612-9.
2. R. C. T. Lee, SS Tseng, R C Chang, Y T Tsai, Introduction to Design and Analysis of Algorithms, A Strategic approach, Tata McGraw Hill, ISBN-13: 978-1-25-902582-2. ISBN-10: 1-25-902582-9.
3. Anany Levitin, Introduction to the Design & Analysis of Algorithm, Pearson, ISBN 81-7758-835-4.
4. Gilles Brassard, Paul Bratle, Fundamentals of Algorithms, Pearson, ISBN 978-81-317-1244-3.

# 20IT 503L Machine Learning Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester:** 25 Marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Python Programming

**Course Objectives:**
Familiarize students with
1. Programming of Machine Learning algorithms
2. Libraries for Machine Learning
3. Usage of large datasets
4. Evaluation metrics for Machine Learning techniques

**Course Outcomes:**
Students will be able to:
1. Implement Machine Learning algorithms
2. Compare the performance of various Machine Learning algorithms
3. Apply Machine Learning algorithms to large datasets
4. Evaluate different Machine Learning models

**Implement the following assignments using Python.**
1. Select a suitable dataset from UCI/Kaggle/Weka for classification. Statistically summarize this dataset. The summaries could be –
    a. dimensions of the dataset,
    b. top and last 5 instances,
    c. mean, count, standard deviation, min, max value for each attribute
    d. class distribution

    AND

    Split the dataset in 1 into training and test datasets. Classify the instances in the test dataset using any two classification algorithms listed below. Compare the results and conclude.

    a. Any one linear model (Perceptron or SVM)
    b. Distance based model (kNN)
    c. Tree based model (ID3)
    d. Probabilistic model (Naïve Bayes)

2. Select a suitable dataset from UCI/Kaggle/Weka for linear regression. Statistically summarize this dataset. Split the dataset into training and test datasets. Predict the values for target attribute. Compare both the methods below.
    a. Use linear regression library and predict values for test instances.

    AND

    b. Use library methods for mean, covariance and variance and predict values for test instances.

3. Select a suitable dataset from UCI/Kaggle/Weka for clustering. Statistically summarize this dataset.

AND

Use any two clustering algorithms listed below and cluster the instances for dataset in 3. Compare the results.
   a. Distance based model (k-means and hierarchical clustering)
   b. Density based model (DBScan)

**Text Books**

1. Andrea Muller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reily – 2017.
2. Michael Bowles, "Machine Learning in Python", Wiley – 2018.

**Reference Books**

1. Ian H. Witten, Eibe Frank, Mark A Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Elsevier 3rd Edition.

**Other Resources**

1. UCI Machine Learning Repository https://archive.ics.uci.edu
2. WEKA Collection of datasets https://waikato.github.io/weka-wiki/datasets/
3. Kaggle datasets https://www.kaggle.com/datasets

# 20PEIT 501L A Artificial Intelligence Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester**: 25 marks
**Oral**: 25 marks
**Credits: 1**

**Prerequisites:** Discrete mathematics, basic probability theory and statistics, Knowledge of data structures

**Course Objectives:**
Familiarize students with
1. Basics of Artificial Intelligence
2. Basic implementation of AI algorithms.
3. Intelligence searches and knowledge Representation
4. AI techniques used for application development.

**Course Outcomes:**
Students should be able to
1. Implement AI core concepts using AI algorithms.
2. Identify appropriate AI techniques for development of applications.
3. Apply basic principles of AI towards problem solving, knowledge representation and learning.
4. Gain basic understanding of various AI applications in intelligent and expert systems, artificial neural networks and other machine learning techniques.

**Suggested List of Laboratory Assignments (Any 5)**
1. Implement A* algorithm for any of the following problems: a) 8 puzzle b) Missionaries and Cannibals c) Blocks World Problem
2. Solve 8-queens problem using backtracking.
3. Implement a program to solve constraint satisfaction problem using any searching technique.
4. Implement minimax algorithm using alpha-beta pruning.
5. Implement the code for decision tree learning.
6. Implement Truth Maintenance System.
7. Implement Neural network to understand back propagation.

**Group Assignment**
1. Develop application such as but not limited to
   a) Chatbot
   b) Interactive Sudoku solver
   c) Stock market predictor (offline past data)
   d) Face Recognition
   e) Captcha breakers
   f) Auto tagging of friends on social media
   g) Pac-Man

**Text Books:**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall.

**Reference Books:**

1. E. Rich and K.Knight, Artificial Intelligence, Tata McGraw Hill
2. Charniack and D. Mcdermott, Artificial Intelligence, Addison Wesley
3. George F. Luger , “Artificial Intelligence: Structures and Strategies for Complex Problem Solving”, Pearson
4. N.P. Padhy, “Artificial Intelligence And Intelligent Systems”, Oxford University Publishers
5. Parag Kulkarni, Prachi Joshi: Artificial Intelligence: Building Intelligent Systems, Prentice Hall of India.
6. Toby Segaran, Programming Collective Intelligence, O‟Reilly

**Web References:**

1. NPTEL Series: Artificial Intelligence, Prof. Anupam Basu and Prof. S. Sarkar, IIT Kharagpur

# 20PEIT 501L B Business Intelligence Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester:** 25 Marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Database Systems, probability basics

**Course Objectives:**
Familiarize students with
1. Implementation of different Business Intelligence (BI) techniques
2. Methods of data processing and modeling
3. Importance of visualization and reporting in business
4. Various library functions to develop BI applications

**Course Outcomes:**
Students will be able to:
1. Apply various library functions to develop BI applications
2. Implement data transformation and modeling techniques for building data warehouse
3. Apply business analytics and visualization concepts for business reporting
4. Develop BI system for different applications

**Suggested list of laboratory assignments:**
Choose a Business Problem as Case Study to design and build BI solution using BI concepts:
1. Execute ETL process for building data warehouse
2. Perform dimension modeling
3. Implement OLAP operations on given data set
4. Visualize data using various charts using data visualization tool
5. Perform business analytics for the chosen application
6. Demonstrate complete BI application

**Text Books**

1. Big Data, Black Book, DT Editorial services, 2015 edition
2. Jiawei Han, Micheline Kamber, Jian Pei "Data Mining: concepts and techniques", 2nd Edition, Publisher: Elsevier/Morgan Kaufmann.

**Reference Books**

1. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit", 3rd edition, Publisher: Wiley
2. Reema Thareja, "Data Warehouse", Publisher: Oxford University Press.
3. William Inmon, "Building the Data Warehouse", Wiley publication 4th edition.

# 20PEIT 501L C Computer Graphics Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-semester:** 25 Marks
**End-semester:** 25 marks
**Credits:** 1

**Prerequisites:** Basics of Programming, Data Structures, Algorithms, Geometry, Trigonometry, Vectors and Matrices

**Course Objectives:**
Familiarize students with
1. Various methods and techniques used in computer graphics
2. Applications of computer graphics in animation and gaming
3. Functions and Libraries of OpenGL
4. Applications and implementation of computer graphics.

**Course Outcomes:**
Students should be able to
1. Develop programs using core graphical concepts.
2. Apply graphics data manipulation in an application.
3. Implement programs using different computer graphics algorithm
4. Make use of OpenGL to implement programs

| Sr. No. | List of Assignments (minimum 8 out of 10) |
|---|---|
| **1** | Get Familiar with basic OpenGL environment, display-window management using GLUT, OpenGL functions. |
| **2** | Write a function in OpenGL on Linux Platform to draw a Line using DDA/ Bresenham's Line Drawing Algorithm. Call the Function to draw any pattern consisting of at least 10 function calls. |
| **3** | Write a function in OpenGL on Linux Platform to draw a circle using Midpoint Circle Drawing Algorithm. Call this function at least 6 times to draw any pattern. Users should only give center coordinates and radius. Rest should be drawn automatically |
| **4** | Write a program in OpenGL on Linux Platform to draw chess board using any Line drawing algorithm and fill alternate blocks using flood fill algorithm |
| **5** | Write a program in OpenGL on Linux Platform to draw a flag using any Line drawing algorithm and fill it using scanline polygon filling algorithm. |
| **6** | Write a program in OpenGL on Linux Platform to draw a polygon and perform following 2DTransformations on Triangle.<br>Translation, Scaling, Rotation |
| **7** | Write a program in OpenGL on Linux Platform to clip a Line using Cohen Sutherland Outcode Method. |
| **8** | Write a program in OpenGL on Linux Platform to clip a Polygon using SutherlandHodgman Polygon Clipping. |
| **9** | Write a program in OpenGL on Linux Platform to animate a scene like "Moving Car", "kite flying" etc. |
| **10** | Write a program to design a game using computer graphics basic techniques and OpenGL |

**Textbooks**

1. D. Hearn, M. Baker, "Computer Graphics with OpenGL", 4th Edition, Pearson Education, 2014,ISBN 978-93-325-1871-1
2. S. Harrington, "Computer Graphics", 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.

**Reference Books**

1. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill publication, 2001, ISBN 0 – 07 – 047371 – 4.
2. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice", 2nd Edition,Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
3. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.
4. Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum"s Series outlines
5. F.S. Hill JR, "Computer Graphics Using Open GL", Pearson Education
6. Samuel R. Buss, "3D Computer Graphics", Cambridge University Press

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

**Autonomous Program Structure of**
**Third Year B. Tech. Sixth Semester**
**(Information Technology)**
**Academic Year: 2022-2023 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Oral | Practical | | |
| 20IT 601 | Information Security | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 602 | Cloud Computing | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 603 | Object Oriented Software Engineering | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20HS 601 | Green Computing | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIT 601 | Programme Elective-III | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE 601 | Open Elective-II | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 601L | Information Security Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IT 603L | Object Oriented Software Engineering Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20PEIT 601L | Programme Elective Lab-III | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20AC 601 | Self Expression | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | No Credits |
| | **Total** | **18** | **1** | **8** | **375** | **300** | **50** | **25** | 750 | 22 |
| | **Grand Total** | 27 | | | 750 | | | | | |

| **Programme Elective – III** | **Programme Elective – III Lab** |
|---|---|
| 20PEIT 601 A Advanced Computer Network | 20PEIT 601L A Advanced Computer Network |
| 20PEIT 601 B Natural Language Processing | 20PEIT 601L B Natural Language Processing |
| 20PEIT 601 C Multimedia Techniques | 20PEIT 601L C Multimedia Techniques |

APPROVED BY
Department of Information Technology
Secretary Governing Body
MKSSS's Cummins College of Engineering For Women, Pune-411052

Karvenagar, Pune-411052

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MKSSS's Cummins College of Engineering For Women, Pune-411052

| 20OE601 Open Elective-II | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE601A | Automation and Control Engineering | Y | Y | Y | Y | Y |
| 2 | 20OE601B | Automotive Electronics | Y | Y | Y | Y | Y |
| 3 | 20OE601C | Avionics | Y | Y | Y | Y | Y |
| 4 | 20OE601D | Bioinformatics | Y | Y | Y | N | Y |
| 5 | 20OE601E | Computer Vision | Y | Y | Y | Y | Y |
| 6 | 20OE601F | Design Thinking | Y | Y | Y | Y | Y |
| 7 | 20OE601G | e-Business | Y | Y | Y | Y | Y |
| 8 | 20OE601H | Electric Vehicles | Y | Y | Y | Y | Y |
| 9 | 20OE601I | Gamification | Y | Y | Y | Y | Y |
| 10 | 20OE601J | Geographical Information Systems | Y | Y | Y | Y | Y |
| 11 | 20OE601K | Multimedia Systems | Y | Y | Y | N | Y |

# 20IT 601 Information Security

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures: 3** hours/week | **In-Semester : 50** Marks |
| | **End-Semester : 50** Marks |
| | **Credits :**3 |

**Prerequisites:** Network Fundamentals, Computer Networks

**Course Objectives:**
Familiarize students with

1. Information Security course surveys central concepts in applied information security and cyber security.
2. Make students aware of the major security risks and attack vectors.
3. Provides tools and practices for building secure systems.
4. Design, develop and support a global security system using the state of mind and reasoning on software systems security.

**Course Outcomes:**
Students should be able to

1. Apply knowledge of mathematical background and different cryptographic techniques to provide security in the computer networks.
2. Apply the knowledge to draft the security goals clearly in the networks.
3. Apply the concept of end-to-end security.
4. To compare merits and demerits of different cryptographic techniques/protocols and take decisions while securing a network.

**Unit – I Classical Encryption Techniques 8 Hours**
Classical Encryption Techniques, Block Ciphers and DES, Basic Concepts in Number Theory and Finite Fields, Advanced Encryption Standard (AES), Block Ciphers. Operations

**Unit – II Modern Cryptographic Techniques 8 Hours**
Pseudo Random Number Generation and Stream Ciphers , Public Key Cryptography, Cryptographic Hash Functions Message Authentication Codes

**Unit – III Key Management Techniques 9 Hours**
Digital Signatures, Public-Key Certificates PKI, PKIX, and X.509, CA Hierarchy , User Authentication Protocols Public-Key Certificates PKI, PKIX, and X.509, CA Hierarchy

**Unit – IV Network and Transport Layer Security 8 Hours**
IP Security , Transport Level Security (TLS) HTTPS, HTTPS Use, Secure Shell (SSH), SSH Protocol Stack, Wireless Network Security, Wireless Network Threats, Countermeasures

**Unit – V Cyber Security 9 Hours**
Electronic Mail Security: Email Security Enhancements, Pretty Good Privacy (PGP), S/MIME Intrusion Detection Malicious Software , Code security, Cloud security, IoT security, Advanced

Protocols: Zero knowledge Proofs, Identity based public key, Secure elections, Secure multi-party computation, and Digital cash.

**Text Books**

1. William Stallings, "Cryptography and Network Security: Principles and Practice," 6th Edition, Pearson.

**Reference Books**

1. D. R. Stinson: Cryptography: Theory and Practice (Discrete Mathematics and Its Applications), 3e, CRC Press.
2. B. Schneier: Applied cryptography: protocols, algorithms, and source code in C, 2e, John Wiley & Sons.
3. Bernard Menezes: Network Security & Cryptography, 1st Edition, Cengage Learning, Delhi, 2011.

# 20IT 602 Cloud Computing

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:** -

**Examination Scheme:**
**In-Semester:** 50 marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Operating Systems and Computer Networks

**Course Objectives:**

Familiarize students with

1. Distributed Systems and its ecosystem.
2. Basics of virtualization and its importance.
3. In-depth analysis of cloud computing capabilities.
4. Overview of cloud programming and services.

**Course Outcomes:**

Students should be able to

1. Recognize need of cloud based solutions.
2. Justify the importance of distributed systems.
3. Determine effective techniques to program cloud systems.
4. Evaluate current challenges and trade-offs in cloud computing.

**Unit – I Introduction to Distributed Systems** **7 Hours**

Scalable Computing over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security, and Energy Efficiency

**Unit – II Computer Clusters for Scalable Parallel Computing** **7 Hours**

Clustering for Massive Parallelism, Computer Clusters and MPP Architectures, Design Principles of Computer Clusters, Cluster Job and Resource Management, Case Study: Top Supercomputer Systems

**Unit – III Virtual Machines and Virtualization of Clusters and Data Centers** **7 Hours**

Implementation Levels of Virtualization, Virtualization Structures/Tools: Hypervisors and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation

**Unit – IV Cloud Platform Architecture over Virtualized Data Centers** **7 Hours**

Cloud Computing and Service Models, Data-Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS, and Azure, Inter-cloud Resource Management, Cloud Security and Trust Management, Private and Hybrid Cloud.

**Unit – V Cloud Programming and Software Environments** **7 Hours**

Features of Cloud and Grid Platforms, Parallel and Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments,

**Unit – VI Grids, P2P, and the Future Internet** **7 Hours**

Grid Architecture and Service Modeling, Grid Projects and Grid Systems Built, Peer-to-Peer Computing Systems, Cloud Trends in Supporting Ubiquitous Computing, Enabling Technologies for the Internet of Things, Data Sovereignty, General Data Protection Regulation

**Text Books**

1. Jack J. Dongarra, Kai Hwang, Geoffrey C. Fox, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", Elsevier, First Edition

**Reference Books**

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Pearson, First Edition
2. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, "Mastering Cloud Computing: Foundations and Applications Programming", McGraw Hill, First Edition
3. A. Srinivasan, J. Suresh, "Cloud Computing: A practical approach for learning and implementation", Pearson, First Edition
4. Anthony T. Velte, "Cloud Computing: Practical Approach", McGraw Hill, First Edition
5. Ronald L. Krutz and Russell D. Vines, "Cloud Security: A Comprehensive guide to Secure Cloud Computing", Wiley, First Edition

# 20IT 603 Object Oriented Software Engineering

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures:** 3 hours/week | **In-Semester:** 50 marks |
| **Tutorial:** 1 hour/week | **End-Semester:** 50 marks |
| | **Credits:** 4 |

**Prerequisites:** Object oriented analysis and design laboratory

**Course Objectives:**
Familiarize students with
1. Basic concepts of object oriented software engineering and process models.
2. Requirements elicitation and analysis activities.
3. Concepts of system and object design.
4. Software coding and testing techniques.

**Course Outcomes:**
Students should be able to
1. Choose appropriate software development process models for real life projects.
2. Analyze requirements with use cases.
3. Develop design models using the UML notations.
4. Apply appropriate coding and testing methods according to requirements.

**Unit – I: Introduction to Software engineering** **7 Hours**
Software life cycle, Processes and activities, Life cycle models: Sequential activity-centered models, Iterative activity-centered models, Entity centered models, Agile Process, Principles, Extreme programming, XP values, XP process, Industrial XP, Scrum

**Unit – II: Requirements gathering and analysis** **7 Hours**
Requirement elicitation, functional and nonfunctional requirements, Elicitation activities, identifying actors, scenarios, use-cases, refinement, Requirements analysis concept, Analysis Object Models and Dynamic Models, Entity, Boundary, and Control Objects, Generalization and Specialization, Analysis Activities: From Use Cases to Objects, Requirement Analysis document

**Unit – III: System Design** **7 Hours**
System Design Concept, Subsystem and classes, Services and Subsystem Interfaces, Coupling and Cohesion, Layers and Partitions, Architectural Styles, System Design Activities: From Objects to Subsystems, addressing design goals.

**Unit – IV: Object Design** **7 Hours**
Reuse concepts: Solution Objects, Inheritance, and Design Patterns, reuse activities: Selecting Design Patterns and Components, managing reuse, Specifying interface, interface specification, interface specification activities, managing object design.

**Unit – V: Construction** **7 Hours**
Mapping models to code, overview of mapping, mapping concept, Model transformation Refactoring, Forward and reverse engineering, mapping activities, mapping implementation

**Unit – VI: Software Testing** **7 Hours**

Overview of testing, testing concepts, Faults, Erroneous States, and Failures, test cases, Test Stubs and Drivers, testing activities, component inspection, usability testing, unit testing, integration testing, system testing, managing testing

**Text Books:**

1. Bernd Bruegge & Allen H. Dutoit, 'Object-Oriented Software Engineering', Third edition, Prentice Hall.
2. Roger S. Pressman, 'Software Engineering: A practitioner's approach', McGraw Hill

**Reference Books:**

1. Pankaj Jalote, 'An integrated approach to Software Engineering', Springer/Narosa.
2. Ian Sommerville, 'Software Engineering', Addison-Wesley.
3. Schwaber, K. and Beedle, M. (2001)., 'Agile Software Development with SCRUM', New Jersey:Pearson. [ ISBN - 9780130676344]

# 20HS 601 Green Computing

**Teaching Scheme:**
**Lectures:** 3 hours/week

**Examination Scheme:**
**In-Semester : 50** Marks
**End-Semester : 50** Marks
**Credits :**3

**Prerequisites:** Basic Sciences

**Course Objectives:**
Familiarize students with
1. Knowledge of green computing practices to minimize negative impacts on the environment.
2. Principles of green computing.
3. Green Computing and how it can help improve environmental sustainability.
4. Green Computing in enterprises and its impact.

**Course Outcomes:**
Students should be able to
1. Relate to the socio-cultural aspects of green computing.
2. Create awareness about green computing and promote a green agenda in their working environments leading to the green movement.
3. Apply green computing skills such as energy efficiency, IT assets disposal, carbon footprint estimation, reporting and development of green products.
4. Justify green initiatives while developing applications and services in enterprises.

**Unit – I Introduction to Green Computing 7 Hours**

Environmental Impacts of IT, Need of green computing, Green IT Standards, Enterprise Green IT Strategy, Hardware: Reuse, Recycle and Dispose, Hardware: Reuse, Recycle and Dispose, present scenario in industry, health issues relevance, Software: Energy-Saving Software Techniques

**Unit – II Software Development and Green Data Centers 7 Hours**

Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics

**Unit – III Green Data Storage and Networks 7 Hours**

Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards

**Unit – IV Enterprise Green IT Strategy 7 Hours**

Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business DimensionsforGreen IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information

**Unit – V Green Computing Services and Roles 7 Hours**

Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise

**Unit – VI Regulating Green Computing 7 Hours**

The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centres, Social Movements

**Text Books**

1. San Murugesan, G. R. Gangadharan: Harnessing Green IT, WILEY, 1st Edition-2013.

**Reference Books**

1. Woody Leonhard, Katherrine Murray, "Green Home computing for dummies", August 2009, WILEY
2. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2011
3. Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shroff/IBM redbook, 2011.
4. Jason Harris, "Green Computing and Green IT-Best Practices on regulations & industry", Lulu.com, 2008
5. Carl Speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.
6. Wu Chun Feng (Editor), "Green computing: Large Scale energy efficiency", CRC Press, 2012.

# 20PEIT 601A Advanced Computer Networks

**Teaching Scheme:**
**Lectures:** 3 hours/week

**Examination Scheme:**
**In-Semester : ** 50 Marks
**End-Semester :** 50 Marks
**Credits :**3

**Prerequisites:** Network Fundamentals, Computer Networks

**Course Objectives:**
Familiarize students with
1. Basic functions and concepts of advanced computer networks.
2. Principles of performance modeling.
3. Mechanisms to handle congestion and routing.
4. Introduction to seminal research papers.

**Course Outcomes:**
Students should be able to
1. Compare resource allocation mechanisms.
2. Evaluate the performance measures in TCP/IP networks.
3. Analyze routing algorithms.
4. Comprehend a few seminal research papers.

**Unit – I Internet architecture and performance modeling 7 Hours**
Introduction. Course logistics. Goals of Internet design, Layering abstraction and encapsulation. Network architecture and protocols. Performance of networks: delay and throughput, End-to-end delay, Concept of packetization, Circuit switching vs packet switching, Bandwidth-delay product, and Simple results from queuing theory.

**Unit – II Applications: architectures and examples 7 Hours**
Application layer architectures: client-server vs. P2P, Socket interface: TCP vs. UDP semantics, Application types: elastic vs. real-time, WWW and HTTP. Persistent vs. non-persistent connections, HTTP message formats, headers, Caching, cookies, FTP, SMTP

**Unit – III Transport protocols 7 Hours**
Basic function of transport - multiplexing and demultiplexing, UDP- simple transport, TCPconnection basics: handshake, reliability, pipelining, congestion control, flow control, Ideal window size and bandwidth delay product, Buffer sizing for TCP, Simple model for TCP throughput, Understanding TCP fairness, RED gateways, Resource allocation, QoS, and fairness, QoS architectures: Intserv and Diffserv, Admission control: Token Bucket Filter

**Unit – IV Internet routing 7 Hours**
Router scheduling, common router scheduling policies / queuing disciplines Hierarchical (intradomain and interdomain) routing, IPv6, IP-in-IP tunneling, MPLS, BGP and advanced BGP concepts

**Unit – V Link layer 7 Hours**

Link layer functions: Link layer addresses, ARP, Shared broadcast, multiple access protocols, the original Ethernet, spanning tree protocol, VLANs, NAT traversal.

**Unit – VI Advanced topics 7 Hours**

Networking with virtual machines, software switches, Network Function Virtualization, Network Virtualization, Key ideas of traditional networks vs. SDN, history, Ethane: the motivation, OpenFlow: the interface, Onix: SDN controllers, Applications - B4 by Google, Datacenter networking.

**Text Books**

1. "Computer Networking, A Top-Down Approach", 6 th edition, James Kurose and Keith Ross, Pearson Publishers.
2. "Computer Networks, A Systems Approach", 5 th edition, Larry Peterson and Bruce Davie, The Morgan Kaufmann series in Networking
3. "Data Networks" 2 nd edition Bertsekas and Gallager, Prentice hall publisher (mainly Chapter 3.3 on basic queuing theory

**Reference papers**

1. The design philosophy of the DARPA internet protocols, David Clark.
2. Chord: A Scalable Peer-to-peer Lookup Service for Internet Applications, Stoica et al
3. Congestion Avoidance and Control, Jacobson and Karels.
4. Sizing Router Buffers, Appenzeller et al
5. Bufferbloat: Dark Buffers in the Internet, Gettys and Nichols
6. The Macroscopic Behavior of the TCP Congestion Avoidance Algorithm, Mathis et al.
7. Analysis of the Increase and Decrease Algorithms for Congestion Avoidance in Computer Networks, Chiu and Jain.
8. Random Early Detection Gateways for Congestion Avoidance, Floyd and Jacobson

# 20PEIT 601B Natural Language Processing

**Teaching Scheme:**
**Lectures:** 3 hours/week
**Tutorial:-**

**Examination Scheme:**
**In-Semester:** 50 Marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Probability Basics, Automata theory

**Course Objectives:**
Familiarize students with
1. Core concepts of Natural language processing (NLP)
2. Levels of language analysis
3. Language modeling and Parsing techniques used in natural language processing
4. State of art NLP areas

**Course Outcomes:**
Students will be able to:
1. Identify challenges involved in developing natural language processing system
2. Apply natural language processing techniques
3. Recommend Natural Language Processing techniques for language modeling, syntax and semantic parsing
4. Analyze Natural Language Processing systems for different applications

**Unit – I Introduction to Natural Language Processing 7 Hours**
Introduction: Natural Language Processing (NLP) and Natural Language Understanding (NLU) NLP applications, Brief history of field, Challenges in developing NLP system, Evaluating Natural Language Understanding Systems, The Different Levels of Language Analysis, representation and understanding, NLP tasks in syntax, semantics and pragmatics

**Unit – II Syntactic Parsing 7 Hours**
Grammar and sentence structure, A Top-Down Parser, A Bottom-Up Chart Parser, Top-Down Chart Parsing, Human Preferences in Parsing, Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, finite state transducers (FST), Finite state models and Morphological processing

**Unit – III Features and Augmented Grammars 7 Hours**
Feature Systems and Augmented Grammars : Some Basic Feature Systems for English, Morphological Analysis and the Lexicon , A Simple Grammar Using Features, Parsing with Features, Augmented Transition Networks: Definite Clause Grammars, Generalized Feature Systems and Unification Grammars

**Unit – IV Language Modeling 7 Hours**
Computational Linguistics - Probability Theory , Estimating Probabilities, Ambiguity and Uncertainty in language, Part-of-Speech Tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Probabilistic language modeling and its applications, Markov models. N-grams. Estimating the probability of a word, and smoothing

**Unit – V Semantic Analysis 7 Hours**

Semantics and Logical Form :Word Senses and Ambiguity, The Basic Logical Form Language, Encoding Ambiguity in Logical Form ,Verbs and States in Logical Form, Case Relations Lexical Resources: WordNet, Semantic web Ontologies

**Unit – VI Future of NLP 7 Hours**

Role of Machine learning in NLP applications, Opinion mining, Sentiment Analysis. Machine Translation(MT), MT evaluation tools such as Bleu, WER (Word Error Rate), Information Extraction, Question answering, Automatic speech recognition, Deep Learning for Natural Language Processing

**Text Books**

1. James Allen, "Natural Language Understanding", Pearson Publication, ISBN: 978-81-317-0895-8 2nd Edition
2. D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education, 2002

**Reference Books**

1. Christopher D. Manning, Hinrich Schutze, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts, 1999.
2. Tanveer Siddiqui, US Tiwary, Natural Language Processing and Information Retrieval
3. Daniel M.Bikel, ImedZitouni, Multilingual Natural Language Processing Applications
4. Abhijit Mishra and Pushpak Bhattacharyya, "Cognitively Inspired Natural Language Processing- An Investigation Based on Eye Tracking", Cognitive Intelligence and Robotics Series, Springer Nature Singapore, ISBN:978-981-13-1515-2, 2018.
5. Niladri Dash, Pushpak Bhattacharyya, Jyoti Pawar (eds.), "WordNets of Indian Languages", Springer, ISBN:978-981-10-1909-8, 2016.

# 20PEIT 601C Multimedia Techniques

**Teaching Scheme:**
**Lectures:** 3 hours/week

**Examination Scheme:**
**In-Semester:**50 Marks
**End-Semester:** 50 marks
**Credits:** 3

**Prerequisites:** Algebra and Geometry

**Course Objectives:**
Familiarize students with
1. Variety of multimedia data modification algorithms
2. Capturing and using multimedia components for presenting a concept
3. Multimedia data processing for its size reduction
4. Usage of multimedia in variety of domain applications

**Course Outcomes:**
Students will be able to:
1. Apply multimedia components in multimedia production.
2. Apply data processing techniques on multimedia data
3. Apply compression techniques on multimedia data
4. Choose different multimedia components for multimedia system design

**Unit – I Multimedia Overview and basics of still Image 7 Hours**
**Multimedia Overview:** Introduction, multimedia presentation and production, characteristics of multimedia presentation, hardware and software requirements, uses of multimedia, analog and digital representation, digitization, Nyquist theorem, quantization error, visual display systems, enterprise data and multimedia component.
**Digital Image:** Image as data, Image acquisition, types of images.

**Unit – II Image Processing 7 Hours**
Binary image processing, grey scale image processing, colored image processing. Image output on monitors, image output on printers, image file formats both lossless and lossy.

**Unit – III Audio data as multimedia component 7 Hours**
Introduction, acoustics, sound waves, types and properties of sound, psycho acoustics, components of an audio system, digital audio, synthesizers, MIDI, audio processing.

**Unit – IV Audio transmission and broadcasting 7 Hours**
Speech, sound card, audio transmission, digital audio broadcasting, surround sound system, audio file formats both lossless and lossy.

**Unit – V Video data as multimedia component 7 Hours**
Motion video, digital video, digital video processing, video recording and storage formats both lossless and lossy, and video editing concepts.

**Unit – VI Data compression 7 Hours**

Image compression technique, audio compression technique, video compression technique.

**Text Books**

1. Ranjan Parekh: Principles of multimedia, TMH 2nd Edition-2013.
2. Nigel Chapman, Jenny Chapman Peter: Digital Multimedia, John Wiley and sons, Edition 2012.

**Reference Books**

1. Kimberly N Rosenfield: Digital Multimedia: Concepts, Methodologies, tools and applications, Information Resources Management association 1st Edition-September 2017

# 20OE 601F Open Elective II: Design Thinking

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures:** 3 hours/week | **In-Semester:** 50 marks |
| Tutorial: - | **End-Semester:** 50 marks |
| | **Credits:** 3 |

**Prerequisites:** -

**Course Objectives:**

Familiarize students with

1. Design thinking process
2. User centric approach for designing a solution
3. Problem analysis with various methods
4. Applications of Design Thinking

**Course Outcomes:**

Students should be able to

1. Analyze problems with various methods
2. Recommend a solution based on empathy, ideation, prototyping, and playful testing
3. Apply design thinking methods to generate innovative and user centric solutions
4. Test designed prototypes to reduce risks and accelerate organizational learning

**Unit – I: Design and Design Problems** **8 Hours**

What is Design? The components of design problems; measurement, criteria and judgement in design

A model of design problems – Defining problems: Selecting goals and diverse teams, creating a unified vision and scope, mapping stakeholders and personas; Analysing design problems, generators of design problems, roles of generators, design constraints

**Unit II: Design Solutions** **8 Hours**

Solutions to Design Problems: Designer's response: procrastination, non-committal design and throw away design, design problems and solutions

Design Process: define, search, ideate, prototype, select, implement, learn, Refresher and restate the challenge, getting inspiration, understanding innovation ambition, Solution ideation, Narrowing solution choice, Solution evaluation, Road map

**Unit III: Design Thinking** **9 Hours**

Types and Styles of Thinking – theories of design, types of thinking; creative thinking - what is creativity? creativity in design, Principles of design thinking

**Unit IV: Design Philosophies and Strategies 9 Hours**

Theory and practice, three early phases of working on the same problem

Prototype Creation: Choosing a prototype approach, user interface prototypes, applications vs custom build, reference architectures, prototype and solution evaluation

**Unit V: Design Tactics and Traps 8 Hours**

Methods and Tactics, understanding the problem, the model of problems, One or many solutions? Common traps and ways of avoiding them

**Text Books:**

1. Bryan Lawson, "How designers think: The design process demystified", 2nd Edition, Butterworth Architecture
2. Nigel Cross, "Design Thinking", Berg Publishers - 2011

**Reference Books:**

1. Ben Crothers, "Design Thinking Fundamentals", O'Reily
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations", HarperCollins – 2009

1. Susan Weins Chenk, "Hundred things every designer needs to know about people", New Riders Publication
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", Wiley Publication
3. Roger L. Martin, "Design of Business: Why Design Thinking is the Next Competitive Advantage" Harvard Business Press
4. Karl Ulrich, "Design: Creation of Artifacts in Society" - 2011
5. Bala Ramadurai, "Karmic Design Thinking"
6. T. Amabile, "How to kill creativity", SAGE Publication - 2006
7. William Lidwell, Kritina Holden, Jill Butler, "Universal principles of Design ", Rockport Publishers
8. Bella Martin, Bruce Hanignton, Bruce M Hanington "Universal methods of design", Rockport Publishers - 2012
9. Roman Kizanie, "Empathy: Why it matters, how to get it", TarcherPerigee Publishers
10. Karla McLaren, "The Art of Empathy: A complete Guide to life's most essential skill", Sounds True Publishers

# 20IT 601L Information Security Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester: -** 25 Marks
**Practical:** 25 marks
**Credits:** 1

**Prerequisites:** Foundations of Computer Networks, Computer Networks

**Course Objectives:**
Familiarize students with
1. Learn to implement the algorithms DES, RSA,MD5,SHA-1 etc.
2. Make students aware of the major security risks and attack vectors.
3. Provides tools and practices for building secure systems.
4. Learn to use network security tools like GnuPG, KF sensor, Net Strumbler

**Course Outcomes:**
Students will be able to:
1. Implement the cipher techniques
2. Analyse the security algorithms and protocols
3. Use different open source tools for network security and analysis
4. A mini project implementation

**Suggested list of laboratory assignments:**

1. Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts (any 2) :
   a. Caesar Cipher
   b. Playfair Cipher
   c. Hill Cipher
   d. Vigenere Cipher
   e. Rail fence – row & Column Transformation

2. Implement the following algorithms (any 3)
   a. DES
   b. RSA Algorithm
   c. Diffie-Hellman
   d. MD5
   e. SHA-1

3. Implement the Digital Signature Scheme

4. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)

5. Analysis of the Security Vulnerabilities of E-commerce services. / Analysis of the security vulnerabilities of E-Mail Application

6. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)

7. Study assignment: (any 1)
   A. Study of different wireless network components and features of any one of the Mobile Security Apps.
   B. Study of the features of firewall in providing network security and to set Firewall Security in windows.
   C. Study of different types of vulnerabilities for hacking websites / Web Applications.

8. Implementation of a mini-project (Case study on college network for security).

**Text Books**

1. William Stallings, “Cryptography and Network Security: Principles and Practice,” 6th Edition, Pearson.

**Reference Books**

1. B. Schneier: Applied cryptography: protocols, algorithms, and source code in C, 2e, John Wiley & Sons.
2. Bernard Menezes: Network Security & Cryptography, 1st Edition, Cengage Learning, Delhi, 2011.

# 20IT 603L Object Oriented Software Engineering Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week
**Tutorial:** -

**Examination Scheme:**
**In-Semester:** 25 marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Object oriented analysis and design laboratory

**Course Objectives:**
Familiarize students with
1. Various Object Oriented concepts along with their applicability contexts using agile development approach.
2. Various domain objects, their properties and relationships among them for given problem domain.
3. Modeling techniques to model different perspectives of object-oriented software design (UML)
4. Object oriented design solutions for the recurring problems

**Course Outcomes:**
Students should be able to
1. Identify use cases from project requirements.
2. Identify potential classes from use case specifications.
3. Design models using the UML notations.
4. Produce industry standard documentation from requirements analysis and design through testing and verification

Software engineering diagrams will be drawn based on some problem statement (Agile Approach)

1. Use-case Diagrams
2. Class Diagrams
3. Sequence Diagram
4. Activity Diagrams
5. Package Diagrams
6. Component Diagrams
7. Deployment diagrams
8. State Machine Diagrams

**Text Books:**
1. Bernd Bruegge & Allen H. Dutoit, "Object-Oriented Software Engineering", Third edition, Prentice Hall.

**Reference Books:**
1. Chris Sims and Hillary Louise Johnson, "Scrum: a Breathtakingly Brief and Agile Introduction", Dymaxicon. ISBN-13: 978-1937965044

# 20PEIT 601L A Advanced Computer Network Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester:** 25 Marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Foundations of Computer Networks, Computer Networks

**Course Objectives:**
Familiarize students with
1. Basic functions and concepts of advanced computer networks.
2. Principles of performance modeling.
3. Mechanisms to handle congestion and routing.
4. Introduction to seminal research papers.

**Course Outcomes:**
Students should be able to
1. Compare resource allocation mechanisms.
2. Evaluate the performance measures in TCP/IP networks.
3. Analyze routing algorithms.
4. Implement basic functions of SDN

**Implementation of a mini-project on any of the following topics (Use NS2/NS3, packet Tracers etc. simulators).**

1. BGP implementation
2. VLAN implementation
3. Wireless adhoc networks
4. Evaluate QoS in a network

**Text Books**

1. "Computer Networking, A Top-Down Approach", 6 th edition, James Kurose and Keith Ross, Pearson Publishers.
2. "Computer Networks, A Systems Approach", 5 th edition, Larry Peterson and Bruce Davie, The Morgan Kaufmann series in Networking
3. "Data Networks" 2 nd edition Bertsekas and Gallager, Prentice hall publisher

# 20PEIT 601L B Natural Language Processing Laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester:** 25 Marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Probability Basics, Automata theory

**Course Objectives:**
Familiarize students with
1. Implementation of Natural language processing (NLP) techniques
2. Application of various libraries to develop NLP system
3. Language modeling and Parsing techniques used in natural language processing
4. State of art NLP areas

**Course Outcomes:**
Students will be able to:
1. Implement various NLP techniques
2. Apply various library functions to develop NLP applications
3. Choose NLP techniques for language modeling, syntax and semantic parsing
4. Develop NLP system for different applications

**Assignments:**

1. Choose any NLP application and design and implement NLP system for the same. The developed system should demonstrate implementation of following NLP concepts:
   a. Analyse morphological features of a word.
   b. Perform syntactic parsing to check acceptance of a sentence
   c. Calculate bigrams from a given corpus and calculate probability of a sentence.
   d. Perform Part of Speech Tagging
   e. Use lexical resources to implement word sense disambiguation
   f. Integrated NLP application

**Text Books**

1. James Allen, "Natural Language Understanding", Pearson Publication, ISBN: 978-81-317-0895-8 2nd Edition
2. D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education, 2002

**Reference Books**

1. Christopher D. Manning, HinrichSchutze, Foundations of Statistical Natural Language Processing, The MIT Press, Cambridge, Massachusetts, 1999.
2. Tanveer Siddiqui, US Tiwary, Natural Language Processing and Information Retrieval
3. Daniel M.Bikel, ImedZitouni, Multilingual Natural Language Processing Applications

# 20PEIT 601L C Multimedia Techniques laboratory

**Teaching Scheme:**
**Practical:** 2 hours/week

**Examination Scheme:**
**In-Semester:** 25 Marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Algebra and Geometry

**Course Objectives:**
Familiarize students with
1. Implementation of Multimedia techniques
2. Use of multimedia library for Image data
3. Use of multimedia library for Audio data
4. Use of multimedia library for Video data

**Course Outcomes:**
Students will be able to:
1. Implement various Image processing techniques
2. Implement various Audio processing techniques
3. Implement various Video processing techniques
4. Develop Multimedia system for different applications

**Assignments:**

Design and implement a Multimedia system for the chosen application. The developed system should demonstrate implementation of following
1. Use of text media
2. Image processing techniques such as edge detection, histogram plotting, grey scaling but not limited to using library files
3. Use of Animation media
4. Audio processing techniques such as load, play, crop, rewind, forward but not limited to using library files
5. Video processing techniques such as load, play, crop, rewind, forward but not limited to using library files

**Text Books**
1. Rajan Parekh: Principles of multimedia, TMH 2nd Edition-2013.
2. Nigel Chapman, Jenny Chapman Peter: Digital Multimedia, John Wiley and sons, Edition 2012.

**Reference Books**
1. Kimberly N Rosenfield: Digital Multimedia: Concepts, Methodologies, tools and applications, Information Resources Management association 1st Edition-September 2017

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

**Autonomous Program Structure of**
**Final Year B. Tech. Eighth Semester**
**(Information Technology)**
**Academic Year: 2023-2024 onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Oral | Practical | | |
| 20IT 801 | Distributed Systems | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIT 801 | Program Elective-IV | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIT 802 | Program Elective-V | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE 801 | Open Elective-III | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE 802 | Open Elective-IV* | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IT 801L | Distributed Systems Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20PEIT 801L | Program Elective–IV Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| | **Total** | **15** | **0** | **4** | **300** | **250** | **50** | **0** | 600 | 17 |
| | **Grand Total** | 19 | | | 600 | | | | | |

*** Inter-disciplinary Course**

| | |
|---|---|
| **Programme Elective – IV**<br>20PEIT 801 A Advanced Machine Learning<br>20PEIT 801 B Introduction to DevOps<br>20PEIT 801 C Design Patterns | **Programme Elective – IV Lab**<br>20PEIT 801L A Advanced Machine Learning<br>20PEIT 801L B Introduction to DevOps<br>20PEIT 801L C Design Patterns |
| **Programme Elective – V**<br>20PEIT 802 A Advanced Databases<br>20PEIT 802 B Unified Communication<br>20PEIT 802 C Information Retrieval | |

Karvenagar, Pune-411052

**APPROVED BY**
Department of Information Technology
**Secretary Governing Body**
**MKSSS's Cummins College of Engineering**
**For Women, Pune-411052**

**APPROVED BY**
**Chairman Governing Body**
**MKSSS's Cummins College of Engineering**
**For Women, Pune-411052**

| **20OE801 Open Elective-III** | | | **Eligible Departments** | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Course Title** | **EnTC** | **Comp** | **IT** | **Mech** | **Instru** |
| 1 | 20OE801A | Big Data and Analytics | Y | Y | Y | Y | Y |
| 2 | 20OE801B | Cyber Physical Systems | Y | Y | Y | N | Y |
| 3 | 20OE801C | Digital Control | Y | N | N | Y | Y |
| 4 | 20OE801D | Industrial Engineering and Management | Y | Y | Y | Y | Y |
| 5 | 20OE801E | Introduction to Cyber-crime and Forensics | Y | Y | Y | Y | Y |
| 6 | 20OE801F | Instrumentation in Food and Agriculture | Y | Y | Y | Y | Y |
| 7 | 20OE801G | Medical IoT | Y | Y | Y | N | Y |
| 8 | 20OE801H | Quantum Computing | Y | Y | Y | N | Y |
| 9 | 20OE801I | Renewable Energy Sources | Y | Y | Y | Y | Y |
| 10 | 20OE801J | Soft Computing | Y | Y | Y | Y | Y |
| 11 | 20OE801K | Software Testing and Quality Assurance | Y | Y | Y | Y | Y |

| **20OE802 Open Elective-IV** | | | **Eligible Departments** | | | | |
|---|---|---|---|---|---|---|---|
| **Sr. No.** | **Course Code** | **Course Title** | **EnTC** | **Comp** | **IT** | **Mech** | **Instru** |
| 1 | 20OE802A | Applied statistics with R Programming | Y | N | N | Y | Y |
| 2 | 20OE802B | Automobile Engineering | Y | Y | Y | N | Y |
| 3 | 20OE802C | Autonomous Robots | N | Y | Y | Y | N |
| 4 | 20OE802D | Building Automation and Energy Audit | Y | Y | Y | Y | N |
| 5 | 20OE802E | Data Analysis and Visualization | Y | N | Y | Y | Y |
| 6 | 20OE802F | Data Science using Python | Y | N | Y | Y | Y |
| 7 | 20OE802G | Industrial Drives and Control | Y | Y | Y | Y | N |
| 8 | 20OE802H | Smart Sensors and Structures | Y | Y | Y | Y | N |
| 9 | 20OE802I | Wireless Networks | N | Y | Y | N | Y |

# 20IT 801 Distributed Systems

**Teaching Scheme:**
**Lectures :** 3 hours/week
**Tutorial : --**

**Examination Scheme:**
**In-Semester : ** 50 Marks
**End-Semester :** 50 Marks
**Credit :** 3

**Prerequisites:** Web Technology, Computer Networks, Operating Systems, Database Management Systems

**Course Objectives:**
Familiarize students with
1. Fundamental knowledge of distributed systems architectures and models.
2. Process Communication and synchronization in a distributed environment.
3. Methods of fault tolerance and replication for distributed systems
4. Distributed File Systems and naming services

**Course Outcomes:**
Students should be able to
1. Apply basic concepts of Distributed systems for communication
2. Apply various synchronization and mutual exclusion algorithms
3. Recommend appropriate techniques for fault tolerance, resource and process management
4. Explain concepts of Distributed File System and naming services for distributed environment

**Unit – I Introduction to Distributed Systems 7 Hours**

Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software concepts, Middleware: Models of Middleware, Services offered by middleware, Client Server model.

Case Study: The World Wide Web

**Unit – II Communication 7 Hours**

Layered Protocols, Inter process communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI), Message Oriented Communication, Stream Oriented Communication, Group Communication.

**Unit – III Synchronization 7 Hours**

Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion - Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, and Performance measure.

Election Algorithms- Non token based algorithm, Token based algorithm.

Case Study: IBM's Websphere Message-Queuing System

**Unit – IV Resource and Process Management 7 Hours**

Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach, Introduction to process management, process migration, Threads, Virtualization, Clients, Servers, Code Migration.

**Unit – V Replication and Fault Tolerance 7 Hours**

Introduction to replication and consistency, Data-Centric and Client- Centric Consistency Models, Replica Management, Fault Tolerance: Introduction, Process resilience, Reliable client-server and group communication, Recovery, Distributed Commit, checkpoints

Case Study: Catching and Replication in Web

**Unit – VI Distributed File Systems and Name Services 7 Hours**

Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS), Introduction to Name services and Domain Name System, Directory Services, Case Study: The Global Name Service, The X.500 Directory Service

Designing Distributed Systems: Google Case Study

**Text Books**

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

**Reference Books**

1. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
2. M. L. Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2004.

3. Sunita Mahajan, Seema Shah, "Distributed Computing", Oxford University Press, 2nd Edition, ISBN-13: 978-0198093480.
4. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni, Srikanth Sunder rajan, "Distributed System Security: Issues, Processes and solutions", Willey online Library, ISBN: 978-0-470-51988-2.
5. "Linux System Programming", 2nd Edition, Robert Love, O'reilly

# 20PEIT 801A Advanced Machine Learning

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures :** 3 hours/week | **In-Semester :** 50 Marks |
| **Tutorial :** -- | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Machine Learning

**Course Objectives:**
Familiarize students with

1. Selection of appropriate features of the dataset for processing
2. Various algorithms in Ensemble Learning
3. Fundamentals of Reinforcement Learning
4. Basic concepts of Neural Network and Deep Learning

**Course Outcomes:**
Students should be able to

1. Perform preprocessing tasks such as dimensionality reduction, vectorization of an image and so on
2. Explain wide variety of advanced Machine Learning algorithms and techniques
3. Apply advanced Machine Learning techniques to solve real-world problems
4. Compare various advanced Machine Learning algorithms

**Unit – I Dimensionality Reduction 7 Hours**

Introduction to Dimensionality Reduction, Feature Selection, Subset Selection, Principal Component Analysis, Linear Discriminant Analysis

**Unit – II Ensemble and Reinforcement Learning 9 Hours**

Ensemble Learning: Wisdom of crowd, Bagging – Bootstrap, Random Forest, Boosting – AdaBoost
Reinforcement Learning: Concept, elements of RL, K-armed Bandit problem, Q-learning
Incremental Learning: Concept, an adaptive incremental learning framework

**Unit – III Neural Network and Artificial Neural Network 9 Hours**

Biological motivation, neurons, McCulloch Pitts neurons, logic gates, Limitations of McCulloch Pitts neurons, Perceptron, Limitations of perceptron, Single Layer Perceptron, Activation layers, Artificial Neural Network and XOR and Multi-layer Perceptron, Error in output, Backpropagation, Gradient Descent

**Unit – IV Convolutional Neural Network 9 Hours**

Vectorization of an image, concept of Convolutional Neural Network, Properties of Convolutional Neural Network, Convolutions, Filters, Strides, layers, padding, Channels, Pooling, Flattening, fully connected network, Convolutional Neural Network and image datasets.

**Unit – V Sequence Modeling: Recurrent Neural Network 8 Hours**

Unfolding Computational Graphs, Recurrent Neural Network, Bi-directional Recurrent Neural Network, Encoder-Decoder Sequence to Sequence Architecture, The challenge of Long-Term Dependencies, Long Short-Term Memory.

**Text Books**

1. Etham Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition – 2013.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press – 2016.

**Reference Books**

1. Nikhil Buduma, "Fundamentals of Deep Learning – Designing Next Generation Machine Intelligence Algorithms", O'Reily – 1st Edition – 2017.
2. Parag Kulkarni, "Reinforcement Learning and Systemic Machine Learning for Decision Making", IEEE Press – 2015.
3. Haibo He, "Self-Adaptive Systems for Machine Intelligence", Wiley – 2011.

**Other Resources**

1. MNIST datasets: https://www.kaggle.com/datasets?search=mnist
2. CIFAR datasets: https://www.kaggle.com/datasets?search=cifar

# 20PEIT 801B Introduction to DevOps

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures :** 3 hours/week | **In-Semester : ** 50 Marks |
| **Tutorial : --** | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Operating Systems and Cloud Computing

**Course Objectives:**

Familiarize students with

1. DevOps Continuous Development and Continuous Integration.
2. DevOps Operation Services.
3. DevOps Architecture.
4. DevOps Technologies.

**Course Outcomes:**

Students should be able to

1. Explain DevOps framework and security aspects in DevOps
2. Apply advanced strategies for software deployment
3. Employ appropriate type of testing in DevOps environment
4. Analyze data to detect anomalies

**Unit – I Introduction to DevOps 7 Hours**

Introduction, Why DevOps?, DevOps Perspective, DevOps and Agile, Team Structure, Co- ordination and barriers. The cloud as a platform, Operations, Operations Services, Service Operation Functions, Continual Service Improvement, Operation and DevOps.

**Unit – II Deployment Pipeline 6 Hours**

Overall Architecture, Does DevOps require architectural change? Overall architecture structure, Microservice architecture, Amazon's rules for teams, Microservice adoption for existing systems.

**Unit – III Building and Testing 7 Hours**

Moving a system through the deployment pipeline, Crosscutting aspects, Development and pre-Commit testing, UAT/Staging/Performance Testing, Production, Incidents, Deployment – Strategies for managing a deployment, logical consistency, packaging, deploying to multiple Environments, partial deployment, rollback, tools

**Unit – IV Deployment 7 Hours**

Introduction, Strategies for Managing a Deployment, Logical Consistency, Packaging, Deploying to multiple environments**,** partial deployments, Rollback, Tools.

**Unit – V Monitoring 7 Hours**

Introduction, what to monitor, How to monitor, When to change the monitoring configuration, Interpreting monitoring data, challenges, tools, diagnosing an anomaly from monitoring data.

**Unit – VI Trends in DevOps 8 Hours**

GitOps, MLOps, AIOps, DataOps, DevSecOps

**Text Books**

1. Len Bass, Ingo Weber, Liming Zhu, DevOps A software Architect's Perspective, Pearson, First edition.
2. Sanjeev Sharma, The DevOps Adoption Playbook, A guide to adopting DevOps in a Multi Speed IT Enterprise. Wiley, IBM Press.

**Reference Books**

1. Jennifer Davis and Katherine Daniels, "Effective DevOps", O'Reilly, First Edition
2. Deepak Gaikwad, Viral Thakkar, "DevOps Tools from practitioner's Viewpoint", Wiley, First Edition
3. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, "Introducing MLOps", O'Reilly Nov 2020
4. Billy Yuen, Jesse Suen, Alex Matyushentsev, Todd Ekenstam, "GitOps and Kubernetes", O'Reilly, April 2021
5. John Schnidt and Kirit Basu, "DataOps: The Authoritative Edition", Sept 2019
6. Geradus Blokdyk, "DevSecOps: A Complete Guide", 2019 Edition

# 20PEIT 801C Design Patterns

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures :** 3 hours/week | **In-Semester : ** 50 Marks |
| **Tutorial : --** | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Object Oriented Analysis and Design Laboratory

**Course Objectives:**
Familiarize students with
1. Principles of software design
2. Necessity of Design Patterns
3. Different types of Design Patterns
4. Applications of design patterns

**Course Outcomes:**
Students should be able to
1. Identify low cohesion and high coupling in a given problem statement
2. Apply behavioral design Patterns to incorporate enhanced class collaboration
3. Apply structural design patterns to overcome the structural incompatibility
4. Analyze scenarios for application of creational design patterns

**Unit – I Role of Design Patterns in Software Design 10 Hours**

SOLID principles, classification of design Patterns, applying SOLID principles using Design Patterns

**Unit – II Behavioral Design Patterns 10 Hours**

Strategy as algorithmic loose cuping, State, Template method as skeleton of algorithm, Chain of responsibility as request handlers" chain , Observer as publish subscribe

**Unit – III Structural Design Patterns 11 Hours**

Adapter as resolving interface incompatibilities, Proxy as placeholder, Façade simplification in handling complex components, Composite compression of has a relationship to is a relationship, Decorator

**Unit – IV Creational Design Patterns 11 Hours**

Singleton as object instantiation restrictor, Factory method as interface for creating subclass objects at run time, Abstract Factory as creating families of objects without specifying their concrete classes

**Text Books**

1. Alan Shalloway and James Trott, "Design Patterns Explained: A new Perspective on object oriented design", Addison Wesley
2. Kethy Seirra , "Head first Design Patterns", SPD 2020

**Reference Books**

1. Eric Gamma "Design Patterns: Elements of reusable object oriented software" Addison Wesley

# 20PEIT 802A Advanced Databases

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures :** 3 hours/week | **In-Semester : ** 50 Marks |
| **Tutorial : --** | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Data structures, database management systems.

**Course Objectives:**

Familiarize students with

1. Concepts and applications of advanced database architectures.
2. Different ways to process queries in advanced databases.
3. Storage and indexing structures.
4. Security management in database management systems.

**Course Outcomes:**

Students should be able to

1. Examine different database architecture of advanced databases.
2. Analyze the techniques of transactions and query processing in advanced databases.
3. Devise appropriate ways to store and index data.
4. Apply appropriate database security techniques.

**Unit – I Parallel Databases 7 Hours**

Database system architecture, client server architecture, parallel database architecture, shared memory, shared disk, shared nothing, hierarchical, I/O parallelism, inter query parallelism, intra query parallelism, interoperation parallelism, intra operation parallelism, design of parallel systems.

**Unit – II Distributed Databases 7 Hours**

Distributed system architecture, homogenous and heterogeneous databases, distributed data storage, distributed transaction, commit protocol, concurrency control in distrusted databases, availability, distributed query processing, cloud databases.

**Unit – III Transaction processing in advance databases 7 Hours**

Distributed transactions, commit protocols, concurrency control in distributed databases, replication, extended concurrency control protocols, coordinator selection, Consensus in Distributed Systems

**Unit – IV Big Databases 7 Hours**

Introduction to Big Data, NoSQL database system – Column based and key value based

Column based Database ( Cassandra ) : Architecture, Managing data, Data Caching, Tuning, Data backup, Cassandra Query Language, CQL Data Model, Indexing Key Value based Database (DynamoDB) : Data Model, Operations, Data Access, Indexing.

**Unit – V Database Indexing and hashing 7 Hours**

Basics of query processing, Introduction to indexing, ordered indices, B+ tree index files, B+ tree extensions, Hash indices, Multiple key access, creation of indices, write optimized index structure, bitmap indices, indexing of spatial and temporal data, static and dynamic hashing.

**Unit – VI No SQL and semi structured Data Management 7 Hours**

Introduction to Big Data, No SQL Databases, MongoDB, Map reduce. XML Databases, DTD, XML Schemas, XQuery, XPath. JSON

**Text Books**

1. Silberschatz A., Korth H., Sudarshan S, Database System Concepts, McGraw Hill Publication, ISBN- 0-07-120413-X, Sixth Edition.
2. Ramez Elmasri, Shamkant B. Navathe**,** Fundamentals of Database Systems, Pearson Publication, ISBN-13: 978-0-136-08620-8

**Reference Books**

1. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Publication, ISBN-978-81- 317-6092-5.
2. C J Date, "An introduction to Database Systems", Addition-Wesley.
3. Raghurama Krishnan, Johannes Gehrke, "Database Management Systems", TATA McGrawHill, 3rd Edition, 2003.
4. Reema Thareja, "Data warehousing", Oxford University Press. ISBN 0195699610.

# 20PEIT 802B Unified Communications

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Lectures :** 3 hours/week | **In-Semester :** 50 Marks |
| **Tutorial :** -- | **End-Semester :** 50 Marks |
| | **Credit :** 3 |

**Prerequisites:** Network Fundamentals, Computer Networks

**Course Objectives:**

Familiarize students with

1. Compare Circuit switching and packet switching related to performance parameters.
2. Choose VOIP protocols for unified communications.
3. Analyze contact center as application of unified communications.
4. Interpret emerging technologies/protocols in VOIP communications.

**Course Outcomes:**

Students should be able to

1. Understand and apply VOIP unified communications and analytics concepts to Contact Center Working.
2. Design and Implement VOIP protocols for telecommunication systems/applications.
3. Interpret and apply current or emerging knowledge in telecommunication engineering.
4. Use relevant mathematics and computer science concepts as tools.

**Unit – I Introduction to digital and lP Telephony 7 Hours**

Digital Telephony: circuit switched networks, ss7, ISDN, Exchanges, E.164 Numbering Plans IP Telephony: Packet switched Networks, signaling & Media separation' Media Encapsulation ' RTP and RTCP, Audio and Video Codecs.

**Unit – II VolP Protocols 7 Hours**

H.323 Network Elements: Terminals, Gateway, Gatekeeper, Multi point Control Unit

H.323 protocol: RAS Channel, H.225 Call signaling, H.245 Media signaling

H.323 Call flows: Basic Audio and Video Call flows

SIP Network Elements: Registrar, Proxy, UAS, UAC, B2BUA

SIP Protocol: Requests and Responses, Methods, Headers and Parameters, Message structure, Transactions and Dialogs, Session Description Protocol SIP Call Flows: Basic Audio and Video Call Flows

H.248 protocol : Media Gateways, Media Gateway controllers, commands, Transactions, Contexts, Terminations, Descriptors' Packages

**Unit – III Unified Communications 7 Hours**

Local and Network features: Call Forward, Call coverage, Automatic Call Back, User Displays, Resource Optimization.

Voice & Data Integration: IM, presence, voice mail,

Collaboration: call Conferencing, Voice, Video, Data and content integration.

Mobility: Mobile Clients, Session Border Controllers.

Business Applications: Framework for custom applications, computer Telephony Interface, Application Sequencing.

**Unit – IV Inbound Contact Center 7 Hours**

Call Centers: Introduction, Evolution and classification of Contact Centers.

Inbound Contact Center :Introduction Self Service / Interactive Voice Response, Routing, Intelligent Routing, VXML

Agent : Skills, Selection Algorithms, Modes, Service Observing, Recording

**Unit – V Outbound Contact Center and Reporting 7 Hours**

Outbound contact center: Introduction, Proactive contact: voice, SMS, E-mail & chat. Contact Center Reporting: Types of Reports, Business use cases. Analytics: Agent Performance, Occupancy

**Unit – VI Emerging technologies in Telecommunications 7 Hours**

High Availability: Load balancing, Reliability, Failover & Failback, Location Redundancy, Hardware footprint, cloud Computing : Applications in Telecommunications Analytics in Voice & Data, Diagnostics & Management

Emerging Technologies: Google Glass, WebRTC, Hosting on Cloud.

**Text Books**

1. Allan Sulkin, "PBX Systems for IP Telephony", McGraw-Hill Professional

**Reference Books**

1. ITU-T H.323 Packet-based multimedia communications systems
2. ITU-TH.225Call Signaling Protocols and media stream packetization
3. ITU-T H-245 Control protocol for multimedia communication
4. IETF RFC 326131P: Session Initiation Protocol
5. IETF RFC4566 SDP: Session Description Protocol
6. Contact Center for' Dummies, Wiley Publishing Inc.
7. Real Time Communication with WebRTC, O'reilly Publishing

# 20PEIT 802C Information Retrieval

**Teaching Scheme:**
**Lectures:** 3 hrs/week
**Tutorial: --**

**Examination Scheme:**
**In-Semester:**50 Marks
**End-Semester:** 50 marks
**Credits:**3

**Prerequisites:** Data structures

**Course Objectives:**
Familiarize students with
1. Concepts of Information Retrieval System.
2. Indexing techniques of Information Retrieval System
3. Clustering in Information Retrieval System
4. Information sharing on semantic web

**Course Outcomes:**
Students will be able to:
1. Apply various algorithms for Information Retrieval System
2. Analyze Search Strategies used in Information Retrieval System
3. Apply different web mining concepts
4. Explain modern trends in Information Retrieval System

**Unit – I Introduction 7 Hours**
Basic Concepts of Information Retrieval, IR system architecture. Automatic Text Analysis: Luhn's ideas, Conflation Algorithm, Porter Stemmer, Retrieval Evaluation: Precision, Recall, F-Score, Mean Average Precision, Mean Reciprocal Rank, User oriented measures

**Unit – II Finite Automata with application 7 Hours**
Indexing and Index Term Weighing, Probabilistic Indexing, Inverted file, Suffix trees & suffix arrays, Signature Files, Clustered files, Cluster Hypothesis, Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm, Complete Link Algorithm

**Unit – III Search Strategies 7 Hours**
Retrieval strategies: Vector Space model, Probabilistic retrieval strategies, Language models, Inference networks, Extended Boolean retrieval, Latent semantic indexing, Fuzzy set retrieval

**Unit – IV Web Mining 7 Hours**
Searching the Web: Challenges, Characterizing the Web, Search Engines, Browsing, Mata-searchers, Web crawlers, Meta-crawler, Web data mining, Finding needle in the Haystack,

Searching using Hyperlinks

**Unit – V Semantic Search Systems 7 Hours**

Semantic Search systems, Semantic Web, Ontology, Searching across ontologies, semantic web search, Google knowledge graphs

**Unit – VI Trends In Information Retrieval 7 Hours**

Case Study: Google Analytics, Search Engine Optimization, Ranking Algorithms, Recommendation Systems: Collaborative Filtering

**Text Books**

1. Yates & Neto, "Modern Information Retrieval", Pearson Education, ISBN:81-297-0274-6
2. C.J. Rijsbergen, "Information Retrieval", (www.dcs.gla.ac.uk).,2ndISBN:978- 408709293

**Reference Books**

1. Grigoris Antoniou and Frank van Harmelen, "A semantic Web Primer", Massachusetts.
2. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutzen, "Introduction to Information Retrieval", Cambridge University Press, Online book, ISBN:978-0-521-86571-5.

# 20OE 801K Software Testing and Quality Assurance

**Teaching Scheme:** **Examination Scheme:**
**Lectures :** 3 hours/week **In-Semester :** 50 Marks
**Tutorial : --** **End-Semester :** 50 Marks
**Credit :** 3

**Prerequisites:**

**Course Objectives:**
Familiarize students with
1. Testing strategies in projects.
2. Levels of testing strategies
3. Various quality assurance models
4. Automated Testing Tools

**Course Outcomes:**
Students should be able to
1. Explain different terminologies in software testing.
2. Apply appropriate testing technique based on the project scenario
3. Choose quality assurance models for the project
4. Make use of modern testing tools suitable for the project

**Unit – I Fundamentals 7 Hours**
Testing as a Process, Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, Testing fundamentals, the defect repository and test design, Defect examples, Developer /Tester support for developing a defect repository. Process model to represent Different phases, Lifecycle models

**Unit – II Levels of testing 7 Hours**
Need for levels of testing, Unit testing, Integration testing, System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing, Stress testing, Regression testing, Alpha, Beta and Acceptance testing.

**Unit – III Testing techniques 7 Hours**
Using White Box Approach to Test design - Static Testing, Structural Testing, Unit Functional Testing, Challenges in White box testing, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing.

**Unit – IV Fundamentals of software quality assurance 7 Hours**

SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.

**Unit – V Quality assurance models 7 Hours**

Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM, Clean-room software engineering, Defect Injection and prevention, Inspections & Walkthroughs, Case Tools and their effect on Software Quality.

**Unit – VI Software test automation 7 Hours**

Software Test Automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug. Combining Manual and Automated Testing

**Text Books**

1. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing: Principles and Practices”, Pearson
2. Ilene Burnstein, “Practical Software Testing”, Springer International edition

**Reference Books**

1. Paul C. Jorgensen, “Software Testing: A Craftsman’s Approach”, Auerbach Publications
2. William Perry, “Effective Methods of Software Testing”, Wiley Publishing, Third Edition
3. Stephen Kan, “Metrics and Models in Software Quality”, Addison – Wesley, Second Edition
4. Watts S Humphrey, “Managing the Software Process”, Pearson Education Inc.

# 20OE 802A Applied Statistics with R programming

**Teaching Scheme:** 
**Lectures :** 3 hours/week
**Tutorial : --**

**Examination Scheme:**
**In-Semester : ** 50 Marks
**End-Semester :** 50 Marks
**Credit :** 3

**Prerequisites:** Mathematics

**Course Objectives:**
Familiarize students with
1. Fundamentals in Statistics
2. Evaluation and Interpretation of applied statistics
3. Hypothesis Test
4. R programming used in statistical analysis

**Course Outcomes:**
Students should be able to
1. Apply probability for statistical analysis.
2. Draw inferences from statistical analysis of data
3. Apply statistical methods and hypothesis tests on data
4. Explain Multivariate Analysis

**Unit – I Probability 7 Hours**

Introduction, conditional probability, Bayes Theorem and independence, random variable and Probability distribution, normal distribution.

**Unit – II Basic statistical measures 9 Hours**

Introduction to statistics, type of data, processing the data, classification, graphical representation.
Introduction Measures of central Tendency: Arithmetic Mean, Weighted Arithmetic Mean, Median, mode, Measurement of variation: Quartile, Average and Standard Deviations, Coefficient Variation, Measurement of skewness

Case Study with R programming
**Unit – III Analysis of Variance 8 Hours**

Normal distribution, evaluating normal distribution, Binomial distribution, confidence Intervals, central limit Theorem, ANOVA, Completely randomized design, Latin square Design, Duncan's Multiple Range Test

Case Study with R programming

**Unit – IV Types of hypothesis 9 Hours**

Introduction , types of hypothesis, Tests of hypothesis concerning means, hypothesis concerning proportions, Hypothesis concerning variations (Chi-square and F-tests), Chi square test for checking independence of categorized data, goodness of Fit Test

Case Study with R programming

**Unit – V Multivariate Analysis 9 Hours**

Correlation: Introduction , types of correlations, Correlation Analysis, correlation coefficients,
Regression: Introduction, Linear Regression, Regression analysis, regression coefficients.
MANOVA, Discrimination Analysis, Factor Analysis, Principle Component Analysis and Independent Component Analysis

Case Study with R programming

**Text Books**

1. S.P. Gupta, "Statistical Methods", Sultan Chand and sons Publication, 41st Edition.
2. B.L. Agarwal, "Basic Statistics", New Age Publication, 9th Edition
3. A. Papoulis, S.U. Pillai, "Probability Random Variables and Stochastic Processes", Tata McGraw Hill, (4th Edition)

**Reference Books**

1. S. M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier Publication, 5th Edition
2. Piegorsch W.W, "Statistical Data Analytics", Wiley Publication.
3. E. Rukmangadchari, E.K.Reddy, "Probability and Statistics", Pearson India Pvt.Ltd.,1st Edition
4. Rohatgi A.K. Md e. Saleh, "Introduction to Probability and Statistics", Wiley Publication Pvt. Ltd. 3rd Edition.

**Web References**

1. NPTEL NOC: Descriptive Statistics with R software, Prof. Shalabh, IIT Kanpur,
2. NPTEL NOC: Applied Statistics and Econometrics, Prof. Mukherjee, IIT Kanpur

# 20IT 801L Distributed Systems Laboratory

**Teaching Scheme:**
**Practical:** 2 hrs/week

**Examination Scheme:**
**In-Semester:** 25 marks
**Oral:** 25 marks
**Credits:** 1

**Prerequisites:** Computer Networks, Operating Systems, Database management Systems

**Course Objectives:**
Familiarize students with
1. Design and Implementation methodology for distributed systems applications
2. Applications of middleware technologies in distributed systems.
3. Methods of communication in distributed environment
4. Algorithms for synchronization and mutual exclusion

**Course Outcomes:**
Students should be able to
1. Implement middleware technologies that support distributed applications
2. Execute various communication protocols in distributed environment
3. Implement algorithms for distributed mutual exclusion and synchronization
4. Develop interoperable communication system using distributed object paradigm

**Suggested List of assignments:**

1. Apply concepts of Remote Procedure Call (RPC) to implement a middleware technology for any distributed application
2. Establish a client server communication using:
   a. Socket Programming
   b. Remote Method Invocation (RMI)
3. Implement Message Passing Interface (MPI) for any distributed application
4. Develop an interoperable communication system using distributed object concepts
5. Implement any one token based and one non-token-based leader election algorithm and evaluate the same
6. Develop any distributed application using Message queuing system in Publish-Subscribe paradigm.

**Text Books**

1. Andrew S. Tanenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

**Reference Books:**

1. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
2. M. L. Liu, "Distributed Computing Principles and Applications", Pearson Addison Wesley, 2004.
3. Sunita Mahajan, Seema Shah, "Distributed Computing", Oxford University Press, 2nd Edition, ISBN-13: 978-0198093480.
4. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni, Srikanth Sunderrajan, "Distributed System Security: Issues, Processes and solutions", Willey online Library, ISBN: 978-0-470-51988-2.
5. "Linux System Programming", 2nd Edition, Robert Love, O'reilly

# 20PEIT 801L A Advanced Machine Learning Laboratory

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| **Practical:** 2 hours/week | **In-Semester:** 25 Marks |
| | **Oral:** 25 marks |
| | **Credits:** 1 |

**Prerequisites:** Machine Learning

**Course Objectives:**
Familiarize students with
1. Dimensionality Reduction techniques
2. Programming of Machine and Deep Learning algorithms
3. Libraries for Ensemble Learning, Deep Learning etc.
4. Usage of large datasets

**Course Outcomes:**
Students will be able to:
1. Write programs for reducing dimensionality of datasets
2. Apply Machine Learning algorithms to large datasets
3. Implement Deep Learning algorithms for classifying images
4. Compare various Machine Learning algorithms

**Implement the following assignments using Python.**

1. Select a suitable dataset having a large number of dimensions from UCI/Kaggle/Weka. Statistically analyze this dataset.
    a. Classify this dataset using any classification algorithm. Note down accuracy, precision, recall, etc.
    b. Using this dataset apply Principal Component Analysis. Classify this data using the same classification algorithm and note down accuracy, precision, recall etc.
    c. Compare both the performances.
2. Select a suitable dataset from UCI/Kaggle/Weka.
    a. Classify the dataset using any classification algorithm. Note down accuracy, precision, recall etc.
    b. Classify the same dataset Ensemble Learning algorithm (any one).
        i. Boosting
        ii. Random Forest
    c. Compare both the performances.

3. Use any image dataset from MNIST (handwritten digits or clothing) and classify using Neural Network. Compare both the performances.
    a. Artificial Neural Network
    b. Convolutional Neural Network

**Text Books**

1. Andrea Muller and Sarah Guido, "Introduction to Machine Learning with Python", O"Reily – 2017.
2. Michael Bowles, "Machine Learning in Python", Wiley – 2018.

**Reference Books**

1. Ian H. Witten, Eibe Frank, Mark A Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Elsevier 3rd Edition.

**Other Resources**

1. UCI Machine Learning Repository https://archive.ics.uci.edu
2. WEKA Collection of datasets https://waikato.github.io/weka-wiki/datasets/
3. Kaggle datasets https://www.kaggle.com/datasets

# 20PEIT 801L B Introduction to DevOps Laboratory

**Teaching Scheme:** | **Examination Scheme:**

**Practical:** 2 hours/week | **In-Semester:** 25 Marks

**Oral:** 25 marks

**Credits:** 1

**Prerequisites:** Operating Systems and Cloud Computing

**Course Objectives:**

Familiarize students with

1. Insights of the DevOps environment
2. An overview of different DevOps tools
3. Continuous integration and testing
4. DevOps containerization

**Course Outcomes:**

Students will be able to:

1. Apply version control software for development
2. Apply continuous integration tool for the application developed
3. Apply containerization tool for the application deployment
4. Apply continuous monitoring tool for the application monitoring

**List of Assignment**

Build an application using DevOps. Use the following guidelines.

1. Use Version Control System for a document/program (check in/check out/update/pull/push modifications, create tags/branches)
2. Build a prototype of an application using tools (such as Maven). Prepare unit test case and execute
3. Test the prototype/application using Integration tests
4. Using Continuous Integration (CI)/Continuous Deployment (CD) automation tool (Jenkins), build pipeline. Integrate build stage. Integrate/API test stage with pipeline.
5. Set up DevOps environment for CI, CD (creation of non-root account, S3 bucket, IAM Role, attach policies, secret keys)
6. Integrate Jenkins with DevOps environment (secret keys exchange)
7. Define Jenkins pipeline incorporating, build, test and deploy (publish) stages – I
8. Define Jenkins pipeline incorporating, build, test and deploy (publish) stages - II
9. Deploy the application, run and troubleshoot

**Text Books**

1. Ethan Thorpe, "Devops: A comprehensive beginners guide to learn DevOps step by step"
2. Deepak Gaikwad, Viral Thakkar, "Devops Tools from Practioners" viewpoint, Wiley

**Reference Books**

1. David Johnson, "Devops for Beginners Handson guide", Createspace Independent.

# 20PEIT 801L C Design Patterns Laboratory

**Teaching Scheme:**
**Practical**: 2 hrs/week

**Examination Scheme:**
**In-Semester**: 25 marks
**Oral**: 25 marks
**Credits:** 1

**Prerequisites:** Object Oriented Analysis and Design Laboratory
Object Oriented Software Engineering

**Course Objectives:**

Familiarize students with

1. Achieving extendibility using Design Patterns
2. Incorporating creational design patterns in software design
3. Incorporating structural design patterns in software design
4. Incorporating behavioral design patterns in software design

**Course Outcomes:**

Students should be able to

1. Model scenarios to a creational design pattern code
2. Apply behavioral design pattern to overcome the class collaboration mismatch
3. Apply structural design pattern to reduce the structural incompatibility
4. Analyze the design document to meet extendibility and modifiability

**List of assignments to be implemented in Java**

1. Implement strategy design pattern
2. Implement decorator design pattern
3. Implement composite design pattern
4. Implement observer design pattern
5. Implement factory method design pattern
6. Implement proxy design pattern
7. Implement all applicable design patterns to the given design document

**Text Book**

1. Alan Shalloway and James Trott, "Design Patterns Explained: A new Perspective on object oriented design", Addison Wesley

**Reference Book**

1. Eric Gamma "Design Patterns: Elements of reusable object oriented software", Addison Wesley.

**Autonomous Program Structure of Second Year B. Tech. Third Semester (Mechanical Engineering)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem. | End Sem. | Practical | Oral | | |
| 20BSME301 | Calculus and Statistics (C&S) | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20ME301 | Engineering Metallurgy (EM) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME302 | Engineering Thermodynamics (ET) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME303 | Machining and Machine Tool Operations (MMTO) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME304 | Strength of Materials (SOM) | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20HS 301 | Universal Human Values-II | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME305L | Computer Aided Machine Drawing lab (CAMD Lab) | 0 | 0 | 4 | 25 | 0 | 25 | 0 | 50 | 2 |
| 20ME301L | Engineering Metallurgy Lab (EM Lab) | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME303L | Machining and Machine Tool Operations Lab (MMTO Lab) | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20AC301 | Audit Course (AC) | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | - |
| | **Total** | **16** | **4** | **10** | **375** | **300** | **50** | **25** | **750** | **24** |
| | **Grand Total** | **30** | | | **675** | | **75** | | | |

## S. Y. B. Tech. – Semester-I

| **Course Code** | **Calculus & Statistics** | **L** | **T** | **P** |
|---|---|---|---|---|
| **20BSME301** | | **3** | **-** | **-** |
| **Pre-requisite** | First order linear ordinary differential equations, Basics of Vector Algebra, Integration – basic properties, standard results, Beta & Gamma Functions, Basics of probability. | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. To provide sound knowledge of engineering mathematics
2. Strengthen thinking power to analyze
3. Solve engineering problems in their respective areas.

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to

1 Solve the higher order linear differential equation and apply it to the mass-spring system.
2 Compute the transforms of simple discrete and continuous functions and solve partial differential equation.
3 Apply the concepts of vector calculus to find vector differentiation and vector integration.
4 Apply the concepts of probability distributions and statistics to interpret the data.

| **Unit/Module: 1** | **Higher Order Linear Differential equation and application** | **9 hours** | **CO: 1** |
|---|---|---|---|

Higher order Linear differential Equation with constant coefficients, Applications in solving Engineering problems. Mass Spring system, Damping effects, Resonance.

| **Unit/Module: 2** | **Transforms** | **9 hours** | **CO: 2** |
|---|---|---|---|

**Fourier Transforms:** Finite Fourier Sine transform, Finite Fourier Cosine transforms, Inversion formula for Sine transform, Inversion formula for Cosine transform. Finite Fourier Sine and Cosine Transforms of derivatives. Discrete Time Fourier Transforms (DTFT) of standard sequences, Existence of DTFT, Properties of DTFT, Inverse DTFT.

**Laplace Transform:** Definition of Laplace transform , Inverse Laplace transform , Laplace and InverseLaplace Transform of standard functions and problems.

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Partial Differential Equations** | **7 hours** | **CO: 3** |
| Basic Concepts, Types of P.D.E. (Hyperbolic, Elliptic, Parabolic). Use of Finite Fourier Transforms for solving of P.D.E | | | |
| **Unit/Module: 4** | **Vector Differentiation** | **5 hours** | **CO: 4** |
| Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence, Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities. | | | |
| **Unit/Module: 5** | **Vector Integration** | **6 hours** | |
| Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. | | | |
| **Unit/Module: 6** | **Statistics and Probability Distribution** | **6 hours** | |
| Measure of Central tendency, Measure of Dispersion, Probability, Random variables, Distributions – Binomial , Poisson, Normal , Weibull. | | | |
| | **Total Lab hours:** | **42 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | B. S. Grewal, „Higher Engineering Mathematics ‟, Khanna Publications. |
| 2. | B. V. Ramana, „Higher Engineering Mathematics ‟, Tata McGraw Hill Publications (2007) |
| 3. | Peter V. O'neil,'Advanced Engineering Mathematics' ,Thomson Brooks / Cole, Singapore (5th edition ) (2007). |
| **Reference Books:** | |
| 1. | C.R.Wylie, L.C. Barrette, „Advanced Engineering Mathematics‟, McGraw Hill Publications, New Delhi.(6th edition)(2003) |
| 2. | Erwin Kreyszig ,'Advanced Engineering Mathematics' Wiley Eastern Ltd. (8th Student Edition), (2004). |
| 3. | S.C. Gupta, V.K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition) (2002). |
| 4 | Michael D. Greenberg, 'Advanced Engineering Mathematics ', Prentice hall College Div., (1998). |

| Course Code | Engineering Metallurgy | L | T | P |
|---|---|---|---|---|
| 20ME301 | | 3 | - | - |
| Pre-requisite | Engineering Physics, Engineering Chemistry, Engineering mathematics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**Course prepares students to**

1. Understand type of materials
2. Understand properties of materials.
3. Understand Constraints in Engineering Industry
4. Correlate the constraints and materials

**Course Outcomes:**

**Students will be able to**.

1. Correlate the relationship between processing-structure-property-performance of materials to define and evaluate properties relevant to engineering
2. Define and evaluate properties relevant to mechanical engineering
3. Cite usual types of failures in materials correlate the structure and integrity of materials with common failures and write their causes
4. Read binary phase diagram, predict and quantify phase transformation using phase diagrams.
5. Specify metals and alloys used in engineering industry.
6. Select method for modification of properties.

| Unit/Module: 1 | Crystal Structure: | 6hours | CO: 1 |
|---|---|---|---|

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

| Unit/Module: 2 | Mechanical Property measurement: | 6hours | CO: 2 |
|---|---|---|---|

Tensile, compression and torsion tests; Young‟s modulus, relations between true and engineering stress- strain curves, generalized Hooke‟s law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.Introduction to non-destructive testing (NDT

| Unit/Module: 3 | Failure theories: | 8 hours | CO: 3 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, | | | |
| **Unit/Module: 4** | **Phase diagrams:** | **6 hours** | **CO: 4** |
| Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron. | | | |
| **Unit/Module: 5** | **Metals and alloys:** | **6 hours** | **CO: 5** |
| Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys | | | |
| **Unit/Module: 6** | **Heat treatment of Steel:** | **6 hours** | **CO: 6** |
| Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening | | | |
| | **Total Lecture hours:** | **36 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016, Second edition. |
| 2. | Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heineman, 2008 |
| **Reference Books:** | |
| 1. | "Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988. |
| 2. | "Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003 |
| 3. | "Material selection in mechanical design', Michael Ashby, Butterworth-Heinemann, 3/e, 2005 |
| 4 | An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann. |
| 5. | Relevant ISO and Indian standards |

| Course Code | Engineering Thermodynamics | L | T | P |
|---|---|---|---|---|
| 20ME302 | | 2 | 1 | - |
| Pre-requisite | Engineering Physics, Engineering Mathematics, Engineering Chemistry | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. To state and illustrate laws of thermodynamics
2. To understand concept of entropy and availability.
3. To get conversant with properties of steam, vapor processes and steam trap.
4. To analyze the performance of various thermodynamics cycles.

**Course Outcomes:**

**Students will be able to**

1. Students will be able to apply laws of Thermodynamics to various processes.
2. Students will understand the concept of entropy and availability.
3. Students will gain the knowledge about steam properties and steam trap.
4. Students will be able to do performance calculations for various thermodynamic cycles.

| Unit :- 1 | Laws of Thermodynamics | 6 hours | CO: 1 |
|---|---|---|---|
| First law of thermodynamics, second law of thermodynamics, zeroth law of thermodynamics. First law applied to closed system and open system, Second law of thermodynamics, Corollaries of Carnot theorem, Second law applied to heat engine, heat pump and refrigeration cycles. | | | |
| **Unit :- 2** | **Entropy** | **4 hours** | **CO: 2** |
| Clausius Inequality, Entropy – a system property, Evaluation of entropy change for solids, liquids and ideal gases, Principle of increase of entropy- entropy generation. | | | |
| **Unit :- 3** | **Properties of Steam** | **5 hours** | **CO: 3** |
| Formation of steam, Properties of steam, First law applied to steam processes, Steam trap. | | | |
| **Unit :- 4** | **Thermodynamic Vapour Cycles** | **5 hours** | **CO: 4** |
| Carnot cycle, Rankine cycle , Reheat and Regeneration | | | |
| **Unit :- 5** | **Thermodynamic Gas Cycles** | **5 hours** | **CO: 4** |

| |
|---|
| Otto cycle, Diesel cycle, Dual cycle |

| | | | |
|---|---|---|---|
| | **Total hours:** | **25 hours** | |

**Text Books and Reference Books**



| | |
|---|---|
| 1. | Principles of Engineering Thermodynamics- Moran, Shapiro, Boettner, Baily Eighth Edition, Wiley Publication. |
| 2. | P. K. Nag, Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publications |
| 3. | C.P. Arora, Engineering Thermodynamics, Tata McGraw Hill |
| 4. | S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers |
| 5. | Cengel and Boles, „Thermodynamics – An Engineering Approach", 7th Edition, Tata Mc Graw Hill Publication. |
| 6. | Rayner Joel, "Basic Engineering Thermodynamics", Addison Wesley Longman |

| Course Code | Machining and Machine Tool Operations (MMTO) | L | T | P |
|---|---|---|---|---|
| 20ME303 | | 3 | - | - |
| Pre-requisite | -- | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. To familiarize with the basic concepts of machining science.
2. To acquaint with various single and multipoint cutting tools designing processes.
3. To make the students understand the economics of machining process

**Course Outcomes:**

**Students will be able to**

1. Identify different machining operation requirements for components considering economics of machining.
2. Select an appropriate single or multipoint cutting tool parameter to evaluate cutting force, power, tool life and surface finish for machining operation.
3. Apply features and applications of non-traditional machining processes.
4. Incorporate use of different locating and clamping devices for jigs and fixture design.
5. Understand the need of automation and its use in manufacturing.

| Unit/Module: 1 | Machine tools | 12 hours | CO: 1 |
|---|---|---|---|
| Material removing (turning, drilling and milling) & finishing processes (grinding, lapping, honing) process parameters, economics of machining | | | |
| **Unit/Module: 2** | **Metal Cutting Theory** | **10 hours** | **CO: 2** |
| Single and multipoint cutting tools (hobs and form tools), tool geometry and materials. Theory of chip formation in metal machining, force relationships and the merchant equation, power and energy relationships in machining, Tool life and tool wear. | | | |
| **Unit/Module: 3** | **Non-conventional machining processes** | **7 hours** | **CO: 3** |
| USM, WJM/WJAM, Chemical Machining, ECM, EDM, LBM, EBM, IBM process parameters and applications. | | | |
| **Unit/Module: 4** | **Jig & Fixture** | **6 hours** | **CO: 4** |

| | | | |
|---|---|---|---|
| Jig, fixtures types (basic and modular) and applications, design of jigs and fixtures. | | | |
| **Unit/Module: 5** | **Automation** | **7 hours** | **CO: 5** |
| CNC types, systems, codes, manufacturing automation (machining center, FMS). | | | |
| | **Total Lecture hours:** | **42 hours** | |

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|---|---|
| **Text Books:** | |
| 1. | Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication. |
| 2. | Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall. |
| **Reference Books:** | |
| 1. | Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group. |
| 2. | Jigs and Fixture, P.H. Joshi, Tata McGraw-Hill |
| 3. | Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press. |

| Course Code | Strength of Materials | L | T | P |
|---|---|---|---|---|
| 20ME304 | | 3 | 1 | -- |
| Pre-requisites | Engineering Mechanics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

1. Define stresses, strains and elastic constants and evaluate the principal stresses and principal planes
2. Explain basic concepts of shear force and bending-moment.
3. Determine the maximum Bending and shear stress in a given beam.
4. Develop slope and Deflection equations for beams subjected to various loads.
5. Evaluate the buckling strength of columns and torsional strength of circular members

**Course Outcomes:**

**Students will be able to**

1. Evaluate principal stress and principal strain.
2. Draw SF and BM diagrams for various beams under different loading conditions.
3. Formulate the bending and shear stresses equations and be able to draw bending and shear stress diagrams.
4. Formulate slope and deflection equations for beams subjected to various loads.
5. Determine torsional strength and buckling strength.

| Unit :1 | Simple and Compound Stress and Strain | 10 hours | CO: 1 |
|---|---|---|---|

Stress, strain, Hooke"s law, Poisson"s ratio, Modulus of Elasticity, Modulus of Rigidity, and Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram, factor of safety. Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self-weight. Temperature stresses in simple members, Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear. Graphical solution using Mohr"s circle of stresses. Principal stresses in shaft subjected to torsion, Bending moment and axial thrust Concept of equivalent torsion and bending moments

**Theories of Elastic Failure** :-Maximum Principal Stress Theory, Maximum shear stress theory, Maximum distortion Theory, Maximum Strain theory

| Unit : 2 | Shear Force and Bending Moment Diagrams | 6 hours | CO: 2 |
|---|---|---|---|

Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading,

| | | | |
|---|---|---|---|
| shear force and bending moment. Maximum bending moment and position of points of contra flexure. | | | |
| **Unit : 3** | **Bending and Shear Stresses in Beams** | **8 hours** | **CO: 3** |
| **Bending stresses :** Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C ) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.<br><br>**Shear stresses:** Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web. | | | |
| **Unit : 4** | **Slope and Deflection of Beams.** | **6 hours** | **CO: 4** |
| Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay"s method), derivation of formula for slope and deflection for standard cases. | | | |
| **Unit : 5** | **Torsion and Buckling.** | **6 hours** | **CO: 5** |
| **Torsion of circular member:** Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts.<br>**Buckling of columns:** Concept of buckling of columns, derivation of Euler"s formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, safe load on columns | | | |
| | **Total Theory Lecture hours:** | **36 hours** | |

| **Tutorial Assignments** | |
|---|---|
| 1. | Solving numerical on simple stress and strains |
| 2. | Analytical and Graphical Solution (Mohr"s Circle) for compound stresses. |
| 3. | Drawing SFD and BMD for standard beam and loading conditions. |
| 4. | Determine bending stresses and shear stresses in the beam. |
| 5. | Finding slope and deflection at various locations for standard beam and loading conditions. |
| 6. | Determination and Graphical representation using Python. **(Any One)**<br>*a)* Determine Principal Stresses, Maximum shear stresses and their locations by plotting Mohr's Circle using Python.<br>*b)* Plot SFD and BMD for a given beam using Python.<br>*c)* Find Bending/Shear Stresses and plot Bending/Shear Stress distribution using Python. |

| | |
|---|---|
| **Text Books:** | |
| 1. | Strength of Materials S. Ramamrutham, Dhanpat Rai Pvt. Ltd. |
| 2. | Elements of Strength of Materials, Timoshenko and Young Affiliated East West Press. |
| 3. | Mechanics of Materials S. S. Rattan, TMH Pvt. Ltd. |
| 4. | Mechanics of Structures S. B. Junnarkar, Charotar Publication |
| 5. | S.S Bhavikatti,"Strength of Materials", Third Edition Vikas Publishing house Pvt Ltd, New Delhi. |
| **Reference Books:** | |
| 1. | Mechanics of Materials, by Russell C. Hibbeler |
| 2. | Introduction to Mechanics of Solids - by E.P. Popov, Prentice Hall Publication. |
| 3. | Singer and Pytel - Strength of materials - Harper and row Publication. |
| 4. | B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi. |
| 5. | Beer and Johnston - Strength of materials - CBS Publication. |

| Course Code | Universal Human Values-II | L | T | P |
|---|---|---|---|---|
| 20HS301 | | 2 | 1 | -- |
| Pre-requisites | Nil | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**Course Outcomes:**

CO1 : Understand human values which is only the solution of most of the present-day problems and a sustained solution could emerge only through understanding of value-based living
CO2: Compare desires of „I" and „Body" distinctly. If any desire appears related to both, students are able to see that the feeling is related to I while the physical facility is related to the body
CO3: Develop Natural acceptance (intention) which is always for living in harmony which leads to fulfillment in relationships.
CO4:Understand the whole existence to see the interconnectedness in the Nature
CO5:Make use of sustainable solutions to the problems in the society and the Nature

| Module 1 | Introduction to Value Education | 6 hours | |
|---|---|---|---|

Understanding Value Education: Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility : Happiness and Prosperity – Current Scenario : Method to Fulfill the Basic Human Aspirations.

| Module 2 | Harmony in the Human Being | 6 hours | |
|---|---|---|---|

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to ensure self-regulation and Health.

| Module 3 | Harmony in the Family and Society | 6 hours | |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Harmony in the Family – the Basic Unit of Human Interaction: Values in Human-to-Human Relationship - 'Trust' the Foundational Value in Relationship, -„Respect" as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order. | | | |
| **Module 4** | **Harmony in the Nature/Existence** | **4 hours** | |
| Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Coexistence at All Levels - The Holistic Perception of Harmony in Existence. | | | |
| **Module 5** | **Implications of the Holistic Understanding – a Look at Professional Ethics** | **6 hours** | |
| Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession. | | | |
| | **Total Theory Lecture hours:** | **28 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | R. R. Gaur, R. Asthana, G. P. Bagaria, "The Textbook A Foundation Course in Human Values and Professional Ethics", *Excel Books*, *New Delhi,* (2nd Revised Edition), (2019). |
| 2. | R. R. Gaur, R. Asthana, G. P. Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", *Excel Books*, *New Delhi,* (2nd Revised Edition), (2019). |
| **Reference Books:** | |
| 1. | A. Nagaraj,"Jeevan Vidya: EkParichaya", *Jeevan Vidya Prakashan, Amarkantak,* (1999). |
| 2. | A.N. Tripathi, "Human Values", *New Age Intl. Publishers, New Delhi*, (2004). |
| 3. | Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", *Prakash books Publishers*, *Daryaganj, New Delhi.* |
| 4. | E. F. Schumacher, "Small is Beautiful", *Harper Collins Publishers, Noida, Uttar Pradesh*, (2010). |
| 5. | Cecile Andrews, "Slow is Beautiful", *New Society Publishers, Canada.* |
| 6 | J. C. Kumarappa, "Economy of Permanence", *Sarva Seva Sangh Prakashan, Wardha, Sevagram*, (2017). |
| 7 | Pandit Sunderlal, "Bharat Mein Angreji Raj", *Prabhat Prakashan, New Delhi* (2018). |
| 8 | Dharampal, "Rediscovering India", Society for Integrated Development of Himalayas, (2003). |
| 9 | Mohandas Karamchand Gandhi, "Hind Swaraj or Indian Home Rule", *Navajivan Publication House, Ahemadabad.* |
| 10 | Maulana Abdul Kalam Azad, "India Wins Freedom", *Orient BlackSwan,*(1989). |
| 11 | Romain Rolland,"Swami Vivekananda", *Advaita Ashrama Publication*, *Ramkrishna Math,* (2nd Edition), (2010). |
| 12 | Romain Rolland, "Gandhi", *Srishti Publishers & Distributor,* (2002). |

| Course Code | Engineering Metallurgy Lab (EM-L) | L | T | P |
|---|---|---|---|---|
| 20ME301L | | - | - | 2 |
| Pre-requisite | Engineering Physics, Engineering Chemistry, Engineering mathematics | Syllabus Version | | |
| | | V:1.1 | | |

The assessment will consist of two components:

1. Evaluation for performing practical and attending demonstrations in predefined closed system of lab instructions (Demonstration and exercise type of lab activity: **5 marks**)
2. Task based performance (Structured enquiry type and open ended enquiry type of lab activity: **20 marks**)

**Course Objectives:**

**Course prepares students to**

1. To provide first-hand experience of facilities for materials property testing and treating.
2. To provide an understanding of structures in material and their relation to properties

**Course Outcomes:**

**Students will be able to**.

1. Implement safety measures required in the laboratory
2. Measure mechanical properties and propose testing method for mechanical properties considered in design, quality assurance and servicing of engineering components
3. Inspect components for materials integrity using equipments in the laboratory.
4. Identify the phases in metals and alloys and measure grain size using metallography techniques to provide interpretation of microstructures and prepare a laboratory report.
5. Specify metals and alloys and find equivalents using standards.
6. Modify properties of steel by modifying microstructure using different heat treatments

| Unit/Module: 1 | Laboratory safety: | 2 hours | CO: 1 |
|---|---|---|---|
| Introduction to laboratory and safety | | | |
| Unit/Module: 2 | Mechanical Property measurement: | 6hours | CO: 2 |
| Tension, hardness and Impact tests. | | | |
| Unit/Module: 3 | Inspection of Components: | 2 hours | CO: 3 |

| | | | |
|---|---|---|---|
| Non destructive test | | | |
| **Unit/Module: 4** | **Metallography:** | **6 hours** | **CO: 4** |
| Study of microstructures of ferrous and non ferrous metals and alloys | | | |

| | | | |
|---|---|---|---|
| **Unit/Module: 5** | **Metals and alloys specification:** | **2 hours** | **CO: 5** |
| Study and use standards for specification of metals and alloys. | | | |
| **Unit/Module: 6** | **Modification of material properties:** | **6 hours** | **CO: 6** |
| Heat treatment of metals and alloys | | | |
| | **Total Lecture hours:** | **24 hours** | |
| **Text Books:** | | | |
| 3. | Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016, Second edition. | | |
| 4. | Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heineman, 2008 | | |
| **Reference Books:** | | | |
| 1. | "Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988. | | |
| 2. | "Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003 | | |
| 3. | "Material selection in mechanical design', Michael Ashby, Butterworth-Heinemann, 3/e, 2005 | | |
| 4 | An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann. | | |
| 5. | Relevant ISO and Indian standards | | |

| Course Code | **Machining and Machine Tool Operations Lab (MMTO-L)** | **L** | **T** | **P** |
|---|---|---|---|---|
| **20ME303L** | | **-** | **-** | **2** |
| **Pre-requisite** | None | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. To familiarize with the basic concepts of machining science.
2. To acquaint with various single and multipoint cutting tools designing processes.
3. To make the students understand the economics of machining process

**Course Outcomes:**

**Students will be able to**

1. Identify different machining operation requirements for components considering economics of machining.
2. Select an appropriate single or multipoint cutting tool parameter to evaluate cutting force, power, tool life and surface finish for machining operation.
3. Apply features and applications of non-traditional machining processes.
4. Understand the need of automation and its use in manufacturing.

**Lab Work**

| | |
|---|---|
| 1. | Demonstration of physical hazards, safety and precautions. |
| 2. | Experimental studies on the cutting tool angle measurement. |
| 3. | Machining of mechanical components using CNC machine (Lathe/Mill/HMC/VMC). Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included. |
| 4. | Composite job machining involving minimum four operations, employing operations on lathe/CNC, precision turning, screw cutting, boring etc. |
| 5. | Cutting Force in Turning Process-an Experimental Approach by using dynamometers. |
| | **Total Lab hours:** **22 hours** |

**Text Books:**

| | |
|---|---|
| 3. | Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication. |
| 4. | Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall. |

| **Reference Books:** | |
|---|---|
| 1. | Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group. |
| 2. | Jigs and Fixture, P.H. Joshi, Tata McGraw-Hill |
| 3. | Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press. |

| Course Code | Computer Aided Machine Drawing Lab (CAMD-L) | L | T | P |
|---|---|---|---|---|
| 20ME305L | | - | - | 4 |
| Pre-requisite | Engineering Graphics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. Conversant with conventional representation of common features and standards
2. Understand the basics of projections and dimensioning techniques
3. Aware of drawing the threaded fasteners and riveted joints
4. Understand the use of dimensional and geometrical tolerances
5. Accustomed to the use of 3-D modeling software
6. Aware of 3-D printing technology

**Course Outcomes:**

**Students will be able to**

1. Interpret machine components and represent it through IS conventions
2. Understand the conventional methods of representing threaded fasteners and riveted joints
3. Apply tolerances of size, forms & positions
4. Create 3-D part and assembly model of mechanical system
5. Create manufacturing drawing with all the details
6. Create components using 3-D printing machine

| Unit/Module: 1 | Conventional Representation | 2 hours | CO: 1 |
|---|---|---|---|

Need of graphical language, importance of machine drawing, drafting equipment (from instrument to current software). Principles of drawings: BIS conventions, ISO standards, IS conventions of springs, gear, shaft, pipe, bar, washer, knurling, array of holes, ratchet and pawl angle etc.

| Unit/Module: 2 | Basics of Projections and dimensioning | 2 hours | CO: 5 |
|---|---|---|---|

**Projections–** dimensioning, relative position of views.

**Sectioning–** Cutting planes and section, hatching lines, half sections, aligned sections, offset sections, sectioning revolved, removed sections, local sections.

**Dimensioning–** principle of dimensioning, dimensioning of common features e.g. diameter, radii, chords, arcs, angles, countersunk, counter drilled holes, counter-bore holes, chamfered and countersunk holes on curved surfaces, spot faces, chamfers, tapered features. Addition of letters and symbols, special indications.

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Threaded Fasteners and Riveted joints** | **2 hours** | **CO: 2** |
| **Threaded Fasteners–** Different screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts.<br>**Locking devices–** lock nut-castle nut-Studs-Tap bolt-Machine screws washers- Keys-sunk key-Gib head key. (For a given standard diameter with proportions).<br>**Riveted joints–** Forms and proportions of river heads, Different views of different types of riveted Lap and Butt joints. | | | |
| **Unit/Module: 4** | **Limit, fits, tolerances and Geometrical dimensioning and tolerancing** | **4 hours** | **CO: 3** |
| **Limits, fits and tolerances–** tolerancing and limit systems, symbols for tolerances, deviation and fits, method of tolerancing, tolerance grade, fits- system of fits, classification of fits, selection of fits, methods of indicating fits on drawing.<br>**Geometrical tolerance–** Need, geometrical characteristics of symbols, characteristics (such as straightness, flatness, circularity, cylindricity, etc) its symbols and interpretations. | | | |
| **Unit/Module: 5** | **Part Modelling** | **12 hours** | **CO: 4** |
| **Parametric solid modeling -** fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, Free form feature modeling, design by features, feature recognition. | | | |
| **Unit/Module: 6** | **Assembly Modelling** | **14 hours** | **CO: 4** |
| Defining relationship between various parts of machine, creation of constraints, and generation of exploded view. Animation of the motions of assembly. | | | |
| **Unit/Module: 7** | **Production Drawing** | **10 hours** | **CO: 5** |
| Generation of manufacturing drawing from parts and assembly 3-D model with representation of appropriate dimensioning and tolerancing. | | | |
| **Unit/Module: 8** | **Introduction to 3-D printing** | **6 hours** | **CO: 6** |
| Introduction to use of 3-D printing technology for manufacturing of a component. | | | |
| | **Total Lab hours:** | **52 hours** | |

**Lab Work**

| | |
|---|---|
| 1. | Assignment on drawing IS conventions, threaded fasteners and riveted joints using the basics of projections and dimensioning rules. (to be completed manually) |
| 2. | Assignment on solid modeling of a machine component. (minimum 10 machine components) |
| 3. | Assignment on parametric solid modeling of a machine component using various commands and features of the software. (minimum 2 machine components) |
| 4. | Assignment on assembly modeling using proper mating conditions and generation of exploded view. (minimum 5 assemblies) |
| 5. | Assignment on creating production drawing with the limit, fits and tolerance representation. |

| | |
|---|---|
| 6. | Design and Manufacturing of an assembly (4-5 components) using 3-D printing. |
| **Text Books:** | |
| 1. | N. D. Bhat, "Machine Drawing", Charotor publishing house, Bombay. |
| 2. | R. K. Dhavan, "Machine Drawing", S. Chand and Company. |
| 3. | N. D. Junnarkar, "Machine Drawing", Pearson Education. |
| 4. | IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications. |
| 5. | IS: 696- Code of practice for general engineering drawing B.I.S. Publications. |
| 6. | IS: 2709- Guide for selection of fits, B.I.S. Publications. |
| 7. | IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications. |
| 8. | IS: 8000- Part I, II, III, IV, geometrical tolerancing of technical drawing – B.I.S. Publications |
| **Reference Books:** | |
| 1. | P. S. Gill, "A textbook of Machine Drawing", revised edition, K Kataria and Sons, New Delhi, 2008, ISBN 81-85749-79-5. |

**Autonomous Program Structure**
**Second Year B. Tech. Fourth Semester**
**(Mechanical Engineering)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours/ Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20ES401 | Elements of Electrical and Electronics Engineering | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20ME401 | Analysis and Synthesis of Mechanisms (ASM) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME402 | Fluid Mechanics (FM) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME403 | Casting, Forming and Joining Processes (CFJP) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME404 | Machine Design (MD) | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20ME405L | Design Lab – I (SOM & ASM) | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME402L | Fluid Mechanics (FM) Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20ME403L | Machine Shop (MS) Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20AC401 | Audit Course (AC) | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **14** | **4** | **8** | **325** | **250** | **50** | **25** | **650** | **20** |
| | **Grand Total** | **26** | | | **575** | | **75** | | | |

## S. Y. B. Tech. – Semester-II

| Course Code | **Elements of Electrical and Electronics Engineering** | L | T | P |
|---|---|---|---|---|
| **20ES401** | | **3** | **1** | **0** |
| **Pre-requisite** | 20ES01 Basic Electrical and Electronics Engineering | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

1. To study principle of operation of DC machines and speed control of DC motors
2. To understand three phase induction motor working and its applications
3. To study Electrical drive system required to drive machines
4. To get acquainted with Electric Vehicle (EV) technology and subsystems
5. To understand Arduino IDE; an open source platform and its basic programming features
6. To interface Atmega328 based Arduino board with different devices and sensors

**Course Outcomes:**

At the end of this course students will demonstrate the ability to:

- Describe the working principle, characteristics and applications of D.C motor and Induction motor.
- Apply fundamental speed control methods of D.C motor and Induction motor.
- Describe different electrical drive systems and explain emerging technology of Electric Vehicle (EV)
- Explain Microcontroller Architecture of ATMega328 and Arduino IDE
- Interface external peripherals and sensors to ATMega328

**Unit :- 1** **DC Machines**

Construction, working principle of DC Machine, emf equation of DC Machine. Working principle of DC motor. Types of DC motor, back emf, torque equation for DC motor, characteristics of DC motor (series, shunt and compound), Braking of D.C. Motor, methods for speed control of DC shunt and series motors, Industrial applications.

**Unit :- 2** **Three phase Induction Motor**

Constructional feature, working principle of three phase induction motors, types, torque equation, torque slip characteristics, power stages and efficiency. Types of starters, Braking of induction motor, methods of speed control & Industrial applications.

| | |
|---|---|
| **Unit :- 3** | **Electrical Drives and Introduction to Electric vehicles** |
| **Electrical Drives**: Advantages of Electrical Drives, Parts of electrical drives, choice of electric drive, Status of ac and dc drives, Brush less dc motor drives, stepper motor drives, synchronous motor variable speed drive.<br>**Introduction to electric vehicles:** Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison, Challenges faced by EV technology | |
| **Unit :- 4** | **Introduction to Microcontrollers** |
| Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega 328P-features, architecture, port structure, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements. | |
| **Unit :- 5** | **Peripheral Interface - 1** |
| Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE | |
| **Unit :- 6** | **Peripheral Interface – 2** |
| Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM | |
| | **Total Theory Lecture hours:** **40 hours** |

**Text Books:**

1. Electrical Machines-D P Kothari and I J Nagrath, Tata McGraw Hill ,Third Edition
2. Electrical Machinery-S.K. Bhattacharya, TTTI Chandigad
3. Fundamentals of Elecrical drives-G K Dubey
4. Ajay Deshmukh-Microcontrollers Theory and Applications, TATA McGraw Hill
5. Arduino microcontroller processing for everyone -Steven F Barret,Morgan and Claypool Publisher.
6. C programming with ardino - Warwick Smith Elektor Publication
7. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press
8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2nd Ed, CRC Press
9. Application notes from “ATMEL micro controller data book.

**List of Tutorials:**

| | Name of the Tutorial |
|---|---|
| 1 | Introduction to Microprocessors and Microcontrollers |
| 2 | Case studies on Embedded Systems and Applications. |
| 3 | Interfacing of LED with Arduino UNO to observe different patterns of LEDs. |
| 4 | Interfacing of LCD with Arduino UNO to display the messages. |
| 5 | Display data using serial communication using Arduino UNO. |
| 6 | Interfacing of Temperature Sensor LM35 to display temperature. |
| 7 | Speed control of DC Motor. |
| 8 | Speed control of Induction Motor. |

| Course Code | **Analysis and Synthesis of Mechanisms** | **L** | **T** | **P** |
|---|---|---|---|---|
| **20ME401** | | **3** | **1** | **0** |
| **Pre-requisite** | Engineering Mechanics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. To understand the fundamentals of Mechanisms.
2. To understand analysis of mechanisms by analytical and graphical methods.
3. To understand dimensional synthesis of mechanisms by analytical and graphical methods.
4. To understand the kinematics of Gears and Gear Trains.
5. To understand kinematics of friction

**Course Outcomes:**

**Students will be able to**

1. Identify the nature of kinematic pair, chains and Mechanism.
2. Construct and analyze velocity and acceleration polygon of Simple mechanism by analytical and graphical method.
3. Perform dimensional synthesis of mechanisms by analytical and graphical methods.
4. Evaluate Speed ratio and Torque for Gear and Epicyclic Gear train.
5. Evaluate torque transmission in clutches and braking torque in brakes.

| **Unit :- 1** | **Fundamentals and Types of Mechanisms** | **8 hours** | **CO: 1** |
|---|---|---|---|

Kinematic Link, types of links, kinematic pair, types of constrained motion, types of kinematic Chains, types of joints, mechanism , machine, degree of freedom, Kutzbach criterion, Grubler's criterion, Grashoff's law, four bar chain and its inversion, Slider crank and its inversion, double slider crank and its inversion, straight line mechanism, Peaucellier Mechanism, Scott Rusell Mechanism, Grasshopper Mechanism, Watt Mechanism. Steering Gear Mechanism, Condition for correct steering, Davis and Ackermann Steering Gear Mechanism.

| **Unit :- 2** | **Displacement, Velocity, and Acceleration Analysis of Mechanism** | **11 hours** | **CO: 2** |
|---|---|---|---|

Kinematics of Rigid Bodies: Types of motions, position velocity and acceleration
Analytical and Graphical method for displacement, position analysis of links with vector and complex algebra methods, Loop Closure equation, chase solution, input and output curves, transmission angle.

| | | | |
|---|---|---|---|
| Analytical Method-velocity and acceleration analysis for four bar and slider crank mechanisms using vector and complex algebra methods<br>Graphical Method-velocity and acceleration polygons for simple mechanisms as well as for the mechanisms involving the Coriolis component of acceleration. ICR Method. | | | |
| **Unit :- 3** | **Dimensional Synthesis of Mechanism-Analytical and Graphical Method** | **9 hours** | **CO: 3** |
| Introduction to Synthesis of Mechanism-Type, number and dimensional synthesis, task of dimensional synthesis, path, function and motion generation(body guidance), precision positions, Chebychev spacing, Mechanical and structural errors.<br>Graphical Method: Two and three position synthesis of four bar and slider crank mechanisms.<br>Analytical Method: Three position synthesis of four bar mechanism using Freudenstein's Equation. | | | |
| **Unit :- 4** | **Kinematics of Gear and Gear Train** | **8 hours** | **CO: 4** |
| Gear Terminology, law of gearing, forms of teeth, path of contact, arc of contact, Number of pairs of teeth in contact (contact ratio), Interference in involute gears, minimum number of teeths, interference between rack and pinion, helical and spiral gear, terminology in helical gear, velocity ratio and centre distance of helical gear, Worm and Worm gear, velocity ratio and centre distance of worm gear, Efficiency of helical, spiral and worm gear. Kinematics of Bevel Gear.<br>Gear Train: types of gear train, Analysis of Epicyclic Gear train. | | | |
| **Unit :- 5** | **Friction** | **4 hours** | **CO: 5** |
| Laws of Friction, coefficient of friction, screw thread, pivots and collars, friction clutches, rolling friction, Greasy Friction, Friction axis of link, film friction. | | | |
| | **Total Theory Lecture hours:** | **40 hours** | |
| **Tutorial Assignments** | | | |
| 1. | Fundamentals of Mechanisms and Degree of Freedom of Mechanism | | |
| 2. | Mechanisms and Its Inversions | | |
| 3. | Planar Kinematics of Rigid body | | |
| 4. | Planar Kinetics of Rigid body | | |
| 5. | Displacement Analysis of Mechanism: Analytical and Graphical Method | | |
| 6. | Velocity and Acceleration Analysis of Mechanism: Analytical and Graphical Method | | |
| 7. | Dimensional Synthesis of Mechanism analytical method | | |
| 8. | Kinematics of Gears | | |
| 9. | Analysis of Epicyclic Gear Train | | |
| **Text Books:** | | | |

| | |
|---|---|
| 1. | S.S.Rattan, Theory of Machines, Tata McGraw Hill |
| 2. | Asok Kumar Mallik, Amitabha Ghosh, and Gunter Dittrich. Kinematic analysis and synthesis of mechanisms. CRC Press, 1994. |

| Reference Books: | |
|---|---|
| 1. | Thomas Bevan, „Theory of Machines" CBS Publisher and Distributors, Delhi |
| 2. | Hartenberg, Richard Scheunemann, and Jacques Denavit. „Kinematic Synthesis of linkages". McGraw-Hill, 1964. |
| 3. | Shiley J. E. and Uicker J.J. , „Theory of Machines and Mechanism", McGraw Hill Inc |
| 4 | Ashok G. Ambekar, „Mechanisms and Machine Theory", Prentice Hall,India |
| 5. | Sadhu Singh, „Theory of Machines", Pearson |
| 6. | Hall A. S. „Kinematics and Linkage Design",Prentice Hall |
| 7. | Wilson C.E., Sandler J.P. „Kinematics and Dynamics of Machinery", Pearson Education |
| 8. | Erdman A.G. and Sandor G. N. „Mechanism Design, Analysis and Synthesis Vol-I, Prentice Hall |

| Course Code | Fluid Mechanics | L | T | P |
|---|---|---|---|---|
| **20ME402** | | **2** | **1** | **-** |
| **Pre-requisite** | Engineering Physics, Engineering Mathematics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. Applying the mass conservation principle, to engineering problems.
2. Applying the momentum and energy equations to engineering problems.
3. Evaluating head loss in pipes and conduits.
4. Introduction to formation of boundary layer, drag and lift concept associated with it

**Course Outcomes:**

**Students will be able to**

1. Apply mass conservation principle to the given system.
2. Understand energy conservation principle for fluid flow.
3. Calculate the pressure drop for a given system.
4. Explain the boundary layer formation on the flat plate.

| Unit :- 1 | Fundamental Concepts of Fluid Flow | 2 hours | CO: 1 |
|---|---|---|---|

Fundamental definitions, Flow characteristics, Classification of fluids, Fluid properties

| Unit :- 2 | Flow Kinematics | 4 hours | CO: 1 |
|---|---|---|---|

Equations for acceleration, Continuity equation, Irrotational and rotational flow, Potential and stream functions.

| Unit :- 3 | Integral Analysis of Fluid Flow | 6 hours | CO: 2 |
|---|---|---|---|

Finite control volume analysis ( Reynolds Transport Theorem) , Euler and Bernoulli"s theorems,

Applications, Venturi and Orifice meter, Pitot Tube

| Unit :-4 | Pipe Flows | 5 hours | CO: 3 |
|---|---|---|---|

Types of flow, Reynolds experiment, Laminar flow between parallel plates, Laminar flow in pipes, turbulent flow in pipes. Darcy-Weisbach equation, Moody diagram, Energy losses in pipelines, Minor losses.

| | | | |
|---|---|---|---|
| **Unit :- 5** | **Differential Analysis of Fluid flow** | **6 hours** | **CO: 2,3** |
| Introduction to Navier- Stokes equations, Exact solutions for simple cases of flow, Plane Poiseuille flow ( Pipe and Channel), Coutte flow, Flow on inclined plane | | | |
| **Unit :- 6** | **Flow past immersed Bodies** | **2 hours** | **CO: 4** |
| Concepts of boundary layer, Drag and lift on immersed bodies. | | | |
| | **Total hours:** | **25 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Munson, Okiishi, Young, „Fluid Mechanics", 7th Ed, Wiley, 2016. |
| 2. | Cengel, Cimbala, „Fluid mechanics", Tata Mcgraw hill publishing |
| **Reference Books:** | |
| 1. | Gupta and Gupta, „Fluid Mechanics", 3rd Ed, New Age publications, 2016. |
| 2. | Kundu, Cohen, Dowling, „Fluid Mechanics", Elsevier India |
| 3. | K. Muralidhar, G. Biswas, „Advance Fluid Mechanics", 3rd Edition, Narosa Publishing House |
| 4. | Fox, Mcdonald, „Fluid Mechanics", 8th Edition, Wiley. |

| Course Code | Casting, Forming and Joining Processes (CFJP) | L | T | P |
|---|---|---|---|---|
| 20ME403 | | 3 | - | - |
| Pre-requisite | Machining and Machine Tool Operations | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. To study basic production processes
2. To study how to select appropriate production processes for a specific application

**Course Outcomes:**

**Students will be able to**

1. Understand basics of manufacturing, elements of casting, construction of pattern, gating system, different types of casting method and their application.
2. Various welding technologies' fundamentals should be recognized, analyzed, and configured.
3. Analyze principles and working of different forming processes such as sheet metal working, forging, rolling and extrusion.
4. Identify different machining operation requirements for non-metal components.

| Unit/Module: 1 | Metal Casting Processes | 9 hours | CO: 1 |
|---|---|---|---|
| Dispensable and permanent mould processes, Analysis of melting, pouring and solidification phenomena, design of pattern, core, feeder and gating system, Casting defects and inspection. | | | |
| **Unit/Module: 2** | **Joining Processes** | **9 hours** | **CO: 2** |
| Introduction, Fusion and solid-state welding, Brazing and soldering, Weld joint design, cooling rate, and joint properties, Heat affected zone, Friction stir welding, reduced pressure EB welding, Metal to composite joining, Welding defects and inspection | | | |
| **Unit/Module: 3** | **Bulk Deformation** | **9 hours** | **CO: 3** |
| Plastic deformation and yield criteria, bulk deformation, cold versus hot working. Analysis (load and force estimation) and defects in deformation processes forging, rolling, drawing and extrusion. | | | |

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Sheet Metal forming** | **8 hours** | **CO: 3** |
| Sheet metal shearing, deep drawing, bending and their applications, drawing ratio, forming limit diagram and analysis | | | |
| **Unit/Module: 5** | **Polymer Processing and sustainable manufacturing** | **7 hours** | **CO: 4** |
| Polymer basics, Injection molding process and analysis, Compression molding, Blow molding, Introduction to composite manufacturing, Environmental impact in Micro-device manufacturing, cutting tool sustainability, MQL in Machining. | | | |
| | **Total Lecture hours:** | **42 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication |

**Reference Books:**

| | |
|---|---|
| 1. | Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall. |
| 2. | Mechanical Engineers' Handbook, Volume 3: Manufacturing and Management, Myer Kutz, Wiley. |
| 3. | Manufacturing processes Vol. 1 and 2, P. N. Rao, Tata McGraw-Hill. |

| Course Code | Machine Design | L | T | P |
|---|---|---|---|---|
| **20ME404** | | **3** | **1** | **-** |
| **Prerequisite** | Strength of machine elements (S.O.M.) | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:** To make students

1. To design simple machine elements subjected to static loads.
2. To compute the torque transmission capacity by the given power screw.
3. To analyze the machine elements subjected to fluctuating loads.
4. To apply A.S.M.E. code for shaft design.
5. To calculate the size of a mechanical joint, subjected to eccentric load.
6. To determine the spring dimensions for a given requirement.

**Course Outcomes:**

After successful completion of the course, student will be able to

1. design simple machine elements subjected to static loads.
2. compute the torque transmission capacity by the given power screw.
3. analyze the machine elements subjected to fluctuating loads.
4. apply A.S.M.E. code for shaft design.
5. calculate the size of a mechanical joint, subjected to eccentric load.
6. design helical spring for given requirements.

| Unit/Module: 1 | Introduction to design engineering | 4 hours | CO: 1 |
|---|---|---|---|

Phases and interactions in design process, design considerations, design tools and resources, design engineer's professional responsibilities, standards and codes, economics aspects.

| Unit/Module: 2 | Failure Prevention: Design against static load | 8 hours | CO: 1 |
|---|---|---|---|

Modes of failures, combined stresses, principal stresses, failure theories and their selection, eccentric loading, design of simple machine elements subjected to static loading.

| Unit/Module: 3 | Failure Prevention: Design against fluctuating load | 8 hours | CO: 3 |
|---|---|---|---|

Fatigue failure, endurance limit and its modifying factors, endurance strength, design for infinite and finite life for completely reversed and fluctuating loads.

| Unit/Module: 4 | Design of machine elements-I: Transmission Shafts | 6 hours | CO: 4 |
|---|---|---|---|

Shaft design based on strength, deflection considerations, torsional and lateral rigidity, ASME code for

| | | | |
|---|---|---|---|
| shaft design, critical speed of shafts, design of keys and splines. | | | |
| **Unit/Module: 5** | **Design of machine elements-II: Mechanical Springs and Power Screws** | **8 hours** | **CO: 2,6** |
| Stress and deflection analysis of helical springs, design for static and fatigue loading, springs in combination, leaf springs.<br>Torque analysis of power screws, standard threads, thread and collar friction, efficiency and stresses in power screws. | | | |
| **Unit/Module: 6** | **Design of machine elements-III: Mechanical Joints** | **8 hours** | **CO: 5** |
| Bolts of uniform strength, fastener stiffness and member stiffness, threaded joints subjected to axial loading and eccentric loading in different planes.<br>Strength of butt and fillet welded joints in torsion and bending, sizing of welded joints subjected to direct and eccentric loads. | | | |
| | **Total hours:** | **42 Hours** | |

**Reference Books:**


| | |
|---|---|
| 1. | Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd |
| 2. | Spotts M.F. and Shoup T.E. ,"Design of Machine Elements" ,Prentice Hall International. |
| 3. | Black P.H. and O. Eugene Adams ,"Machine Design",McGraw Hill Book Co. Inc. |
| 4. | Willium C. Orthwein,"Machine Components Design",West Publishing Co. and Jaico Publications House. |
| 5. | "Design Data",P.S.G. College of Technology, Coimbatore. |
| 6. | Juvinal R.C,"Fundamentals of Machine Components Design",John Wiley and Sons. |
| 7. | Hall A.S., Holowenko A.R. and Laughlin H.G,"Theory and Problems of Machine Design" , Schaum‟s Outline Series. |
| 8. | Michael Nikowitz, „Advanced Hybrid and Electric Vehicles, System Optimization and Vehicle Integration‟, Springer International Publishing Switzerland 2016. |
| 9. | Iqbal Husain, „Electric and Hybrid Vehicles, Design Fundamentals‟, CRC PRESS. |


**Text Books:**


| | |
|---|---|
| 1. | Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd. |

| Course Name | Design Lab- I (ASM & SOM-L) | L | T | P |
|---|---|---|---|---|
| Course Code | 20ME405 | - | - | 2 |
| Pre-requisite | Analysis and Synthesis of Mechanism, and Strength of Materials | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. To understand the fundamentals of Mechanisms for Practical Application.
2. To understand dimensional synthesis of mechanisms by graphical methods
3. To understand the Cam jump phenomenon, Epicyclic Gear Train and Gyroscopic principle
4. To determine experimental data include universal testing machines and torsion equipment.
5. To determine stress analysis and design of beams subjected to bending and shearing loads using several methods.

**Course Outcomes:**

**Students will be able to**

1. Draw Mechanisms for practical Application
2. To understand dimensional synthesis of mechanisms by graphical methods
3. To understand and perform experiment for Cam Jump phenomenon , Epicyclic Gear Train and Gyroscopic principle
4. Understand the basic concepts of stress, strain, deformation, and material behaviour under different types of loading (axial, torsion, bending).
5. Perform stress analysis and design of beams subjected to bending and shearing loads using several methods.

**Lab Work (Any 8)**

| | |
|---|---|
| 1. | To draw mechanisms for Practical Application and straight line mechanisms. |
| 2. | To Synthesize the 4-bar mechanism using relative pole method and inversion methods with 3-precision points. |
| 3. | To synthesize the slider crank mechanism using relative pole method and inversion methods with 3-precision points. |
| 4. | Epicyclic Gear Train |
| 5. | Cam Jump Phenomenon |
| 6. | Gyroscopic Principle |

| | | | |
|---|---|---|---|
| 7. | Tension test | | |
| 8. | Compression Test | | |
| 9. | Direct Shear Test | | |
| 10. | Bending Test | | |
| 11. | Torsion Test | | |
| 12. | Impact test | | |
| | **Total Lab hours:** | **18 hours** | |
| **Text Books:** | | | |
| 1. | S.S.Rattan, Theory of Machines, Tata McGraw Hill | | |
| 2. | Asok Kumar Mallik, Amitabha Ghosh, and Gunter Dittrich. Kinematic analysis and synthesis of mechanisms. CRC Press, 1994. | | |
| 3. | Strength of Materials S. Ramamrutham, Dhanpat Rai Pvt. Ltd | | |
| **Reference Books:** | | | |
| 1. | Thomas Bevan, „Theory of Machines" CBS Publisher and Distributors, Delhi | | |
| 2. | Hartenberg, Richard Scheunemann, and Jacques Denavit. „Kinematic Synthesis of linkages". McGraw-Hill, 1964. | | |
| 3. | Mechanics of Materials, by Russell C. Hibbeler | | |
| 4. | Singer and Pytel - Strength of materials - Harper and row Publication. | | |

| Course Code | **Fluid Mechanics Lab** | L | T | P |
|---|---|---|---|---|
| **20ME402L** | | - | - | 2 |
| **Pre-requisite** | Engineering Physics, Engineering Mathematics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. Applying the mass conservation principle, to engineering problems.
2. Applying the momentum and energy equations to engineering problems.
3. Evaluating head loss in pipes and conduits.
4. Introduction to formation of boundary layer, drag and lift concept associated with it

**Course Outcomes:**

**Students will be able to**

1. Students will understand the basic experimental techniques in fluid mechanics.
2. Students will be present the results in the graphical form.
3. Students will able to measure the pressure drop in a pipe determine friction factor.
4. Students will able to understand the process of calibration of flow meters.

| **Lab Work** |
|---|
| 1.Measurement of Viscosity and Sp. Gravity |
| 2.Measurement of Pressure and velocity |
| 3.Measurement of coefficient of orifice |
| 4.Verification of Bernoulli's theorem |
| 5.Calibration of Venturi/Orifice meter |
| 6.Flow visualization using Reynolds Apparatus |
| 7.Measurement of coefficient of friction in pipe |
| 8.Verification of momentum equation |
| 9.Project based learning thermal engineering starts |
| **Total Lab hours:- 18 hrs** |
| **Text Books:** |
| 1.Munson, Okiishi, Young, 'Fluid Mechanics', 7th Ed, Wiley, 2016. |
| 2.Cengel, Cimbala, 'Fluid mechanics', Tata Mcgraw hill publishing |

| **Reference Books:** |
|---|
| 1. Gupta and Gupta, 'Fluid Mechanics', 3rd Ed, New Age publications, 2016. |
| 2.Kundu, Cohen, Dowling, 'Fluid Mechanics', Elsevier India |
| 3.K. Muralidhar, G. Biswas, 'Advance Fluid Mechanics', 3rd Edition, Narosa Publishing House |
| 4.Fox, Mcdonald, 'Fluid Mechanics', 8th Edition, Wiley. |

| Course Code | Machine Shop Lab (MS-L) | L | T | P |
|---|---|---|---|---|
| 20ME403L | | - | - | 2 |
| Pre-requisite | Machining and Machine Tool Operations | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. To study basic production processes
2. To study how to select appropriate production processes for a specific application

**Course Outcomes:**

**Students will be able to**

1. Various welding technologies' fundamentals should be recognized, analyzed, and configured.
2. Analyze principles and working of different forming processes.
3. Identify different machining operation requirements for non-metal components.
4. Identify different machining operation requirements for assembly manufacturing.

**Lab Work**

| | |
|---|---|
| 1. | A demonstration of any one welding technique out of TIG/ MIG/Resistance/Gas welding. A job drawing to be prepared by an individual institute with details of welding process parameters with weld joint design such as edge preparation, type and size of electrode used, welding current, voltage etc. |
| 2. | Demonstration of the usage of manufacturing processes like casting, forging, sheet metal. |
| 3. | Manufacturing of Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques. |
| 4. | Demonstration on any one plastic component like bottle, bottle caps, machine handles etc. by injection moulding process/ by additive manufacturing process. |
| 5. | Demonstration on grinding operations, measurement of surface roughness produced and estimation of machining time. |
| 6. | Composite job machining involving minimum four components, employing operations on lathe, precision turning, screw cutting, boring etc. and involving the use of milling and grinding operations.<br>Raw material selection and / estimation, process planning and sales presentation. |

| | | | |
|---|---|---|---|
| | **Total Lab hours:** | **22 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication |
| **Reference Books:** | |
| 1. | Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall. |
| 2. | Mechanical Engineers' Handbook, Volume 3: Manufacturing and Management, Myer Kutz, Wiley. |
| 3. | Manufacturing processes Vol. 1 and 2, P. N. Rao, Tata McGraw-Hill. |

**Autonomous Program Structure of**
**Third Year B. Tech. Fifth Semester**
**(Mechanical Engineering)**
**Academic Year: 2022-2023 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20ME501 | Computer Aided Engineering (CAE) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME502 | Heat Transfer (HT) | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20ME503 | Power Train Design (PTD) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME504 | Industrial Inspection & Quality Control (IIQC) | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 2 |
| 20ME505 | Numerical Methods (NM) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OEHS501 | Open Elective I (Humanities) | 3 | 0 | 0 | 25 | 0 | 0 | 25 | 50 | 3 |
| 20ME501L | Computer Aided Engineering (CAE) Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20ME504L | Industrial Inspection & Quality Control (IIQC) Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME505L | Numerical Methods (NM) Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20ME506L | Thermal Lab (ET & HT) | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME507L | Design Lab- II (MD & PTD) | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20AC501 | Audit Course (AC) | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | - |
| | **Total** | **15** | **3** | **10** | **400** | **250** | **50** | **100** | **800** | **23** |
| | **Grand Total** | **28** | | | **650** | | **150** | | | |

## Open Elective I (Humanities)

| Sr. No. | Course Code | Course Title |
|---|---|---|
| 1 | 20OEHS501A | Entrepreneurship Development |
| 2 | 20OEHS501B | Intellectual Property Rights |
| 3 | 20OEHS501C | Introduction to Digital Marketing |
| 4 | 20OEHS501D | Law for Engineers |
| 5 | 20OEHS501E | Organizational Behaviour |
| 6 | 20OEHS501F | Project Management |

## T. Y. B. Tech. -- Semester-I

| Course Code | Computer Aided Engineering (CAE) | L | T | P |
|---|---|---|---|---|
| 20ME501 | | 3 | - | - |
| Pre-requisite | Engineering Graphics, Engineering Mathematics, Computer Aided Machine Drawing, Strength of Materials | | | |

**Course Objectives:**

**To make students**

1. To apply the homogeneous transformation of geometric 2D/3D CAD entities
2. To model the curves and surfaces geometry
3. To compute stresses, strains, and deflection in the given problem under static loading
4. To compute stresses, strains, and deflection in the given problem under static loading by applying finite element methods for solving 2D structural problems
5. To understand generalized FEM procedure along with the type of analysis and meshing technique

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, students will be able to

1. Apply homogeneous transformation matrix for geometrical transformations of 2D & 3D CAD entities for basic geometric transformations
2. Model the curves and surfaces geometry
3. Apply finite element methods to solve 1D structural problems
4. Compute stresses, strains, and deflection in the given problem under static loading by applying finite element methods to solve 2D structural problems
5. Understand generalized FEM procedure along with the type of analysis and meshing technique

| Unit/Module: 1 | Computer Graphics | 8 hours | CO: 1 |
|---|---|---|---|

Transformations (2D & 3D): Introduction, Formulation, Translation, Shear, Rotation, Scaling and reflection, Homogeneous representation, Concatenated transformation, Mapping of geometric models, Inverse transformations, Introduction to 3D transformation

Projections: Orthographic, Isometric, Perspective projections

| Unit/Module: 2 | Curve and Surface Modeling | 6 hours | CO: 2 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Curves – Introduction, Analytical curves (Line, circle, ellipse, parabola, hyperbola), Synthetic curves (Hermite Cubic Spline, Bezier, B-Spline Curve)<br><br>Surfaces – Introduction, Surface representation, Analytic surfaces, Synthetic Surfaces, Hermite bicubic, Bezier, B-Spline, Coons patch surface, Applications in freeform surfaces | | | |
| **Unit/Module: 3** | **One Dimensional Finite Element Analysis** | **8 hours** | **CO: 3** |
| One Dimensional Problem: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, (stepped bar, spring in series and parallel), Temperature Effects, Penalty approach,<br><br>Trusses: Introduction, 2D Trusses, Element stiffness matrix for truss, Assembly of Global Stiffness Matrix, load vector | | | |
| **Unit/Module: 4** | **Two Dimensional Finite Element Analysis** | **8 hours** | **CO: 4** |
| Plane Stress/Strain problems in 2D elasticity, constitutive relations, Constant Strain Triangle (CST), Liner Strain Rectangle (LSR), displacement function, Pascal‟s triangle, compatibility, and completeness requirement, geometric isotropy, convergence requirements, strain filed, stress filed.<br><br>Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems<br><br>Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations | | | |
| **Unit/Module: 5** | **Practical Finite Element Analysis** | **6 hours** | **CO: 5** |
| Introduction: Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, p and h formulation, Advantages and disadvantages of FEM<br>Type of Analysis: Linear static, nonlinear, dynamic, buckling, thermal, fatigue, CFD, Crash<br>Introduction to meshing. Types of the element, meshing Techniques. 1D, 2D, and 3D Meshing, Mesh quality check. Effect of mesh density in the critical region, Effect of biasing in the critical region | | | |
| | **Total hours:** | **36 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | Ibrahim Zeid and R. Sivasubramanian, CAD/CAM - Theory and Practice, Tata McGraw Hill Publishing Co. 2010 |
| 2. | Daryl Logan, A First Course in the Finite Element Method, Cengage Learning India Pvt. Ltd., 6th Edition 2017 |

| | |
|---|---|
| 3. | Seshu P., Textbook of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010 |
| 4. | Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., Practical Finite Element Analysis, Finite to Infinite, Pune |
| **Reference Books:** | |
| 1. | J. N. Reddy, An Introduction to the Finite Element Method, Tata McGraw Hill, 2003 |
| 2. | Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India |

| Course Code | Heat Transfer | L | T | P |
|---|---|---|---|---|
| 20ME502 | | 3 | 1 | - |
| Pre-requisite | Physics, Calculus, Fluid Mechanics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**Course prepares students to**

1. To apply laws of heat transfer to ascertain the heat transfer
2. To formulate heat conduction equation using given boundary conditions
3. To identify the requirement of extended surfaces for heat transfer enhancement
4. To determine heat transfer rate in forced and natural convection
5. To predict the radiation heat transfer with the use of radiation shield for given application
6. To calculate efficiency of heat exchanger

**Course Outcomes:**

**Students will be able to**

1. apply laws of heat transfer to ascertain the heat transfer rate in steady and transient state heat conduction in solids
2. formulate the equation for heat conduction with heat generation applying suitable BC‟s
3. evaluate the requirement of extended surfaces for heat transfer and calculate the heat transfer enhancement using it.
4. analyse the convective heat transfer rate using appropriate correlations
5. predict the heat transfer rate in radiation mode and with the use of radiation shield
6. calculate the efficiency of heat exchanger for given set of operating conditions

| Unit/Module: 1 | Steady State Conduction Heat Transfer | 10 hours | CO: 1,2,3 |
|---|---|---|---|

Modes of Heat transfer, Fourier's law of heat conduction. Steady heat conduction in 1 – D systems. Heat conduction in composite slab, cylinder and sphere, Heat conduction with internal heat generation. Heat transfer through extended surfaces. Critical radius of insulation and insulating materials

| Unit/Module: 2 | Transient Heat Conduction Analysis | 4 hours | CO: 1 |
|---|---|---|---|

Transient heat conduction in solids using lumped heat capacity analysis

| Unit/Module: 3 | Convection Heat Transfer | 8 hours | CO: 4 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Mechanism of convection heat transfer, Energy Equation, Forced convection over flat plate, cylinder and sphere. Concepts of thermal and velocity boundary layer, Empirical correlations. Forced Convection in a pipe, thermal Entrance region, Empirical correlations, Reynolds and Colburn's analogy. Non dimensional parameters and its significance.<br>Natural convection over vertical flat plate and cylinder. Non dimensional parameters and its significance | | | |
| **Unit/Module: 4** | **Radiation Heat Transfer** | **8 hours** | **CO:5** |
| Fundamental concepts and laws of radiation, Black and Gray body radiation analysis, Radiation between two gray surfaces, Radiation shields. | | | |
| **Unit/Module: 5** | **Heat Exchangers** | **8 hours** | **CO: 6** |
| Introduction and classification. Overall heat transfer coefficient. Heat exchanger analysis using LMTD and NTU method. Effectiveness of heat exchanger. | | | |
| | **Total Lecture hours:** | **38 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley |
| 2. | Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited. |
| 3. | S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press |

| Course Code | **Powertrain Design** | L | T | P |
|---|---|---|---|---|
| **20ME503** | | **2** | **1** | **-** |
| **Prerequisite** | Strength of machine elements, Machine Design | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

To make students
1. To apply AGMA equations to design a spur and helical gear pair based on strength.
2. To analyze the forces and strengths for designing bevel and worm gears for the required power transmission.
3. To evaluate the tensions and stresses to design/select a flexible drive.
4. To compute the required dynamic load rating for a given bearing to select it from the manufacturer's catalog.
5. To describe the features of transmission systems used for automotive and industrial applications.
6. To elaborate various configurations and operations of hybrid electric vehicles.

**Course Outcomes:**

After successful completion of the course, student will be able to
1. apply AGMA equations to design a spur and helical gear pair based on strength.
2. analyze the forces and strengths for designing bevel and worm gears for the required power transmission.
3. evaluate the tensions and stresses to design/select a flexible drive.
4. compute the required dynamic load rating for a given bearing to select it from the manufacturer's catalog.
5. describe the features of transmission systems used for automotive and industrial applications.
6. elaborate various configurations and operations of hybrid electric vehicles.

| **Unit/Module: 1** | **Elements of transmission systems- Rigid Drives** | **8 hours** | **CO: 1,2** |
|---|---|---|---|

Rigid drives-I: Classification and selection of rigid drives, conjugate action, standard tooth systems, force analysis, modes of failures, gear design based on AGMA strength equations and for dynamic load, thermal considerations.

| **Unit/Module: 2** | **Anti-friction Bearings and Flexible Drives** | **8 hours** | **CO: 3** |
|---|---|---|---|

Modes of failures, static and dynamic load ratings, equivalent dynamic load, reliability and survival of bearing, load-life relationship and selection of bearings from manufacturers catalog.
Power rating, tensions, stresses and selection from manufacturers catalog for flexible drives.

| **Unit/Module: 3** | **Mechanical Transmission Systems** | **4 hours** | **CO: 4** |
|---|---|---|---|

Manual transmission systems (MT), Automatic transmission systems (AT), hydraulic torque converter, epicyclic gear train. Gear boxes for automobiles and industrial use: Constant mesh, sliding mesh, synchromesh, differential and planetary gearbox.

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Transmission in Electric and Hybrid Vehicles** | **8 hours** | **CO: 5** |
| Constructional, operational and performance features, transmission configurations, torque-speed characteristics, sizing of motor and components, motors, power splitting concepts and interface within powertrain system, powertrain architecture -parallel, series and combined, types of EVs, vehicle layout and packaging options, energy devices & combinations, duty cycles in Indian cities, performance, sustainability assessment. | | | |
| | **Total hours:** | **28** | |

**Reference Books:**


| | |
|---|---|
| 1. | Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd |
| 2. | Spotts M.F. and Shoup T.E. ,"Design of Machine Elements" ,Prentice Hall International. |
| 3. | Black P.H. and O. Eugene Adams ,"Machine Design",McGraw Hill Book Co. Inc. |
| 4. | Willium C. Orthwein,"Machine Components Design",West Publishing Co. and Jaico Publications House. |
| 5. | "Design Data",P.S.G. College of Technology, Coimbatore. |
| 6. | Juvinal R.C,"Fundamentals of Machine Components Design",John Wiley and Sons. |
| 7. | Hall A.S., Holowenko A.R. and Laughlin H.G,"Theory and Problems of Machine Design" , Schaum"s Outline Series. |
| 8. | Michael Nikowitz, „Advanced Hybrid and Electric Vehicles, System Optimization and Vehicle Integration", Springer International Publishing Switzerland 2016. |
| 9. | Iqbal Husain, „Electric and Hybrid Vehicles, Design Fundamentals", CRC PRESS. |


**Text Books:**


| | |
|---|---|
| 1. | Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd. |

| **Course Code** | **Industrial Inspection & Quality Control (IIQC)** | **L** | **T** | **P** |
|---|---|---|---|---|
| **20ME504** | | **2** | **-** | **-** |
| **Pre-requisite** | Manufacturing Process, Machine Drawing | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. Understand the GD & T symbols and its use w.r.to selection of methods of measurement and measuring instruments.
2. Aware about the concept of IS-919 tolerance, limits of size, fits, geometric and position tolerances, gauges and their design procedure.
3. Understand the advances in Metrology [viz. CMM, Laser, Machine Vision System] for industrial inspection etc.
4. Understand the process of use of Quality Control Technique in engineering industries.
5. Understand Quality Management System.

**Course Outcomes:**

**Students will be able to**

1. Interpret/apply GD&T for a part drawing
2. Analyze the given part drawing / inspection requirement to select a suitable instrument / gauge / inspection method.
3. Specify type and dimension of limit gauges
4. Apply/use appropriate Quality Management Tool and Quality Control Technique for clearly defined problems.
5. Apply Statistical Quality Control tool(s) to analyse and interpret the data.

| **Unit/Module: 1** | **Geometric Dimensioning, Tolerancing and Inspection Needs** | **6 hours** | **CO: 1** |
|---|---|---|---|

- **GD&T Basics**: Need and Rules, Features and Material Conditions [MMC & LMC] Regardless of Feature's Size & Rule, Functional Gauging,
- **Datums**: Types, Selection & Datums Control, MMB and LMB, Adding GD&T to a Design;
- **Feature Control Frame**: SLOF for Drawings (Size, Location, Orientation & Form)
- **Form Tolerances**: (Surface, Median Line/MMC): Straightness, Flatness, Circularity, Cylindricity **Orientation Tolerances**: (Surface, Axis): Parallelism, Perpendicularity Angularity Profile Tolerances: Profile of a Surface and Line – Basics, Profile (Modifiers)
- **Location Tolerances**: True Position Concentricity, Symmetry: Runout Tolerances, Circular and Total Runout and Real Life Example

| **Unit/Module: 2** | **Inspection Gauge and Dedicated Metrology** | **8 hours** | **CO: 1,2** |
|---|---|---|---|

- **Design of Gauges:** Tolerances, Limits and Fits [IS 919-1993], Taylor‟s principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).

- **Comparators:** Mechanical, Pneumatic, Optical, Electrical (LVDT)
- **Gear Metrology and Thread Metrology:** Types of errors, dedicated instruments and applications

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Advances in Industrial Inspection** | **3 hours** | **CO: 1** |

- **Coordinate Measuring Machine (CMM):** Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes
- **Machine Vision Systems:** vision system measurement – Multisensory systems.
- **Interferometer:** Principle, NPL Interferometer
- **Laser Metrology:** Basic concepts, laser types, laser interferometers, and applications
- **Industry 4.0:** Inspection 4.0

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Quality: Tools, Techniques and System** | **8 hours** | **CO: 3** |

***Quality***: Characteristics & elements, Cost vs Value, Deming‟s cycles & 14 Points, Juran Trilogy
***Quality Tools***: 7 QC Tools, Quality Function Deployment, FMECA, 5S, Kaizen, Poka yoke, Kanban, Six Sigma: DMAIC - Concept and application
***Quality Management System***: Introduction to ISO 9001, TS-16949, ISO-14000.

| | | | |
|---|---|---|---|
| **Unit/Module: 5** | **Statistical quality control and Acceptance Sampling** | **8 hours** | **CO: 4** |

**Statistical quality control**: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart),
Process Capability Indices: (cp, cpk, ppk), Statistical Process Control (Numerical).
**Acceptance Sampling:** Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)

| | | | |
|---|---|---|---|
| | **Total Lecture hours:** | **25 hours** | |

**Text Books:**

| | |
|---|---|
| 4. | Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication. |
| 5. | I. C. Gupta, Engineering Metrology, Dhanpath Rai Publication. |
| 6. | Jain R.K., Engineering Metrology, Khanna Publication. |
| 7. | Narayana K.L., Engineering Metrology, Scitech Publications (India) Pvt Limited. |
| 8. | IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications. |
| 9. | Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication. |
| 10. | Basterfield D. H., Quality control, Pearson Education India, 2004. |

| | |
|---|---|
| 11. | Grant S.P., Statistical Quality Control, Tata McGraw hill Publication. |
| **Reference Books:** | |
| 1. | ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd. |
| 2. | Juran J. M., Quality Handbook, McGraw Hill Publications. |
| 3. | Online Education resources: viz. NPTEL web site:<br>**(1)** nptel.ac.in/courses/112106179<br>**(2)** www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;<br>**(3)** www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf;<br>nptel.ac.in/courses/110101010/;<br>**(4)** freevideolectures.com › Mechanical › IIT Madras<br>(5) nptel.ac.in/courses/112107143/37. |

| Course Code | Numerical Methods | L | T | P |
|---|---|---|---|---|
| **20ME505** | | **2** | **1** | **-** |
| **Pre-requisite** | Engineering Mathematics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. To understand numerical errors and error propagation.
2. To apply numerical methods for finding the root of the equation.
3. To solve simultaneous linear algebraic equations by numerical methods.
4. To use numerical methods for curve fitting and interpolation.
5. To apply numerical methods for integration and differentiation
6. To implement numerical techniques for ordinary and partial differential equations.

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to

1. Understand errors and error propagation.
2. apply numerical method for finding root of the equation
3. solve simultaneous linear algebraic equations by numerical methods
4. use numerical methods for curve fitting and interpolation
5. apply numerical methods for integration and differentiation
6. Obtain an approximate solution of ordinary and partial differential equations applying numerical techniques.

| | | | |
|---|---|---|---|
| **Unit/Module: 1** | **Root of Equations and Errors** | **3 hours** | **CO: 1, 2** |
| Bisection method, Newton Raphson method, Successive approximation method<br>Types of errors, error propagation | | | |
| **Unit/Module: 2** | **Simultaneous Linear Algebraic Equations** | **4 hours** | **CO: 3** |
| Gauss elimination method, LU decomposition method, Thomas algorithm for tridiagonal matrix, Gauss Seidel method, Jacobi iterative method | | | |
| **Unit/Module: 3** | **Curve Fitting and Interpolation** | **6 hours** | **CO: 4** |

| | | | |
|---|---|---|---|
| Least square technique- straight line, quadratic equation, power equation, exponential equation<br>Interpolation- Newton‟s forward interpolation, Lagrange‟s Interpolation, Spline interpolation | | | |
| **Unit/Module: 4** | **Numerical Integration and Differentiation** | **4 hours** | **CO: 5** |
| Numerical Integration: trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Gauss quadrature two point formula and three point formula, double integration<br><br>Numerical Differentiation: | | | |
| **Unit/Module: 5** | **Ordinary and Partial Differential Equations** | **8 hours** | **CO: 6** |
| Euler‟s method, Heun‟s method, Runge Kutta fourth order method, Runge Kutta second order method for simultaneous ordinary differential equations.<br>PDE: Finite difference method, Elliptic equation , parabolic equation | | | |
| | **Total Course hours:** | **25 hours** | |

| **Texts and Reference materials:** | |
|---|---|
| 1. | Steven C Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill |
| 2. | Steven C Chapra, Applied numerical methods with MATLAB for engineers and scientists, Tata McGraw Hill |
| 3. | Dr. B.S. Grewal, Numerical methods in Engineering and science, Khanna Publishers |
| 4. | E. Balagurusamy, Numerical methods, Tata McGraw Hill |
| 5. | Laurene Fausett, Applied Numerical analysis using MATLAB, PHI |
| 6. | P.Kandasamy, K.Thilagavathy, K.Gunavathi, Numerical Methods, S. Chand |

| Course Code | Computer Aided Engineering (CAE) Lab | L | T | P |
|---|---|---|---|---|
| 20ME501L | | - | - | 2 |
| Pre-requisite | Strength of material, Computer Aided Machine Drawing | | | |

**Course Objectives:**

1. To prepare a program in MATLAB/OCTAVE tool for finding transformations of CAD object
2. To formulate 1D FEM problem for static structural analysis
3. To use finite element tool for solve bar, beam, and truss problem of static structural
4. To use finite element tool for static structural of mechanical components

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Develop program in MATLAB tool for finding transformations of CAD object
2. Write a program to formulate 1D FEM problem for static structural analysis and solve
3. Compute stresses, strains, and deflection in the given 1D and 2D problem under static loading
4. Analyze plane stress/plane strain problem under static loading
5. Compute stresses, strains, and deflection of any mechanical component using 3D elements

**Lab Work:**

1. Build and execute a computer program on concatenated Transformation
2. Program to formulate a static structural analysis of stepped bar/beams
3. Static structural analysis of stepped bar/beam using FEA tool
4. Program to formulate a static structural analysis of truss
5. Static structural analysis of trusses using FEA tool
6. Static structural analysis of any mechanical element/part/component i.e. plate with a hole, bracket, seat belt hook, etc.
7. Static structural analysis of any mechanical component using 3D elements
8. Static structural analysis of any mechanical assembly

**Text Books/References:**

1. Nitin S. Gokhale, Practical Finite Element Analysis, Finite to Infinite; First edition
2. ANSYS user guide https://www.ansys.com/academic/learning-resources

| Course Name | **Industrial Inspection & Quality Control (IIQC) Lab** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20ME504 L** | **-** | **-** | **2** |
| **Pre-requisite** | Manufacturing Process, Machine Drawing | **Syllabus Version** | | |
| | | **V:1.1** | | |
| **Course Objectives:** | | | | |

To make students

1. Understand the GD & T symbols and its use w.r.to selection of methods of measurement and measuring instruments.
2. Aware about the concept of IS-919 tolerance, limits of size, fits, geometric and position tolerances, gauges and their design procedure.
3. Understand the advances in Metrology [viz. CMM, Laser, Machine Vision System] for industrial inspection etc.
4. Understand the process of use of Quality Control Technique in engineering industries.
5. Understand Quality Management System.

**Course Outcomes:** Students will be able to

1. Demonstrate the use of different length and angle measuring instruments and comparators.
2. Calibrate the measuring instrument and design the limit gauges
3. Select and apply/use appropriate Quality Management Tool and Quality Control Technique for clearly defined problem.
4. Apply Statistical Quality Control tool(s) to analyse and interpret the inspection data.

**Part [A] Experiment no. 1 and 6 are mandatory. Perform any three from experiment no. 2 to 5 & any three from experiment no. 7 to 10.**

| | | | |
|---|---|---|---|
| Expt. No.1 | Measurement of linear and angular dimensions using standard measuring instruments. | 2 hours | CO: 1 and CO: 2 |
| Expt. No.2 | Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, MSA (Gauge R & R). | 2 hours | |
| Expt. No.3 | Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) | 2 hours | |
| Expt. No.4 | Verification of dimensions & geometry of given components using Mechanical comparator. | 2 hours | |
| Expt. No.5 | Machine tool alignment testing on machine tool – Lathe / Drilling / Milling. | 2 hours | |
| Expt. No.6 | Demonstration of surfaces inspection using optical flat/interferometers. | 2 hours | |
| Expt. No.7 | Determination of geometry & dimensions of given composite object / single point tool, using profile projector and tool maker"s microscope. | 2 hours | |

| | | | |
|---|---|---|---|
| Expt. No.8 | Measurement of thread parameters using floating carriage diameter measuring machine. | 2 hours | |
| Expt. No.9 | Measurement of spur gear parameters using Gear Tooth Vernier, Span Micrometer/ Gear Rolling Tester. | | |
| Expt. No.10 | Determination of given geometry using coordinate measuring machine (CMM). | | |
| **Part [B] Statistical Quality Control (SQC) (Any Two assignments)**<br>**Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended** | | | |
| Assignment1 | Note: For completing this assignment....<br>1. The templates ('.excel format') for drawing/developing Pareto Chart, Cause and Effect Diagram, FMEA sheet, 5S Sheet & Kaizen Sheet.<br>2. Make a screenshot and paste it in the '.ppt format' are made available on Google Classroom.<br>Part - I: Select any product / process and complete following steps...<br>i. Identify & enlist its Quality Characteristics,<br>ii. Identified Failure Modes [related to identified Quality Characteristics],<br>iii. Prepare Check Sheet,<br>iv. Draw Pareto Chart to prioritize quality characteristics,<br>v. Draw Cause and Effect Diagram,<br>vi. Develop FMEA Sheet<br><br>Part - II: Study any reference / case study available with you (in books or downloaded from internet) related to 5S activity & Kaizen activity then use attached formats of 5S & Kaizen Sheets, prepare it accordingly & add it (ie. its screenshot) in the same template file attached in '.ppt format' to complete this assignment...<br>[Note: Any opportunity of implementing 5S & Kaizen activity at any possible work place like, industry, workshops, shops, your home etc... you are most welcome. Only you need to explain it properly in the given format]. | Out of the class activity.<br><br>[As per selected task for completing this assignment] | CO: 3 |
| Assignment2 | Q.1. Instructions... for Variable type data-set...<br>Refer excel sheet for data one variable & two attribute data sets,<br>1. Select appropriate type of charts,<br>2. Calculate three sigma limits for specific charts,<br>3. Plot Control Charts of Variables<br>4. Interpret the meaning,<br>5. Determine process capability,<br>6. Comment on what conclusion would you draw about the ability of the process to produce the items within specified limits or not ? | Out of the class activity.<br><br>[As per selected task for completing this assignment] | CO: 4 |

| | | | |
|---|---|---|---|
| | Q.2. Instructions... for Attribute type data-set...<br>Refer excel sheet for data one variable & two attribute data sets,<br>1. Select appropriate type of charts,<br>2. Calculate three sigma limits for specific charts,<br>3. Control Charts of Attribute, | | |
| | 4. Interpret the meaning,<br>5. Determine process capability,<br>6. Comment on what conclusion would you draw about the ability of the process to produce the items within specified limits or not ?<br><br>Q. 3. Differentiate between single, double & multiple sampling plans. | | |
| | **Total Lecture hours:** | **25** | |

**Text Books:**

| | |
|---|---|
| 1 | Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication. |
| 2 | I. C. Gupta, Engineering Metrology, Dhanpath Rai Publication. |
| 3 | Jain R.K., Engineering Metrology, Khanna Publication. |
| 4 | Narayana K.L., Engineering Metrology, Scitech Publications (India) Pvt Limited. |
| 5 | IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications. |
| 6 | Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication. |
| 7 | Basterfield D. H., Quality control, Pearson Education India, 2004. |
| 8 | Grant S.P., Statistical Quality Control, Tata McGraw hill Publication. |

**Reference Books:**

| | |
|---|---|
| 1. | ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd. |
| 2. | Juran J. M., Quality Handbook, McGraw Hill Publications. |
| 3. | Online Education resources: viz. NPTEL web site:<br>(1) nptel.ac.in/courses/112106179<br>(2) www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;<br>(3) www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf;<br>nptel.ac.in/courses/110101010/;<br>(4) freevideolectures.com › Mechanical › IIT Madras<br>(5) nptel.ac.in/courses/112107143/37. |

| Course Code | Numerical Methods Lab | L | T | P |
|---|---|---|---|---|
| 20ME505 L | | - | - | 2 |
| Prerequisite | Engineering Mathematics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

1. To use numerical methods to solve problems
2. To use mathematical solver.
3. To prepare flowcharts for numerical methods.
4. To write programs for numerical methods

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Apply numerical methods to solve engineering problems.
2. Employ mathematical solver for numerical methods.
3. Prepare flowcharts for numerical methods.
4. Write programs for numerical methods.

**Lab Work:**

1. To prepare flowcharts and write programs for finding Root of Equation: i)Newton Raphson method ii) Successive approximation method iii) bisection method
2. To prepare flowcharts and write programs for Simultaneous Linear Algebraic Equations: i) Gauss elimination methods ii) LU decomposition method iii) Tridiagonal matrix algorithm iv) Jacobi iteration method v) Gauss Seidel method
3. To prepare flowcharts and write programs for Curve Fitting : i) straight line ii) quadratic equation iii) power equation iv) exponential equation
4. To prepare flowcharts and write programs for Interpolation : i) Newton"s forward interpolation ii) Lagrange interpolation iii) Inverse Lagrange Interpolation
5. To prepare flowcharts and write programs for Numerical Integration : i) Newton Cotes methods ii) Gauss quadrature methods iii) double integration
6. To prepare flowcharts and write programs Ordinary Differential Equations: i) Heun"s methods ii) Runge Kutta method- 4th order iii) RK2 method for simultaneous ODE
7. To prepare flowchart and write program for Partial Differential Equation : parabolic explicit method

| **Text Books/References:** | |
|---|---|
| 1. | Steven C Chapra, Applied Numerical Methods with MATLAB for engineers and Scientists, McGraw Hill Education |

| Course Code | Thermal Lab | L | T | P |
|---|---|---|---|---|
| 20ME506 L | | - | - | 2 |
| Pre-requisite | Manufacturing Process, Machine Drawing | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

1. To conduct experiments involving steady state heat transfer phenomenon
2. To analyze and process the experimental data/observations to ascertain the heat transfer
3. To illustrate the results in the graphical form
4. To Compare the results with available theoretical/experimental results and deduce the conclusion from it
5. To study the boiler construction and working

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Conduct experiments involving steady state heat transfer phenomenon
2. Analyze and process the experimental data/observations to ascertain the heat transfer rate
3. Illustrate the results in the graphical form to find the nature of temperature variation over time and length
4. Compare the results with available theoretical/experimental results and deduce the conclusion from it
5. Understand the construction and working of industrial boiler and its accessories

**Lab Work:**

1. Determination of Thermal Conductivity of insulating powder
2. Determine heat transfer through composite solid
3. Determination of heat transfer coefficient in Natural Convection
4. Determination of heat transfer coefficient in Forced Convection
5. Determination of Emissivity of a Test surface
6. Determination of Stefan Boltzmann Constant
7. Determination of critical heat flux for given wire
8. Determination of temperature distribution along the fin length
9. Trial on parallel and counter flow heat exchanger
10. Visit to the industry for the study of boiler construction and operations

**Text Books/References:**

| | |
|---|---|
| 1. | R. C. Sachdeva, „Fundamentals of Engineering Heat and Mass Transfer" New Age International Publishers |
| 2. | R. K. Rajout, „Thermal Engineering", Laxmi Publications |

| **Course Code** | **Design Lab II** | **L** | **T** | **P** |
|---|---|---|---|---|
| **20ME507 L** | | - | - | 2 |
| **Prerequisite** | Strength of machine elements, Machine design, Transmission system design. | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

1. To explain the design process, various design considerations and theories of failures.
2. To design/select the required machine elements for the given application.
3. To design the mechanical system (assembly) for the given application.
4. To present the design work in the form of reports and drawings.

**Course Outcomes:**

After successful completion of the course, students will be able to

1. explain the design process, various design considerations and theories of failures.
2. design/select the required machine elements for the given application.
3. design the mechanical system (assembly) for the given application.
4. present the design work in the form of reports and drawings.

**Lab Work: The lab work will begin in semester IV and conclude at the end of semester V.**

A. **Assignments** based on,
   - i) Design process, design considerations, standards in design.
   - ii) Engineering materials, their features, applications and selection.
   - iii) Principal stresses and theories of failures.
   - iv) Manufacturing and assembly considerations in design.

B. **Case studies** based on any three of the following engineering applications,
   - Design of a mechanical joint for a roof truss/valve mechanism/foundation bolt.
   - Design of a mechanical coupling for a compressor/pump/gear box.
   - Design of turnbuckle for stay rope/jib crane.
   - Select a belt from the manufacturer's catalogue for the given application.
   - Select a bearing from the manufacturer's catalogue for the required application.

C. **Comprehensive Design Project (Project Based Learning):**
   - Comprehensive project to design a transmission system (gear box) for the specified application.
   - The project work is carried out by a group of 3-5 students.
   - The project involves identification of functional requirements, configuration of specifications, selection of mechanisms, preparation of layout, design of individual elements and the overall assembly.
   - Each group will present the design project work by preparing a design report and drawings by using suitable software.

| **Text Books/References:** | |
|---|---|
| 1. | Shigley J.E. and Mischke C.R., "Mechanical Engineering Design",McGraw Hill Publication Co. Ltd. |
| 2 | Spotts M.F. and Shoup T.E. ,"Design of Machine Elements", Prentice Hall International. |
| 3 | Bhandari V.B ,"Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd. |
| 4 | P.S.G. Design Data, PSG College of Technology Coimbatore. |
| 5 | Bhandari V.B ,"Machine Design Data Book", Tata McGraw Hill Publication Co. Ltd. |

**Third Year B. Tech. Sixth Semester**
**(Mechanical Engineering)**
**Academic Year: 2022-2023 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20ME601 | Robotics and Control Systems (RCS) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME602 | Applied Thermodynamics (AT) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME603 | System Dynamics - Modeling and Simulation (SDMS) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME604 | Turbo Machines (TM) | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20HS601 | Industrial Engineering and Operation Research (IIOR) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE601 | Open Elective II | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20ME601L | Robotics and Control Systems (RCS) Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME602L | Applied Thermodynamics (AT) Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20ME603L | System Dynamics - Modeling and Simulation (SDMS) Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20ME604L | Turbo Machines (TM) Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| | **Total** | **15** | **3** | **8** | **400** | **250** | **25** | **75** | **800** | **22** |
| | **Grand Total** | **28** | | | **650** | | **150** | | | |

| 20OE601 Open Elective-II | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE601A | Automation and Control Engineering | Y | Y | Y | Y | Y |
| 2 | 20OE601B | Automotive Electronics | Y | Y | Y | Y | Y |
| 3 | 20OE601C | Avionics | Y | Y | Y | Y | Y |
| 4 | 20OE601D | Bioinformatics | Y | Y | Y | N | Y |
| 5 | 20OE601E | Computer Vision | Y | Y | Y | Y | Y |
| 6 | 20OE601F | Design Thinking | Y | Y | Y | Y | Y |
| 7 | 20OE601G | e-Business | Y | Y | Y | Y | Y |
| 8 | 20OE601H | Electric Vehicles | Y | Y | Y | Y | Y |
| 9 | 20OE601I | Gamification | Y | Y | Y | Y | Y |
| 10 | 20OE601J | Geographical Information Systems | Y | Y | Y | Y | Y |
| 11 | 20OE601K | Multimedia Systems | Y | Y | Y | N | Y |

## T. Y. B. Tech. -- Semester-II

| Course Code | Robotics and Control Systems | L | T | P |
|---|---|---|---|---|
| **20ME601** | | **3** | **0** | **0** |
| **Prerequisite** | Basic Mathematics, Engineering Mechanics, Elements of Electrical and Electronics Engineering | **Credit : 03** | | |

**Course Objectives:**

To familiarize the students

1. Basics of Robotics
2. Robotic control and Actuation
3. Control Technology
4. System Modelling, Stability and Control actions.

**Course Outcomes:**

**At the end of the course, student will be able to**

1. Identification of the basic Robotic systems components and performance parameters
2. Understand the fundamentals of Robotic sensory and actuation systems
3. Analyze the robotic kinematics
4. Identify the basic control systems and it"s classifications
5. Prepare the system model and can perform the stability analysis of the model
6. Analyze the different controller modes and perform the frequency domain analysis

| **Unit 1** | **Introduction to Robotics** | **5 hours** | **CO : 1** |
|---|---|---|---|

Basic concepts, Laws of Robotics, Classification, Structure of Robots, Point to point and continuous path control system, Robot performance measurement characteristics- accuracy, resolution, repeatability, precision, dexterity, Industrial Applications.

| **Unit 2** | **Robotic Sensors & Actuation** | **6 hours** | **CO : 2** |
|---|---|---|---|

Classification, Selection and application, Need for sensors and vision system is robotic control.
**Sensors:** Light,Soud,Temperature,Contact,Proximity,Distance,Pressure,Tilt,Navigation,Acceleration GPS, IMU, Vision, PVDF Tactile( Construction, working and selection)
**Actuation:** Selection of Drives, Actuators and transmission system of manipulator.

**Machine Vision System:** Vision system devices, image acquisition, Masking, Sampling and Quantization, Image processing techniques, Noise reduction, Edge detection, Segmentation.

| | | | |
|---|---|---|---|
| **Unit 3** | **Robot Kinematics** | **6 hours** | **CO : 3** |
| Transformation matrices ,link and joint, Denavit- Hartenberg (D-H) parameters, kinematics redundancy, kinematics calibration, inverse kinematics<br>Static force and velocity in manipulators, Motion of the manipulator links, Jacobians, Singularities, static forces, Jacobian in force domain. | | | |
| **Unit 4** | **Control System** | **6 hours** | **CO : 4** |
| Definition, Classification- open loop and closed loop control system, case studies, Feedback and Feed Forward Control System, Transfer Function, Block diagram reduction techniques, Signal flow Graphs- Mason's Gain Formula | | | |
| **Unit 5** | **System Modelling and Stability** | **7 hours** | **CO : 5** |
| Basic system Models: Thermal, Fluid, Hydraulic, Mechanical: Spring-Mass-Damper system equations<br>Stability Analysis in S-Domain: The concept of stability , Poles and Zeros of system – Routh-Hurwitz"s stability criterion – qualitative stability and conditional stability – Limitations of Routh-Hurwitz"s stability. Root Locus Technique: Concept of root locus – Construction of root locus.<br>Time domain Response analysis. | | | |
| **Unit 6** | **Controllers and Frequency Response Analysis** | **6 hours** | **CO : 6** |
| **Controllers:** On-Off,P,I,D,PI,PD and PID Controller working principle.<br>**Frequency domain specifications**, Bode plot diagrams-Determination of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots. | | | |
| | **Total Lecture hours:** | **36 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | S.K.Saha, "Introduction to Robotics", 2nd edition, TataMcGraw Hill Publication, |
| 2. | John J. Craig, "Introduction to Robotics: Mechanics & Control", 3rd edition, Pearson Education. |
| 3. | Ogata K., "Modern Control Engineering" Prentice Hall of India |
| 4. | Nagrath I.J., & Gopal M, "Control system Engineering." Wiley Eastern Reprint |
| 5. | C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi |

**Reference Books:**

| | |
|---|---|
| 1. | Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons |
| 2. | W. Bolton: Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Third Edition, Pearson Education (Low Price Edition) |

| Course Name | Applied Thermodynamics | L | T | P |
|---|---|---|---|---|
| **Course Code** | **20ME602** | **2** | **1** | **-** |
| **Pre-requisite** | Engineering Thermodynamics, Fluid Mechanics, Heat Transfer | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. understand performance parameters of reciprocating air compressor.
2. understand and analyze refrigeration cycles
3. understand various psychrometric processes
4. understand performance parameters of gas turbines.

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to

1. Evaluate isothermal and volumetric efficiency of reciprocating compressor.
2. Analyze refrigeration cycles and calculate COP.
3. Plot psychrometric processes and perform air conditioning load calculations.
4. Calculate the efficiency and power developed for a gas turbine

| **Unit/Module: 1** | **Reciprocating Air Compressors** | **6 hours** | **CO: 1** |
|---|---|---|---|
| Computation of work done, Isothermal efficiency, Volumetric efficiency, Multi staging of compressor, Capacity control of compressor | | | |
| **Unit/Module: 2** | **Refrigeration** | **6 hours** | **CO: 2** |
| Vapor compression cycle, Multistage refrigeration, Vapor absorption cycle | | | |
| **Unit/Module: 3** | **Psychrometry** | **6 hours** | **CO: 3** |
| Basic concepts and definitions, Psychrometric chart, Analysis of various psychrometric processes | | | |
| **Unit/Module: 4** | **Gas Turbines** | **6 hours** | **CO: 4** |
| Working of Brayton Cycle, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Actual cycle, Effect of operating variables on thermal efficiency, Inter-cooling, Reheating, and Regeneration cycle | | | |
| | **Total Course hours:** | **hours** | **24** |

| **Text Books:** | |
|---|---|
| 1. | S. Domkundwar, C.P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & Co |
| 2. | Arora C.P. Refrigeration and Air Conditioning, Tata McGraw-Hill |
| 3. | Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd |
| 4. | V. Ganeshan, Gas Turbines, Tata Mcgraw Hill |

| | | | | |
|---|---|---|---|---|
| **Course Name** | **System Dynamics – Modeling and Simulation** | **L** | **T** | **P** |
| **Course Code** | **20ME603** | **2** | **1** | **0** |
| **Pre-requisite** | Analysis and Synthesis of Mechanisms, Machine Design, Power Train Design | **Credit: 03** | | |

**Course Objectives:**

1. To understand the methods to find natural frequency of system subjected to undamped free vibrations
2. To analyze the system subjected to vibrations with viscous/coulomb damping
3. To calculate the amplitude and phase difference for various cases of forced vibrations
4. To determine natural frequencies and mode shapes of multiple degree of freedom system
5. To explain the features and applications of various dynamic modeling techniques

**Course Outcomes:**

Upon completion of this course, the student will be able to,

1. evaluate the natural frequency of system subjected to undamped free vibrations
2. analyze the system subjected to vibrations with viscous/coulomb damping
3. calculate the amplitude and phase difference for various cases of forced vibrations
4. determine natural frequencies and mode shapes of multiple degree of freedom system
5. understand features and applications of various dynamic modeling techniques

| | | | |
|---|---|---|---|
| **Unit 1** | **Fundamentals of Dynamic System** | **4 hours** | **CO: 1** |

Elements of a vibratory system, S.H.M., degrees of freedom, modeling of a system, concept of linear and non-linear systems, equivalent spring, linear and torsional systems. Matrix Algebra

| | | | |
|---|---|---|---|
| **Unit 2** | **Single Degree of Freedom Systems – Free and Forced Vibrations** | **6 hours** | **CO: 2** |

Natural frequency by equilibrium and energy methods for longitudinal and torsional vibrations.
Forced vibrations of longitudinal and torsional systems, simple harmonic excitation, excitation due to reciprocating and rotating unbalance, base excitation, magnification factor and phase difference, force and motion transmissibility
Different types of damping, free vibrations with viscous damping - over damped, critically damped and under damped systems, dry friction damping.

| | | | |
|---|---|---|---|
| **Unit 3** | **Multiple Degree of Freedom Systems - Undamped Vibrations** | **6 hours** | **CO: 3** |

Free vibration of spring coupled systems – longitudinal and torsional, natural frequency and mode shapes. Eigen value and Eigen vector by Matrix method, Geared systems.

| | | | |
|---|---|---|---|
| **Unit 4** | **Frequency Response and Vibration** | **6 hours** | **CO: 4** |
| Digital and Fast Fourier Transform, Frequency Response of first and second order Systems, Vibration Isolator and Vibration Absorption, Response to General Periodic Inputs | | | |
| **Unit 5** | **Dynamic Modeling and Simulation** | **6 hours** | **CO: 5** |
| Introduction to Laplace Method for Step input, impulse input to SDOF, Laplace Transform, Response for First Order Models, State Space system, Simulations using MATLAB and SIMULINK, Base Excitation, Rotating Imbalance | | | |
| | **Total Lecture hours:** | **28 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, Wiley,latest edition |
| 2. | Rao S. S., „Mechanical Vibrations", Pearson Education Inc. Dorling Kindersley (India) Pvt. Ltd. |
| **Reference Books:** | |
| 1. | William J. Palm III, System Dynamics, Mc-Graw Hill, latest edition |
| 2. | Grover G. K., „Mechanical Vibrations", Nem Chand and Bros. |
| 3. | Thomson, W. T., „Theory of Vibration with Applications", CBS Publishers and Distributors. |
| 4. | V P Singh, „Mechanical Vibrations", Dhanpat Rai & Sons. |
| 5. | Kelly S. G., „Mechanical Vibrations", Schaum„s outlines, Tata McGraw Hill Publishing Co. Ltd. |
| 6. | Meirovitch, „Elements of Mechanical Vibrations", McGraw Hill. |
| 7. | M.L.Munjal, „Noise and vibration control", Cambridge University Press India Private Limited. |
| 8. | Bies, D. and Hansen, C., „Engineering Noise Control - Theory and Practice", Taylor and Francis. |

| | | | | |
|---|---|---|---|---|
| **Course Name** | **Turbo Machines** | **L** | **T** | **P** |
| **Course Code** | **20ME604** | **3** | **1** | **-** |
| **Pre-requisite** | Physics, Calculus, Fluid Mechanics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**Course prepares students to**

1. differentiate between impulse and reaction turbine
2. illustrate inlet and outlet conditions of a turbomachine with the help of velocity triangles
3. calculate the head requirement and efficiency of a centrifugal pump
4. determine the slip and efficiency of a centrifugal compressor

**Course Outcomes:**

**Students will be able to**

1. Compute the power developed and efficiency of hydraulic turbine
2. Determine head developed by a centrifugal pump and power required to operate it
3. Calculate the diagram efficiency and diagram power for a given steam turbine
4. Perform calculations for the power developed and efficiency for gas turbine
5. Construct velocity triangles and calculate thermal efficiency of centrifugal compressor

| | | | |
|---|---|---|---|
| **Unit/Module: 1** | **Introduction** | **4 hours** | **CO: 1** |

Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines, Concepts of Velocity triangle and impact of jet on curved vanes

| | | | |
|---|---|---|---|
| **Unit/Module: 2** | **Hydraulic Turbines** | **8 hours** | **CO: 2** |

Pelton wheel- Construction, principle of working, velocity diagrams and analysis, design aspects,
Reaction Water Turbines : Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction,

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Steam Turbine** | **8 hours** | **CO: 3** |

Steam Turbines: Classifications (Axial and Radial), construction details, compounding of steam turbines, velocity diagrams and analysis of Impulse and reaction turbines (single stage), governing of steam turbines

| **Unit/Module: 4** | **Centrifugal Pump** | **8 hours** | **CO:4** |
|---|---|---|---|
| Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, specific speed, performance characteristics of centrifugal pump, Cavitation, open, semi open impeller pumps | | | |
| **Unit/Module: 5** | **Centrifugal Compressor** | **8 hours** | **CO: 5** |
| Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input, actual work input, dimension parameters, surging, choking, stalling. | | | |
| | **Total Lecture hours:** | **36 hours** | |

| **Text Books:** | |
|---|---|
| 1 | Jagdish Lal, Hydraulic Machines, Metropolitan Book Company |
| 2 | Kadambi & Prasad, An Introduction To Energy Conversion: Turbomachinery - Vol. III, New Age International |
| 3 | William W. Peng, Fundamentals of Turbomachinery, John Wiley & Sons. |
| 4 | Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill |
| 5 | S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966. |
| 6 | R. K. Rajput Hydraulic Machines, S. Chand |
| 7 | V. Ganeshan, Gas Turbines, Tata Mcgraw Hill |

| Course Name | Industrial Engineering and Operations Research [IEOR - OEHS] | L | T | P |
|---|---|---|---|---|
| **Course Code** | **20OEHS601** | **3** | **-** | **-** |
| **Pre-requisite** | Manufacturing Process, Industrial Inspection, Quality Control | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**Course prepares students to**

1. Effectively explain production planning and Control functions.
2. Understand different types of analysis using industrial engineering techniques viz. Method Study and Work Measurements
3. Develop mathematical skills to analyse Project Scheduling arising from a wide range of applications.
4. Understand procedure for Replacement and Queuing System analysis

**Course Outcomes:**

**Students will be able to**

1. Analyze different types of production planning functions viz. productivity analysis, Aggregate and Capacity production planning, forecasting, inventory control,
2. Apply method study and work measurements technique to solve industrial problem,
3. Analyze the given Project for optimum schedule and sequence.
4. Analyze the given industrial situation to optimize replacement decision and queuing problem

| Unit/Module: 1 | Industrial Engineering, Productivity and PPC | 6 hours | CO: 1 |
|---|---|---|---|

- **Industrial Engineering:** Objectives, Functions & Tools; Production Systems and Organisation structures: Types, Strategies & Principles
- **Productivity Analysis:** Definition, Factors Affecting the Productivity, Productivity models and index (numerical);
- **Production Planning and Control:** Functions of PPC, Aggregate production planning; Capacity Planning, ERP

| Unit/Module: 2 | Production Forecasting and Facility Planning | 6 hours | CO: 1 |
|---|---|---|---|

- **Forecasting Techniques**: Qualitative and Quantitative Methods: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical)
- **Facility Layout Planning**: Factors Influencing, Material Flow Patterns, Tools & Techniques

used

- **Inventory Control:** Inventory costs, Types of inventory models - Deterministic and Probabilistic, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis (Numerical).

| Unit/Module: 3 | Method Study and Work Measurements | 8 hours | CO: 2 |
|---|---|---|---|

- **Method Study:** Definition, objective and procedural steps; activity recording tools, Human factors considerations; Value Engineering
- **Work measurement:** Definition, objectives and techniques: **Time study & Work samplin**g, (numerical); **Synthetic motion studies**: PMTS and MTM, MOST

| Unit/Module: 4 | Project Scheduling | 8 hours | CO: 3 |
|---|---|---|---|

- **Critical Path Method (CPM)**: Network Diagram;
- **Program Evaluation and Review Technique (PERT)**: Problems, Time Cost Trade Off (Crashing),
- **Jobs Sequencing**: „N" Jobs & 2 / 3 Machines
- **Jobs Assignment**:

| Unit/Module: 5 | Replacement and Queuing System analysis | 8 hours | CO: 4 |
|---|---|---|---|

- **Replacement analysis**: Maintenance cost increases with time and the value of money remains same / increases during the period; replacement of items that fail completely and suddenly.
- **Queuing System analysis**: M / M / 1 / (□ / FIFO); (FCFS/ □ / □ ): (Birth – Death process)

| | | | |
|---|---|---|---|
| | **Total Lecture hours:** | **36 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH |
| 2. | Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002. |
| 3. | Industrial engineering and management by O. P. Khanna, Dhanpatrai publication |
| 4. | Industrial Engineering , Martend Telsang, S. Chand Publication |
| 5. | Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication. |
| 6. | Prem Kumar Gupta and D S Hira, Operations Research, S Chand in publication 2007. |
| 7. | J. K. Sharma, Operations Research: Theory And Application, Laxmi pub. India. |

**Reference Books:**

| | |
|---|---|
| 1. | H.B. Maynard, KJell, Maynard"s Industrial Engineering Hand Book, McGraw Hill, Education, 2001 |
| 2. | Taha, H. A. 2007, Operations Research, 8th Edn, Pearson. |

| | | L | T | P |
|---|---|---|---|---|
| **Course Name** | **Robotics and Controls Lab** | **L** | **T** | **P** |
| **Course Code** | **20ME601L** | **-** | **-** | **2** |
| **Pre-requisite** | Engineering Mechanics, Elements of Electrical and Electronics Engineering | **Syllabus Version** | | |
| | | | | |

**Course Objectives:**

To familiarize the students with the

1. Basics of robots and robotic manipulator components
2. Control system and controller actions
3. Industrial application of robotics and Controllers

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to

1. Identify the elements of robotics and apply the knowledge to design simple control system.
2. Perform forward and Inverse kinematic analysis of robotic system.
3. Integrate different types of sensors and control the basic robotic motion.
4. Identify and Apply the knowledge of basic concepts of robotic system and its components.

| | |
|---|---|
| **1** | Study components of an industrial robot (PUMA, KUKA, FANUC, MTAB , UR , Etc) and its DH parameters. |
| **2** | Forward kinematics and validation using suitable software (Robo Analyser/ MatLab or any other free software tool). |
| **3** | Inverse kinematics of an industrial robot and validation using any open source software |
| **4** | Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers in a robotic system. (Free software, Matlab) |
| **5** | Control experiment using available hardware or software. (Open source or Matlab). |
| **6** | Tunning of PID Controller for suitable application. |

| | | | | |
|---|---|---|---|---|
| | **7** | Small group project work relevant to Industrial automation. | | |
| | **8** | Industrial visit to any Robotic assembly line or Robot assisted manufacturing. | | |
| | | **Total Lab hours:** | **hours** | **20** |

| **Textbooks:** | |
|---|---|
| 1. | Introduction to Robotics : J. Craig , Pearson |
| 2. | Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill |
| 3. | Robotics : Subir K Saha , Mc GrawHill |
| 4. | Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hill |
| 5. | S.R.Deb, "Robotic Technology and Flexible Automation".TataMcGraw Hill Publication. |

| Course Name | Applied Thermodynamics Lab | L | T | P |
|---|---|---|---|---|
| Course Code | 20ME602 L | - | - | 2 |
| Prerequisite | Engineering Thermodynamics, Fluid Mechanics, Heat Transfer | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

1. To study performance parameters of I C Engines.
2. To conduct trial and do performance calculations for reciprocating air compressor
3. To evaluate performance of refrigeration cycles
4. To analyze various psychrometric processes

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Conduct trial on IC engines and calculate performance parameters.
2. Conduct trial on reciprocating air compressor to ascertain volumetric and isothermal efficiency.
3. Compute performance parameters of vapor compression refrigeration system
4. Perform a trial on air conditioning tutor to understand different psychrometric processes.

**Lab Work:**

1. Study and trial on petrol engine.
2. Study and trial on Diesel engine
3. Morse Test on multi cylinder petrol/Diesel engine for determination of friction power.
4. Trial on vapor compression test rig.
5. Trial on ice plant test rig.
6. Trial on air conditioning test rig.
7. Trial on two stage reciprocating air compressor.
8. Visit to the air conditioning plant.
9. Assessment of mini project in Thermal Engineering.

**Text Books/References:**


| | |
|---|---|
| 1. | V. Ganesan, Internal Combustion Engines, Tata McGraw Hill |
| 2. | M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai |
| | Publications |
| 3. | S. Domkundwar, C.P. Kothandraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & CO |
| 4. | Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill |

| | | | | |
|---|---|---|---|---|
| **Course Name** | **System Dynamics – Modeling and Simulation Lab** | **L** | **T** | **P** |
| **Course Code** | **20ME603L** | **-** | **-** | **2** |
| **Prerequisite** | 1.Analysis and Synthesis of Mechanisms<br>2.Machine Design<br>3.Power Train Design | **Syllabus Version** | | |
| **Co -requisites**: | System Dynamics - Modeling and Simulation | **V:1.1** | | |

**Course Objectives:**

1. To understand the methods to find natural frequency of system subjected to undamped free vibrations
2. To determine natural frequencies and mode shapes of multiple degree of freedom system
3. To understand the implications of rotating imbalance
4. To explain the features and applications of various dynamic modeling techniques

**Course Outcomes:**

Upon completion of this course, the student will be able to,

1. evaluate the natural frequency of system subjected to un-damped free vibrations
2. determine natural frequencies and mode shapes of multiple degree of freedom system
3. perform experiment of rotating imbalance
4. understand features and applications of various dynamic modeling techniques

**Text Books/References:**

William J. Palm III, Modeling, Analysis, and Control of Dynamic Systems, Wiley, latest edition

**List of Experiments:**

| | |
|---|---|
| 1 | MATLAB and some Functions |
| 2 | Data Acquisition Basics + SDOF Undamped |
| 3 | Cantilever Beam (SDOF System) |
| 4 | SDOF Simulation – MATLAB SIMULINK –Underdamped Free Vibrations |
| 5 | SIMULINK Examples and Numerical Methods |
| 6 | Air Track SDOF and 2DOF Free Vibration |
| 7 | Eigenvalue in MATLAB/Simulation of 2 DOF system |
| 8 | Rotating Imbalance |

| | | | | |
|---|---|---|---|---|
| **Course Name** | **Turbo Machines Lab** | **L** | **T** | **P** |
| **Course Code** | **20ME604L** | **-** | **-** | **2** |
| **Pre-requisite** | Fluid dynamics | **Syllabus Version** | | |
| | | | | |

**Course Objectives:**

**To make students**

1. To conduct experiments involving various parameters of different turbo machines
2. To calculate hydraulic and overall efficiency of a given hydraulic turbine
3. To Illustrate the characteristics in the graphical form
4. To Compare the results with available characteristic curves and deduce the conclusion from it

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to

1. conduct experiments involving various parameters of different turbo machines
2. calculate hydraulic and overall efficiency of a given hydraulic turbine
3. Illustrate the characteristics in the graphical form
4. Compare the results with available characteristic curves and deduce the conclusion from it

1. Verification of impulse moment principle using impact of jet on curved vane
2. Study and constant speed trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and constant head trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
4. Study and constant speed trial on any hydraulic reaction turbine and plotting of main and operating characteristics
5. Study and constant head trial on any hydraulic reaction turbine and plotting of main and operating characteristics
6. Study and trial on centrifugal pump and plotting operating characteristics Study and trial of rotary compressors.
7. Visit to hydro/steam power plant and report to be submitted.
8. Performance Test on Gear (Oil) Pump Test Rig

| | | | |
|---|---|---|---|
| | **Total Lab hours:** | **hours** | **20** |

**Autonomous Program Structure of**
**Final Year B. Tech. Seventh Semester**
**(Mechanical Engineering)**
**Academic Year: 2023-2024 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20ME701 | Internship/Project | 0 | 0 | 30 | 200 | 0 | 0 | 100 | 300 | 15 |
| 20HS702 | Economics and Personal Finance (EPF) (Online) | 2 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 2 |
| | **Grand Total** | **32** | | | | | | | **400** | **17** |

| Credits | Marks | Teaching Hrs / week | Evaluation Mode |
|---|---|---|---|
| Internship / Project = 15 | 300 | 30 | Presentations + Oral |
| HS- EPF (Online) = 3 | 100 | 2 | ISE + ESE |

**Duration of Internship / Project :**

1. Full Internship 6 Months
2. Full Project 6 Months
3. Combination : Internship 3 Months + Projects 3 Months
   (June-Aug + Sep- Nov)

**For Internship / Project:**
**In-Sem-Reviews =Two ; ESE = One Review with external (Final)**

## Final Year B. Tech. -- Semester-I

| **Course Name** | **Economics and Personal Finance** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20HS701** | **3** | **-** | **-** |
| **Pre-requisite** | Engineering Mechanics, Strength of Materials, Engineering Metallurgy | | | |

**Course Objectives:** To make students

1.To enable students to acquire knowledge and develop an understanding of basic concepts and principles of Economics & Finance
2. To make students acquaint with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector
3. To sensitize students to the current economic issues of the nation
4. To develop an understanding of the role of institutions in the functioning of an economy
5. To understand Markets and behaviour of the firm
6. To enhance financial literacy of engineering students.

**Course Outcomes:** After successful completion of the course, student will be able to

CO1 Demonstrate the importance of National and International economy in ones economic life
CO2 Analyse the behaviors of consumer, firms and market and its impact on corporate finance
CO3 Apply financial techniques to evaluate companies and investments
CO4 Develop Personal Financial strategies using various investment options and taxation

| **Unit/Module: 1** | **Macro Economics: Understanding Indian Economy-Domestic and International** | **3 hours** | |
|---|---|---|---|

Economics for Engineers, Definition and classification of Economics, Basic Economic Problems and Economic Systems, India Economy: Mixed economy, Sector-wise contributors Gross Domestic Product (GDP) of India, GDPs of other nations, Macroeconomics, Per Capita Income, Employment, Inflation calculation : Consumer Price Index (CPI), Wholesale Price Index (WPI), Fiscal Policy, Fiscal Deficit, Government expenditure and Taxation, Concept of Goods and Service Tax (GST), Monetary policy, Central Bank- Reserve Bank of India (RBI), Statutory Liquidity Ratio (SLR), Prime Lending Ratio (PLR), Cash Reserve Ratio (CRR).

| **Unit/Module: 2** | **Microeconomics: Understanding behaviors of Consumers, Firms and Markets** | **5 hours** | |
|---|---|---|---|

Consumer Behaviour, Concept of Demand and Supply, Determinants of Demand and Supply, Price Elasticity of Demand and Supply, Market Equilibrium and it's applications, Market and Market Structures- Perfect Competition, Monopolistic Competition, Oligopoly and Monopoly Cost Concepts, Product Costing and Pricing strategy.

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Personal Finance and Taxation I: Personal Financial strategies Background Concepts** | **6 hours** | |
| Financial analysis of a business firm: Statement of Profit and Loss, Balance Sheet, Analyzing various business firms though Ratio Analysis, Time value of money, Annuities. Calculations in Excel, International Trade and Comparative Advantage, International Financing : Foreign Exchange (FOREX) market and Exchange rates, Balance of Payment. | | | |
| **Unit/Module: 4** | **Personal Finance and Taxation II:** Personal Financial strategies **Goal Setting and Tax, Credit and Risk Management** | **7 hours** | |
| Understanding Personal Finance : Financial Goal, Importance, Opportunity Costs in Decision Making, The Time Value of Money, Basics of Financial Planning, Personal financial statements, Cash flow and debt management, Tax Management : Taxes, Direct and Indirect, Income Tax slabs and sections, Other taxes, Credit Management : Consumer Loans, Credit cards, Credit Rating, Credit Information Bureau (India) Limited (CIBIL), Interest Rates, Understanding Monetary Policy, Risk Management : Insurance-Life and General, Types of life Insurance, Unit Linked Insurance Plan (ULIPS), Health Insurance, Vehicle Insurance and other major types, Understanding Insurance riders and decision making while buying insurance. | | | |
| **Unit/Module: 5** | **Personal Finance and Taxation III: Personal Financial strategies Investments in Bonds, Stocks and Mutual Funds, Retirement Planning** | **7 hours** | |
| Investment in Government Securities : Bank Accounts, Government Securities, Bonds, Fixed Deposits, Gold Bonds, Investment in Stock Market : Introduction to Stock Market, Stock Exchange Sensitive Index (SENSEX), National Stock Exchange (NSE), Dematerialised account (Demat) Account, How to select stocks- Price per Earning (P/E) ratio, Fundamentals analysis, Investment in Mutual Funds : What is Mutual Fund, Types, Exchange Traded Funds, Net Asset Value (NAV), Factors for selection of Mutual Funds, Retirement Planning : Public Provident Fund (PPF), Employee Provident Fund (EPF) , National Pension Scheme (NPS) and other Pension Funds, Annuity calculations. | | | |
| | **Total Lab hours:** | **28 hours** | |

**Text Books:**

1.Paul A Samuelson, "**Economics"**, Indian Adaptation, Sudip Chaudhari,Anindya Sen, *Mc Graw Hill* (2010), 19th edition
2. Lawrence J Gitman, "**Principles of Managerial Finance"**, *Pearson.*(2016) 11th edition
3. Prasanna Chandra , "**Finance Sense: Finance for Non-finance Executives**", 5th edition, CFMTMH professional series in Finance
4. Monika Halan , "**Let's Talk Money**" Harper Business 2018
5. P V Subramanya, **"Retire Rich"** TV18 Broadcast Ltd., 2019
6. Abhishek Kumar, "**The Richest Engineer"**, Manjul Publishing House, 2016

**Reference Books:**

1. Lipsey, R.G. & Chrystal, K.A., "**Economics"**, 11th Edition, Oxford University Press, 2007
2. K.K.Dewett, "**Modern Economic Theory"**, S.Chand, 2005

**Autonomous Program Structure of**
**Final Year B. Tech. Eight Semester**
**(Mechanical Engineering)**
**Academic Year: 2023-2024 onwards**

| Course Code | Course Title | Teaching Scheme Hrs /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20PEME801 | Programme Elective – I* | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEME802 | Programme Elective - II | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEME803 | Programme Elective -III | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEME804 | Programme Elective -IV | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE801 | Open Elective III** | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE802 | Open Elective IV*** | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEME802L | Programme Elective – II Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| | **Total** | **18** | **0** | **2** | **325** | **300** | **0** | **25** | **650** | **19** |
| | **Grand Total** | **20** | | | **625** | | **25** | | | |

*NPTEL / Swayam Course, **Open Elective-III: Department Level Course,***Open Elective-IV: Multi-disciplinary Course.

| |
|---|
| **20PEME802 Programme Elective – II**<br>**20PEME802L Programme Elective – II Lab**<br>A. Mechanics of Composite Materials<br>B. Computational Fluid Dynamics<br>C. Finite Element Method |
| **20PEME803 Programme Elective - III**<br>A. Industrial Internet of Things<br>B. Product Design and Development<br>C. Data Science for Mechanical Engineering<br>D. Design Thinking for Innovations |
| **20PEME804 Programme Elective - IV**<br>A. Advanced Refrigeration and Air Conditioning<br>B. Advance Solid Mechanics<br>C. Optimization Techniques |

| 20OE801 Open Elective-III | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE801A | Big Data and Analytics | Y | Y | Y | Y | Y |
| 2 | 20OE801B | Cyber Physical Systems | Y | Y | Y | N | Y |
| 3 | 20OE801C | Digital Control | Y | N | N | Y | Y |
| 4 | 20OE801D | Industrial Engineering and Management | Y | Y | Y | Y | Y |
| 5 | 20OE801E | Introduction to Cyber-crime and Forensics | Y | Y | Y | Y | Y |
| 6 | 20OE801F | Instrumentation in Food and Agriculture | Y | Y | Y | Y | Y |
| 7 | 20OE801G | Medical IoT | Y | Y | Y | N | Y |
| 8 | 20OE801H | Quantum Computing | Y | Y | Y | N | Y |
| 9 | 20OE801I | Renewable Energy Sources | Y | Y | Y | Y | Y |
| 10 | 20OE801J | Soft Computing | Y | Y | Y | Y | Y |
| 11 | 20OE801K | Software Testing and Quality Assurance | Y | Y | Y | Y | Y |

| 20OE802 Open Elective-IV | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE802A | Applied statistics with R Programming | Y | N | N | Y | Y |
| 2 | 20OE802B | Automobile Engineering | Y | Y | Y | N | Y |
| 3 | 20OE802C | Autonomous Robots | N | Y | Y | Y | N |
| 4 | 20OE802D | Building Automation and Energy Audit | Y | Y | Y | Y | N |
| 5 | 20OE802E | Data Analysis and Visualization | Y | N | N | Y | Y |
| 6 | 20OE802F | Data Science using Python | Y | N | N | Y | Y |
| 7 | 20OE802G | Industrial Drives and Control | Y | Y | Y | Y | N |
| 8 | 20OE802H | Smart Sensors and Structures | Y | Y | Y | Y | N |
| 9 | 20OE802I | Wireless Networks | N | Y | Y | N | Y |

## Final Year B. Tech. -- Semester-II

| **Course Name** | **Programme Elective – II**<br>**Mechanics of Composite Material** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20PEME802 A** | **3** | **-** | **-** |
| **Pre-requisite** | Engineering Mechanics, Strength of Materials, Engineering Metallurgy | | | |

**Course Objectives: To make students**

1. Understand a perspective utilization and processing of composite materials
2. Micro and macro mechanical analysis of the composite material at lamina level
3. Analyze the laminated composite material at macro level
4. Understand testing methods of composite materials to evaluate mechanical properties

**Course Outcomes:**

After successful completion of the course, student will be able to

1. Define need, utilization of class of composite material, its constitution and list its application fields
2. Demonstrate the various fabrication process of composite materials
3. Analyze lamina at micro-mechanical and macro-mechanical level of polymer matrix composites
4. Analyze laminated composites using classical lamination theory
5. Express testing method of evaluation of mechanical properties of polymer composites as per ASTM standard

| **Unit/Module: 1** | **Introduction to composite** | **6 hours** | **CO: 1** |
|---|---|---|---|

Introduction to advanced materials and types, Definition, General Characteristics, Applications, Fibers, Types of fibers, Mechanical Properties of fibers; Matrix, Types of matrix, Polymer Matrix- Thermoset and Thermoplastic, Fillers/Additives/Modifiers of Fiber Reinforced Composites

| **Unit/Module: 2** | **Manufacturing of composites** | **6 hours** | **CO: 2** |
|---|---|---|---|

fabrication process for thermoset and thermoplastic PMC, open mould process as hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, and Closed mould process as pultrusion, performing, thermo-forming, injection molding, blow molding, Process parameters.

| **Unit/Module: 3** | **Elastic and strength Behaviour of Lamina** | **9 hours** | **CO: 3** |
|---|---|---|---|

**Micromechanical Analysis of Lamina**: Introduction, Volume and mass fraction, density, void content, evaluation of elastic moduli, ultimate strength of unidirectional lamina
**Macro-mechanical Analysis of Lamina**: Review and definition of stress, strain and Elastic Moduli, Hooke's Law for different types of materials, Hook's law for 2D unidirectional and angular lamina, engineering constants of an angle lamina, Strength failure theories of an angle lamina

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Elastic Behavior of Laminate** | **9 hours** | **CO: 4** |
| Introduction to Laminate Code, Strain-displacement relations, Stress-strain relation for a laminate, force and moment resultants related to mid plane strains and curvatures, In-Plane engineering constants of a laminate, Flexural engineering constants of a laminate | | | |
| **Unit/Module: 5** | **Testing of Composites** | **6 hours** | **CO: 5** |
| Societies for Testing Standards, Background to Mechanical Testing of Composites, Test Method and analysis of Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Inter-laminar Shear Strength properties, Impact Properties. | | | |
| | **Total Lab hours:** | **36 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, Taylor & Francis Group, 2012. |
| **Reference Books:** | |
| 1. | Robert M. Jones, "Mechanics of Composite Materials" 2nd Edition, CRC Press 1998 |
| 2. | Isaac M. Daniels, Ori Ishai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 2010 |
| 3. | Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press, 2004. |

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|---|---|---|---|---|
| **Course Name** | **Programme Elective – II**<br>**Computational Fluid Dynamics** | **L** | **T** | **P** |
| **Course Code** | **PEME802 B** | **3** | **-** | **-** |
| **Prerequisites** | Fluid dynamics, Heat transfer, Numerical methods | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives: To make students**

1. Finite volume method (FVM) of discretization for differential equations ,
2. Development of solution of discretized equations using various methods,
3. CFD tools to solve practical problems
4. Interpret CFD results of complex problems

**Course Outcomes: Students will be able to**

1. Discretize a given differential equation with FVM,
2. Write a simple codes for diffusion and convection problems,
3. Solve fluid flow and heat transfer problems with CFD tools
4. Apply CFD techniques to real life industrial problems.

| | | | |
|---|---|---|---|
| **Unit/Module: 1** | **Introduction to CFD** | **4 hours** | **CO: 1** |

What is CFD, Advantages of CFD, Applications: as a design and analysis tool, applications in aerospace, applications in automobile and EV, applications in bioscience etc.

| | | | |
|---|---|---|---|
| **Unit/Module: 2** | **CFD Fundamentals** | **6 hours** | **CO: 2** |

Governing differential equations of fluid dynamics and heat transfer, RTT, continuity equation, Navier Stokes equations and energy equation, RANS, different types of boundary conditions.

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **CFD Procedure** | **8 hours** | **CO: 3** |

Finite volume method, discretization of conduction and convection equations, various convective schemes, discretization of momentum equations, pressure velocity coupling, SIMPLE algorithm.

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **CFD Mesh Generation** | **6 hours** | **CO: 4** |

Types of meshes, structuared, body-fitted and unstructured meshes, mesh refinement, moving meshes, mesh quality.

| | | | |
|---|---|---|---|
| **Unit/Module: 5** | **CFD Solution and Postprocessing** | **6 hours** | **CO: 5** |

Convergence, residual and tolerance, consistency and stability, accuracy, sources of errors in solution, mesh independence study, verification and validation.

| **Unit/Module: 6** | **Applications with Examples** | **4 hours** | **CO: 6** |
|---|---|---|---|
| Lid driven cavity, pipe flow, flow over bends, heat transfer coupled with fluid flow, turbulent flow through a channel, flow over an aerofoil etc. | | | |
| | **Total Lab hours:** | **34 hours** | |

| **Text Books:** | |
|---|---|
| 1. | Jiyuan Tu, Guan-Heng Yeho and Chaoqun Liu, Fluid Dynamics: A Practical Approach, Elsevier. |
| 2. | S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. |
| 3. | John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor & Francis |
| 4. | Versteeg, H. K. and Malalasekara, W. (2008). Introduction to Computational Fluid Dynamics: The Finite Volume Method. Second Edition (Indian Reprint) Pearson Education. |
| 5. | 4. Anderson, J.D. Computational Fluid Dynamics, McGraw Hill, 1995. |
| 6. | Ansys Fluent User's Guide, Ansys Inc. |

| Course Name | Programme Elective – II<br>Finite Element Method | L | T | P |
|---|---|---|---|---|
| Course Code | 20PEME802 C | 3 | - | - |
| Pre-requisite | Strength of Materials, Engineering Metallurgy, Heat Transfer | | | |

**Course Objectives:**

**To make students**

1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics problems
2. To familiarize students with finite element method for displacement and stress analysis of 1D and 2D problems
3. To evaluate temperature distribution of heat transfer problem using FEM
4. To evaluate dynamic analysis problem using FEM

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Understand the different FEM techniques used to solve mechanical engineering problems.
2. Derive and apply element stiffness matrices and load vectors to solve beam and rigid frame problems
3. Derive and apply isoparametric elements and numerical integration to solve plane stress problems
4. Apply 1D heat transfer FEM formulation to solve for temperature distribution
5. Evaluate dynamic analysis of beam using FEM formulation

| Unit/Module: 1 | Introduction to Finite Element Method | 6 hours | CO: 1 |
|---|---|---|---|

General description and engineering applications of finite element method, Boundary conditions: homogeneous and nonhomogeneous for structural, heat transfer and fluid flow problems.
Different approaches: Potential energy method, Rayleigh-Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretisation process.
Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes.
Types of Analysis: Linear static analysis, Non-linear analysis, Dynamic analysis, Linear buckling analysis, Thermal analysis, Fatigue analysis, Crash analysis.

| Unit/Module: 2 | Analysis of Beams and Rigid Frames | 8 hours | CO: 2 |
|---|---|---|---|

Introduction, Beam Analysis Using two Noded Elements, Analysis of Rigid Plane Frame Using 2 Noded Beam Elements, Timoshenko Beam Element: Formulation, element stiffness matrix, assemblage stiffness matrix and solve for static load

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Analysis of Plane stress with isoparametric elements and numerical integration** | **8 hours** | **CO: 3** |
| Concept of isoperimetric elements, Terms isoperimetric, super parametric, and sub parametric.<br>Coordinate mapping: Natural coordinates, Area coordinates (for triangular elements), higher-order triangular and quadrilateral elements, geometry associative mesh, quality checks, mesh refinement- p vs h refinements, Uniqueness of mapping – Jacobian matrix.<br>Numerical integration: Gauss Quadrature in one and two dimensions, Order of Gauss integration, full and reduced integration, sub-modelling, sub structuring. | | | |
| **Unit/Module: 4** | **Steady-State Heat Transfer** | **6 hours** | **CO: 4** |
| Introduction, One-dimensional steady-state heat transfer problem- Governing differential equation, Finite Element formulation using Galerkin's approach for composite wall and thin fin, essential and natural boundary conditions and solving for temperature distribution | | | |
| **Unit/Module: 5** | **Dynamic Analysis** | **8 hours** | **CO: 5** |
| Types of dynamic analysis, general dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar, truss and beam element.<br>Undamped-free vibration: Eigenvalue problem, evaluation of eigenvalues and eigenvectors. | | | |
| | **Total hours:** | **36 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Daryl Logan, First Course in the Finite Element Method, Cengage Learning India Pvt. Ltd. |
| 2. | S.S. Bhavikatti, Finite Element Analysis, New Age International (P) Ltd, 2005 |
| **Reference Books:** | |
| 1. | R. D. Cook, et al., Concepts and Applications of Finite Element Analysis. Wiley, India |
| 2. | Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005. |
| 3. | G Lakshmi Narasaiah, Finite Element Analysis, BS Publications, 2008. |
| 4. | Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002. |
| 5. | P., Seshu, Textbook of Finite Element Analysis, PHI Learning Private Ltd. , New Delhi, 2010. |

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| **Course Name** | **Programme Elective – III**<br>**Industrial Internet of Things** | **L** | **T** | **P** |
| **Course Code** | **20PEME803 A** | **3** | **-** | **-** |
| **Pre-requisite** | Engineering fundamentals and principles | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

**To make students**

1. Understand protocol, prototype of IoT based smart system
2. Understand Automatic Storage Management.
3. Understand Internet of Things-Ethics and Governance.
4. Understand Smart Manufacturing techniques, smart design, and fabrication Smart application.

**Course Outcomes:**

**Students will be able to**

After successful completion of the course, student will be able to
1. Apply protocol and prototype concepts for IIOT.
2. Justify the role of Automatic storage Management in IIOT
3. Follow ethical practices while developing IIOT applications
4. Design Smart manufacturing and Fabrication applications.

| | | | |
|---|---|---|---|
| **Unit/Module: 1** | **The Internet of Things, Thinking about Prototyping, Prototyping Embedded devices** | **6 hours** | **CO: 1** |

1**The Internet of Things**: **Protocols and Prototyping, Prototyping Embedded devices** An overview; Design Principles for Connected Devices, Internet Principles– Electronics, Embedded Computing Basics, Arduino/Raspberry Pi/ BeagleBone Black/ etc. Prototyping online Components – Getting Started with an API, Writing a New API(Application programming interface)

| | | | |
|---|---|---|---|
| **Unit/Module: 2** | **Automatic Storage Management** | **6 hours** | **CO: 2** |

**Real Time Reactions and Automatic Storage Management**, Other Protocols. Techniques for Writing Embedded Code – Memory Management, Performance. Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud.Smart Connected System Design Case Study.

| | | | |
|---|---|---|---|
| **Unit/Module: 3** | **Internet of Things-Ethics, Privacy, Security and Governance** | **4 hours** | **CO: 3** |

Introduction, Ethics Overview of Governance, Privacy and Security Issues,

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Introduction to Smart Manufacturing** | **8 hours** | **CO: 4** |

Smart manufacturing, Smart Manufacturing Processes- Three Dimensions: (1) Demand Driven and Integrated Supply Chains;(2) Dynamically Optimized Manufacturing Enterprises (plant + enterprise

| | | | |
|---|---|---|---|
| operations);(3) Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG) | | | |
| **Unit/Module: 5** | **Smart Design/Fabrication, Smart Applications, Tools for IIOT** | **8 hours** | **CO: 4** |
| Smart Design/Fabrication - Digital Tools, Manufacturing Systems and Standards.<br>Smart Applications Case study | | | |
| | **Total Lab hours:** | **32 hours** | |

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|---|---|
| **Text Books:** | |
| 1. | Designing the Internet of Things by Adrian McEwen and Hakim Cassimally |
| 2. | Getting Started with the Internet of Things: Connecting<br>Sensors and Microcontrollers to the Cloud by Cuno Pfister |
| 3. | Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development, Joe Biron& Jonathan Follett, Oreilly, First Edition, March 2016 |
| 4. | The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, 2016, Lucas Darnell |
| 5 | Designing Connected Products, 1st Edition, Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland |
| 6 | Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547) |

| Course Name | Programme Elective – III<br>Product Design and Development | L | T | P |
|---|---|---|---|---|
| Course Code | 20PEME803 B | 3 | - | - |
| Pre-requisite | Manufacturing Processes, Industrial Inspection, Quality Control, Machin Design | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**Course prepares students to**

1. Understand to Product Design Process and Product Policy.
2. Learn the fundamental of Product Design Morphology Tools.
3. Understand Design for Manufacturing and Assembly.
4. Learn Design for Environment, Quality and IPR.

**Course Outcomes:**

**Students will be able to**

1. Analyse to identify different phases of product design and Product life-cycle,
2. Apply product design morphology tools to analyse requirements/functionality,
3. Apply techniques of Design for Manufacturing and Assembly for product design,
4. Identify factors while designing for Environment w.r.to manufacturing reusability, standards

| Unit/Module: 1 | Introduction to Product Design Process and Product Policy | 6 hours | CO: 1 |
|---|---|---|---|

- Introduction to product design: Product design process, Product life-cycle,
- Product policy of an organization. Selection of a Profitable product, Product design process, Product analysis,
- System engineering in product design: Boundary Diagram and P-Diagram.

| Unit/Module: 2 | Product Design Morphology Tools | 6 hours | CO: 1 |
|---|---|---|---|

- Problem identification and selection, Product Characteristics, KJ Model, DFMEA,
- Analysis of functions, and Anatomy of function: Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST),
- Visual Design, and Quality Function Deployment (QFD),
- Value engineering in product design; Advantages, Applications in product design,
- Ergonomics in product design, Case studies.

| Unit/Module: 3 | Material and Manufacturing Process Selection | 8 hours | CO: 2 |
|---|---|---|---|

- DFX and DFMA during product design: Advantages and case studies,
- Classification and Selection: Introduction to Manufacturing processes,
- Introduction to selection of Manufacturing processes and materials for product design.

| Unit/Module: 4 | Product Design for Assembly and Maintenance | 6 hours | CO: 3 |
|---|---|---|---|

- Design for Assembly: The assembly process, Characteristics and applications, General taxonomies of assembly operation and systems, Examples of common assemblies;
- DFA for design consideration and design recommendation for Part Handling- Insertion, Fasteners [e.g. for manual assembly, high-speed automatic assembly and robot assembly],
- DFA analysis (evaluating assembly): Assembly Metrics, DFA index, Example of worksheet.

| Unit/Module: 5 | Product Design for Manufacturing | 5 hours | CO: 3 |
|---|---|---|---|

- Design for Marching: Turning, Milling, Round-Holes Machining, Grinding etc.
- Design for Forming and Joining Processes: Design for Castings, Injection Molding, Forging, Sheet-metal stamping Welding Extrusion and Powder Metal Processing
- Product design for Rapid Prototyping:, Needs, Advantages, Working Principle
  - [Process steps, typical characteristics and applications; Defects; Suitable materials; Dimensional factors and tolerances Design consideration and recommendations for selected process],

| Unit/Module: 6 | Design for Environment, Quality and IPR | 3 hours | CO: 4 |
|---|---|---|---|

- Product design for Environment (w.r.to Standards / Norms),
- Product design for Quality Control (Inspection requirements w.r.to GD&T),
- Introduction to Reverse Engineering and Frugal Technology,
- Product design and IPR.

| | Total Lecture hours: | 36 hours | |
|---|---|---|---|

**Text Books:**


| | |
|---|---|
| 4. | Eppinger, S. and Ulrich, K., 2015. Product design and development. McGraw-Hill Higher Education |
| 5. | Magrab, E.B., Gupta, S.K., McCluskey, F.P. and Sandborn, P., 2009. Integrated product and process design and development: the product realization process. CRC Press. |
| 6. | Boothroyd, G., 1994. Product design for manufacture and assembly. Computer-Aided Design, 26(7), pp505-520. |


**Reference Books:**


| | |
|---|---|
| 1. | G. Boothroyd, P. Dewhurst, W. A. Knight, Product Design for Manufacture and Assembly, CRC Press. |
| 2. | K. T. Ulrich and S. D. Eppinger, Product Design and Development, McGraw-Hill Higher Education. |
| 3. | Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill. |

| | |
|---|---|
| 4. | G E Dieter, Engineering Design - A Material Processing Approach, McGraw Hill. |
| 5. | B. R. Fischer, Mechanical Tolerance stackup and analysis, CRC Press. |

| Course Name | Programme Elective - III<br>Data Science for Mechanical Engineering | L | T | P |
|---|---|---|---|---|
| Course Code | 20PEME803 C | 3 | - | - |
| Pre-requisite | Engineering fundamentals and principles | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives:**

**To make students**

1. Relevance of data science in mechanical engineering
2. Mathematics and statistical fundamentals for data science
3. Machine learning and AI software frameworks
4. Current trends in mechanical engineering using data science

**Course Outcomes:**

**Students will be able to**

1. Solve data driven problems
2. Use ML software frameworks
3. Apply reinforcement learning to robotic problems
4. Undertake research problem in mechanical engineering that involves data science concepts

| Unit/Module | | Hours | CO |
|---|---|---|---|
| **Unit/Module: 1** | | **6 hours** | **CO: 1** |
| Mathematical and statistical foundations of data science | | | |
| **Unit/Module: 2** | | **4 hours** | **CO: 2** |
| Introduction to data science, machine learning, and Artificial Intelligence | | | |
| **Unit/Module: 3** | | **6 hours** | **CO: 3** |
| Foundations of Python programming for data science, numpy, pandas, OpenCV, matplotlib etc. | | | |
| **Unit/Module: 4** | | **8 hours** | **CO: 4** |
| Introduction to Neural Networks and Deep Learning: Theoretical concepts, ML frameworks such as Tensorflow, PyTorch | | | |
| **Unit/Module: 5** | | **6 hours** | **CO: 5** |
| Reinforcement learning: Applications of RL in Robotics, OpenAI Gym for RL environment | | | |
| **Unit/Module: 6** | | **4 hours** | **CO: 6** |
| Applications and case studies: Recent research in solid mechanics, fluid dynamics and robotics in | | | |

| | | | |
|---|---|---|---|
| context of data science | | | |
| | **Total Lab hours:** | **32 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | Andreas Müller, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Relly Media |
| 2. | Laura Igual, Introduction to Data Science, Springer |
| 3. | Gareth James, Introduction to Statistical learning, Springer, 2017 |
| 4. | www.tensorflow.org, www.pytorch.org, www.openai.com, www.python.org |

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|---|---|---|---|---|---|
| **Course Name** | **Programme Elective - III**<br>**Design Thinking for Innovations** | | **L** | **T** | **P** |
| **Course Code** | **20PEME803 D** | | **3** | **-** | **-** |
| **Pre-requisite** | Engineering fundamentals and principles | | **Syllabus Version** | | |
| | | | **V:1.1** | | |

**Course Objectives: To make students**

1. Principles of innovative mindset
2. Methods and techniques to define customer needs
3. Generate a pool of ideas and solutions
4. Seek solutions to real life problems though innovations

**Course Outcomes: Students will be able to**

1. Identify needs and problems for innovations
2. Create ideas and find alternate solutions
3. Implement ideas and create prototypes
4. Apply design thinking principle to real life problems

| | | | |
|---|---|---|---|
| **Unit/Module: 1** | **Principles of design thinking** | **4 hours** | **CO: 1** |
| Empathise, define, ideate, prototype and test | | | |
| **Unit/Module: 2** | | **6 hours** | **CO: 2** |
| Need identification and problem definition | | | |
| **Unit/Module: 3** | | **6 hours** | **CO: 3** |
| Ideation and brainstorming | | | |
| **Unit/Module: 4** | | **4 hours** | **CO: 4** |
| Implementation, Prototyping and testing of ideas | | | |
| **Unit/Module: 5** | | **4 hours** | **CO: 5** |
| Applications and examples of Design Thinking | | | |
| **Unit/Module: 6** | **Design Thinking case studies** | **6 hours** | **CO: 6** |
| business, manufacturing, service industries and public services. | | | |
| | **Total Lab hours:** | **30 hours** | |

| **Text Books:** | |
|---|---|
| 1. | Christian Muller-Rotenberg, Design Thinking for Dummies, Wiley 2020 |
| 2. | Design Thinking Toolkit, Ideo.org |
| 3. | Harry Plattner, Christopher Meinel, Larry Leifer, Design Thinking, Springer |
| 4. | Jeane Liedtka, Solving Problems with Design Thinking, Columbia Uni. Press, 2013 |

| Course Name | Programme Elective – IV<br>Advanced Refrigeration and Air Conditioning | L | T | P |
|---|---|---|---|---|
| Course Code | 20PEME804_A | 3 | - | - |
| Prerequisite | 1. Heat Transfer<br>2. Fluid Mechanics<br>3. Applied Thermodynamics | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives: To make students**

1. Select appropriate refrigerant for the given application analyze refrigeration cycles and understand heat driven refrigeration systems
2. Analyze refrigeration cycles and understand heat driven refrigeration systems.
3. Estimate cooling load for air conditioning systems.
4. Analyze various air conditioning systems.
5. Analyze duct systems for air distribution.
6. Appraise energy performance of the buildings

**Course Outcomes: Students will be able to**

1. Select appropriate refrigerant for the given application analyze refrigeration cycles and understand heat driven refrigeration systems
2. Analyze refrigeration cycles and understand heat driven refrigeration systems.
3. Estimate cooling load for air conditioning systems.
4. Analyze various air conditioning systems.
5. Analyze duct systems for air distribution.
6. Appraise energy performance of the buildings

| Unit/Module: 1 | Refrigerants | 3 hours | CO: 1 |
|---|---|---|---|

Classification of refrigerants, designation of refrigerants, desirable properties of refrigerants, environmental issues, selection of environment friendly refrigerants, alternative refrigerants

| Unit/Module: 2 | Vapor Refrigeration Cycles | 6 hours | CO: 2 |
|---|---|---|---|

Advanced vapor compression cycles – Trans critical cycle, Ejector refrigeration cycle

Vapor absorption systems- Aqua ammonia system, Electrolux refrigerator

| Unit/Module: 3 | Air Conditioning Load Estimation | 15 hours | CO: 3 |
|---|---|---|---|

Refrigeration and Air Conditioning System Components: –
Compressors- Reciprocating, centrifugal, screw, scroll, inverter based
Evaporators
Condensers- Shell and Tube type , evaporative condenser
Expansion Devices- Capillary tube, Thermostatic Expansion valve, Electronic Expansion valve

Cooling Towers
Air cooling v/s Air Conditioning, Review of psychrometric processes, Thermodynamic of human body
Factors impacting heating/cooling load
Concept of infiltration, ventilation, indoor air quality requirements, solar radiation
Cooling Load Temperature Difference method
Overview of energy codes – ECBC, Eco Niwas Samhita, IECC
Overview of Energy Simulation Softwares

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Advanced Air Conditioning systems** | **6 hours** | **CO: 4** |
| Desiccant air conditioning systems, evaporative cooling, thermal energy storage air conditioning systems, radiant cooling heat pump systems, Under floor air delivery systems<br><br>Selection Criteria | | | |
| **Unit/Module: 5** | **Air Distribution System** | **6 hours** | **CO: 5** |
| Ducts - Air flow through simple duct system. Pressure losses in duct<br>Method of duct system design- equal friction, velocity reduction method, static regain method<br>Air handling unit- Fan coil unit, filters, supply and return grills | | | |
| **Unit/Module: 6** | **Building Energy Efficiency** | **3 hours** | **CO:6** |
| Introduction to high performance buildings, building controls and building management system, commissioning and audits of building systems, Green building rating systems | | | |
| | **Total course hours:** | **hours** | **39** |

**Text Books:**

| | |
|---|---|
| 1. | Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill |
| 2. | Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd |
| 3. | McQuiston, Heating Ventilating and air Conditioning: Analysis and Design, Wiley India |
| 4. | Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpat Rai & Company, New Delhi |
| 5. | ASHRAE Handbooks |
| 6 | Threlkeld J.L., Thermal Environmental Engineering, Prentice Hall Inc. New Delhi |
| 7 | Shan Wang, Handbook of Refrigeration and Air Conditioning, McGraw Hill Publications |

| Course Name | Programme Elective – IV<br>Advanced Solid Mechanics | L | T | P |
|---|---|---|---|---|
| Course Code | 20PEME804_B | 3 | 0 | 0 |
| Pre-requisites | Basics of Engineering Mechanics and Strength of Materials | Syllabus Version | | |
| | | V:1.1 | | |

**Course Objectives: To make students**

1. Understand the concept of tensor.
2. Analyse advanced concept of stress and strain in structural problems.
3. Apply the concept of different elastic functions to solve complex problems.
4. Evaluate the influence of various geometric and loading parameters in plane stress and plane strain problems.
5. Implement advanced concept of solid mechanics in torsion, plates and shells

**Course Outcomes : Students will be able to**

1. Understand the concept of tensor.
2. Analyse advanced concept of stress and strain in structural problems.
3. Apply the concept of different elastic functions to solve complex problems.
4. Evaluate the influence of various geometric and loading parameters in plane stress and plane strain problems.
5. Implement advanced concept of solid mechanics in torsion, plates and shells

| Unit :1 | Mathematical Preliminaries: | 7 hours | CO: 1 |
|---|---|---|---|

Introduction to tensor algebra: symmetric and skew-symmetric tensor, summation convention, eigenvalue and eigenvector of tensor, spectral theorem, polar decomposition theorem, product of tensor, principal invariants of tensor, coordinate transformation of tensor, Tensor calculus: gradient, divergence, curl, differentiation of scalar function of a tensor.

| Unit : 2 | Analysis of Stress and Strain: | 8 hours | CO: 2 |
|---|---|---|---|

Definition and notation of stress, Cauchy stress tensor, equations of equilibrium, principal stresses and stress invariants, stress deviator tensor, octahedral stress components, General deformations, small deformation theory, strain transformation, principal strains, spherical and deviatoric strains, Strain-displacement relations, strain compatibility, stress and strain in curvilinear, cylindrical, and spherical coordinates, fundamental equations of plasticity.

| | | | |
|---|---|---|---|
| **Unit : 3** | **Problem formulation and solution strategies:** | **7 hours** | **CO: 3** |
| Field equations, boundary conditions, stress and displacement formulation, Beltrami-Michell compatibility equations, Lame-Navier's equations, principle of superposition, uniqueness theorem, Saint-Venant's principle, Brief descriptions about general solution strategies - direct, inverse, semi-inverse, analytical, approximate, and numerical methods. | | | |
| **Unit : 4** | **Two-dimensional problems:** | **7 hours** | **CO: 4** |
| Plane stress and plane strain problems, generalized plane stress, Antiplane strain, Airy stress function, polar coordinate formulation and solutions, Cartesian coordinate solutions using polynomials and Fourier series method. | | | |
| **Unit : 5** | **Applications:** | **7 hours** | **CO: 5** |
| Torsion of noncircular shafts: Warping and Prandtl stress function, Torsion analysis of circular, elliptical, and rectangular cylinder using Warping and Prandtl function, Membrane analogy, Photo elasticity, Plates and shells – Fundamental equations, Kirchhoff's theory, axisymmetric bending of circular plates, membrane theory of shells of revolutions. | | | |
| | **Total Theory Lecture hours:** | **35 hours** | |

| | |
|---|---|
| **Text Books:** | |
| 1. | Elasticity, Theory, Applications, and Numerics by Martin H. Sadd |
| 2. | Theory of Elasticity by Stephen Timoshenko and , J. N. Goodier |
| 3. | Advanced Mechanics of Solids, Otto T. Bruhns, Springer publications. |
| **Reference Books:** | |
| 1. | Continuum Mechanics, A.J.M Spencer, Dover Publications, INC |
| 2 | Advanced Mechanics of Materials by H. Ford and J. M. Alexander |
| 3 | The Linearized Theory of Elasticity, W. S. Slaughter, Springer Science+Business Media, LLC |

| **Course Name** | **Programme Elective – IV**<br>**Optimization Techniques** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20PEME804 C** | **3** | **-** | **-** |
| **Prerequisite** | Engineering Mathematics | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives:**

1 To introduce to the students optimization problems and various solution techniques ,

2 To impart knowledge of various classical and modern optimization techniques

3 To make students aware about industrial optimization problems

4 To expose students to numerical techniques to solve optimization problems

**Course Outcomes:** Upon completion of this course, the student will be able to:

1 formulate objective functions and constraint equations for a given classical problem,

2 apply classical and modern method of optimization to standard problems

3 solve realistic and industrial design problems

4 use computational tools such as MATLAB/OCTAVE to get solutions

| **Unit/Module: 1** | **Introduction to Optimization** | **4 hours** | **CO: 1** |
|---|---|---|---|

Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems, Graphical Optimization Techniques.

| **Unit/Module: 2** | **Classical Optimization Techniques** | **6 hours** | **CO: 2** |
|---|---|---|---|

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints: Solution by Direct Substitution, Solution by the Method of Constrained Variation, Solution by the Method of Lagrange Multipliers, Multivariable Optimization with Inequality Constraints: Kuhn–Tucker Conditions, Constraint Qualification, Convex Programming Problems.

| **Unit/Module: 3** | **Linear Programming: Simplex Method** | **4 hours** | **CO: 3** |
|---|---|---|---|

Applications of Linear Programming,Standard Form of a Linear Programming Problem, Simplex Algorithm, Two Phases of the Simplex Method

| | | | |
|---|---|---|---|
| **Unit/Module: 4** | **Nonlinear Programming** | **6 hours** | **CO: 4** |
| Introduction, Unrestricted Search, Interval Halving Method, Golden Section Method, Quadratic Interpolation Method, Newton's Method, Practical Considerations | | | |
| **Unit/Module: 5** | **Intro to Special Optimization Methods** | **6 hours** | **CO: 5** |
| Dynamic Programming, Optimal Control | | | |
| **Unit/Module: 6** | **Modern Methods of Optimization** | **6 hours** | **CO: 6** |
| Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Neural-Network-Based Optimization, Practical Aspects of Optimization | | | |
| | **Total Lab hours:** | **32 hours** | |

**Text Books:**

| | |
|---|---|
| 1. | Engineering Optimization -Theory and Practice/ Singerusu S. Rao/ New Age. |
| 2. | Optimum Design of Mechanical elements/ Johnson Ray C/ Wiley, John & Sons |
| 3. | Optimization for Engineering Design Algorithms and Examples/ Kalyanamoy Deb/Prentice Hall of India |

| Course Name | **Programme Elective – II Lab**<br>**Mechanics of Composite Material Lab** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20PEME802L_A** | **-** | **-** | **2** |
| **Pre-requisite** | Engineering Mechanics, Strength of Materials, Engineering Metallurgy | | | |

**Course Objectives:**

**To make students**

1. Micro and macro mechanical analysis of the composite material at lamina level
2. Analyze the laminated composite material at macro level
3. Manufacture the unidirectional laminated composite material
4. Test composite materials to evaluate mechanical properties

**Course Outcomes:**

After successful completion of the course, student will be able to

1. Analyze lamina at micro-mechanical and macro-mechanical level of polymer matrix composites
2. Analyze laminated composites using classical lamination theory
3. Fabricate the unidirectional composite laminate using compression molding process
4. Test and evaluate mechanical properties of polymer composites as per ASTM standards

**Lab Work:**

1. Develop a program for micro mechanical analysis of composite lamina
2. Develop a program for macro mechanical analysis of composite lamina and laminate
3. Develop a program for failure analysis of composite laminate using different failure theories.
4. Manufacturing of unidirectional and multidirectional fiber reinforced polymer matrix composites
5. Tensile testing of composite lamina to find out tensile strength and tensile modulus
6. Flexural testing of composite lamina to find out flexural strength and flexural modulus
7. Izod/Charpy impact test of composite lamina to find out impact strength

**Text Books:**

1. P K Mallik, "Fibrer Reinforced Composites: Materials, Manufacturing and Design", CRC Press, Taylor & Francis Group, Third Edition 2015.

| **Course Name** | **Programme Elective – II Lab**<br>**Computational Fluid Dynamics Lab** | **L** | **T** | **P** |
|---|---|---|---|---|
| **Course Code** | **20PEME802 L_B** | **-** | **-** | **2** |
| **Prerequisites** | Fluid Dynamics, HT, CFD | **Syllabus Version** | | |
| | | **V:1.1** | | |

**Course Objectives: Introduce students to**

1. To develop simple FVM codes
2. To set up and solve fluid flow and HT problems with CFD tools
3. To carry out simulations of real life CFD problems

**Course Outcomes:**

After successful completion of the course, students will be able to

1. Develop simple FVM codes
2. Use CFD tools
3. Simulate CFD problems and postprocess the results.
4. Interpret CFD results and draw scientific conclusions

**Lab Work:**

1. Finite Volume Method code for two-dimensional conduction problem.
2. FVM code for convection problem.
3. Demonstration and study of NSE Solver
4. Lid driven cavity problem using Ansys Fluent
5. Flow through a channel: Fluent tutorial
6. Flow over airfoil: Fluent tutorial
7. 2-D heat transfer problems in Fluent
8. Simple turbulent flow simulations in Fluent

**Text Books/References:**

1. ANSYS user guide https://www.ansys.com/academic/learning-resources

| Course Name | **Programme Elective – II Lab<br>Finite Element Method Lab** | L | T | P |
|---|---|---|---|---|
| **Course Code** | **20PEME802L_C** | - | - | 2 |
| **Pre-requisite** | Strength of Materials, Engineering Metallurgy, Heat Transfer | | | |

**Course Objectives:**

1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics problems
2. To familiarize students with finite element method for displacement and stress analysis of 1D and 2D problems
3. To evaluate temperature distribution of heat transfer problem in FEM
4. To evaluate natural frequency through dynamic analysis of mechanical component

**Course Outcomes:** After successful completion of the course, students will be able to

1. Understand the different FEM techniques used to solve mechanical engineering problems.
2. Derive and apply beam and rigid frame element stiffness matrices and load vectors to solve for displacements and stresses.
3. Derive and apply isoparametric formulation of element stiffness matrices and load vectors to solve plane stress problems for displacements and stresses.
4. Apply 1D heat transfer FEM formulation to solve for temperature distribution

**Lab Work:**

1. A computer program for stress analysis of beam using linear and quadratic elements
2. A computer program for stress analysis of rigid frame using FEM formulation
3. A computer program for stress analysis of plane stress using the isoparametric formulation
4. A computer program for 1-D temperature analysis for heat transfer problem
5. Static stress concentration factor calculation for a plate with center hole using FEA software
6. Stress and deflection analysis of any machine component consisting of 3-D elements using FEA software.
7. Modal analysis of any machine component using FEA software.
8. Temperature distribution analysis of Steady-state heat transfer problem using FEA software

**Text Books/References:**

| | |
|---|---|
| 1. | Nitin S. Gokhale, Practical Finite Element Analysis, Finite to Infinite; First edition |
| 2. | ANSYS user guide https://www.ansys.com/academic/learning-resources |

# 20EC301 Electronic Circuits and Applications

**Teaching Scheme**
Lectures: 3 Hours / Week
Tutorial: 1 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 4**

**Course Objectives:**

1. To understand semiconductor devices such as JFET and MOSFET, Its characteristics, Parameters and its applications
2. To understand Operational amplifier, Concept, Parameters and applications
3. To understand Linear and non-linear applications of Op-Amp
4. To understand Characteristics of Active filters and Operating principles of PLL

**Course Outcomes:**
After completion of the course, students will be able to

| CO | CO Statement |
|---|---|
| CO1 | Interpret the characteristics of JFET and MOSFET |
| CO2 | Analyze parameters of JFET and MOSFET towards its application as an Amplifier |
| CO3 | Illustrate the significance of internal stages of Op-Amp, Interpret and calculate performance parameters of Op Amp and PLL |
| CO4 | Design and Analyze Linear and Nonlinear applications of Op Amp and Butterworth filters |

**Unit I: JFET** **(07)**
Introduction, Types, Construction of JFET, Characteristics (Transfer and Drain), and working of JFET, Schockley's equation, JFET biasing and DC analysis, JFET as amplifier and its configurations (CS/CD/CG), CS amplifier analysis.

**Unit II: MOSFET** **(07)**
Two terminal MOS structure, EMOSFET-construction, symbols, Ideal EMOSFET V-I characteristics, Additional MOSFET structures (DMOSFET and CMOS), Non-ideal V-I characteristics of EMOSFET (finite output resistance, body effect, Break down effect, Temperature effect, Short channel effects), MOSFET biasing and DC circuit analysis, MOSFET small signal amplifier (CS configuration).

**Unit III: OP-AMP Basics** **(07)**
Block diagram of OP-Amp, Differential Amplifier configurations, Symbol and ideal equivalent circuit of Op-Amp, Differential amplifier analysis for dual-input balanced-output configuration, DC and AC characteristics of Op-Amp, Methods for improving CMRR of Differential Amplifier.

**Unit IV: Linear Applications of OP-AMP** **(08)**
Inverting and Non-inverting amplifier, Voltage follower, Summing amplifier, Difference Amplifier, Instrumentation Amplifiers, Ideal integrator, errors in ideal integrator, Practical integrator, Ideal differentiator, errors in ideal differentiator, Practical differentiator.

**Unit V: Non-linear Applications of OP-AMP** **(07)**

Comparator, Characteristics of comparator, Applications of Comparator, Schmitt trigger, Square wave generator, Triangular wave generator, Need of precision rectifier, Half wave and Full wave precision rectifiers.

**Unit VI: Active filters and PLL** **(06)**

First order and second order active LP Butterworth filter, Filter design and frequency scaling, Block diagram of PLL, Characteristics of PLL, Applications of PLL.

**Text Books:**

1. R.L.Boylestad, L.Nashlesky, **"Electronic Devices and Circuits Theory"**, *Prentice Hall of India*, (11th Edition), (2013).
2. Donald Neaman, **"Electronic Circuit Analysis and Design"**, *Tata McGraw Hill*, (3rd Edition), (2007).
3. Ramakant A. Gaikwad, **"Op Amps and Linear Integrated Circuits"**, *Prentice Hall*, (4th Edition), (2000).
4. Salivahanan and Kanchanabhaskaran, **"Linear Integrated Circuits"**, Tata *McGraw Hill Education*, (1st Reprint 2008).

**Reference Books:**

1. Sergio Franco, **"Design with Operational Amplifiers and Analog Integrated Circuits"**, McGraw Hill Education, (3rd Edition), (2002).
2. Sedra Smith, **"Microelectronic Circuits"**, Oxford Publications, (5th Edition), (2004).
3. David A. Bell, **"Electronic Devices and Circuits"**, Oxford, (5th Edition) (2008).
4. MillmanHalkias, **"Integrated Electronics- Analog and Digital Circuits and Systems"**, *Tata McGraw Hill*, (2nd Edition) (2010).

**Online Resources:**

1. https://www.ti.com
2. NPTEL Course **"Analog Electronic Circuits"**
   https://nptel.ac.in/courses/108/105/108105158/
3. NPTEL Course on **"Analog Circuits"**
   https://nptel.ac.in/courses/108/101/108101094/

# 20EC301L ELECTRONICS CIRCUITS AND APPLICATIONS LAB

**Teaching Scheme**
Practical: 4 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Practical:25 Marks
**Credits: 2**

**Course Objectives:**
1. To identify and characterize the device such as JFET and MOSFET.
2. To measure Op-Amp performance parameters and understand the difference between ideal and practical values for different ICs.
3. To design and implement linear and non-linear applications of Op-Amp and verify the functionality

**Course Outcomes:**
After completion of the course, students will be able to
CO1 Interpret characteristics of JFET and MOSFET
CO2 Design biasing circuits for JFET amplifier and analyze performance of JFET amplifier
CO3 Select an appropriate Op-Amp IC for given application and analyze their performance
CO4 Design Op-Amp based circuits and analyze their performance

**List of Experiments:**
1. Plot V-I characteristics of JFET.
2. Implement biasing circuits for JFET and verify DC operating point.
3. Implement JFET CS amplifier and calculate $A_V$, $R_i$ **and** $R_o$.
4. Plot V-I characteristics of MOSFET.
5. Measure Op-Amp parameters and compare with the ideal specifications:
    - Input bias current,
    - Input offset current,
    - Input offset voltage,
    - Slew rate,
    - CMRR.
6. Design, Build and Test Integrator for given frequency $f_a$.
7. Design, Build and Test three Op-Amp Instrumentation amplifier for typical application.
8. Design, Build and Test Schmitt trigger and plot transfer characteristics.
9. Design, Build and Test Square and Triangular waveform generator.
10. Build and Test half and full wave precision rectifier.
11. Simulate JFET CG and CD amplifier.
12. Simulate and verify virtual ground and virtual short concept in inverting and non-inverting configuration of Op-Amp.
13. Simulate and verify the response of Differentiator for given frequency $f_a$.
14. Simulate and verify the response of I$^{st}$ and II$^{nd}$ order Butterworth low pass filter.
15. Build and Test a small project using Op-Amp IC or suitable discrete components.

# 20EC303 DATA STRUCTURES & ALGORITHMS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
ISE: 50 Marks
ESE: 50 Marks
**Credits: 3**

**Course Objectives:**

1. To recall the primitive data types, concepts of logic building and problem solving
2. To understand data representation, implementation and applications of linear and nonlinear data structures
3. To learn and apply different algorithms on different types of data structures
4. To learn the concept and understand the importance of time and space complexity

**Course Outcomes:**

After completion of the course, students will be able to:

CO1 Classify and categorize data structures that make up for a programming language

CO2 Infer to the modelled data structures from the premise of the baseline models

CO3 Apply algorithms on linear and non-linear data structures for performing different operations on data

CO4 Categorize the choice of data structures and its memory allocation on the basis of data definition, data access and manipulation

**Unit I: Introduction to Data and Data Structures (07 )**

Concepts and definition of Data, Data type, Data object, Data structures, Searching Methods: Algorithms for Sequential Search, Indexed Sequential Search and Binary Search, Sorting Methods: Algorithms for Selection sort, Bubble sort, Insertion sort, Quick sort, Merge sort, Introduction to Time complexity and Space complexity, Brief overview of the Big Oh and other notations as performance metrics for the algorithms.

**Unit II: Pointers, Structures and Functions in C (07)**

Pointers: Basic concepts, Pointer declaration and initialization, Scale factor, Pointer to a pointer, Pointers and arrays, Structures in C: Concept, Comparison with arrays as a data structure, Array of Structures, Pointers and Structures, Concept of ordered list and polynomial representation using array of structures. Functions: Type of functions and their categories, Parameter passing by value, Parameter passing by reference, Recursive functions, Bitwise Operators.

**Unit III: Linked lists (07)**

Concept of Lists, Single linked list: algorithms for Creation, Insertion, Deletion and traversals of above data structure, Concept of Doubly Linked List and Circular Linked List, Applications of Linked lists, Abstract Data Type (ADT), List as an ADT, Generalized Linked List (GLL): Concept, Parenthesized enumeration, Representation of multivariable polynomials using GLL

**Unit IV: Modeled Data Structures - Linear (07)**

Stacks: Definition and example, Representation using arrays and linked list, Applications of Stacks: Concept of infix, Postfix and Prefix expressions, Algorithm to convert infix expression to a postfix expression, Algorithm to evaluate a postfix expression, Queues: Definition and example, Representation of queue using array and linked list, Concept of Circular queue, Concept of priority queue, Applications of Queue

**Unit V: Modeled Data Structures – Non Linear (Trees) (07)**

Difference between Linear and Non-linear data structures, Binary Trees (BT): Basic terminology, Types of Binary Trees, Binary Search Tree (BST): Difference between BST and BT. Representation of BST(Static and Dynamic), Algorithms for BST traversals: Preorder, Inorder and Postorder (recursive), Primitive operations on BST: Create, Insert, Delete, Algorithm for Non-recursive in-order traversals for BST.

**Unit VI: Modeled Data Structures – Non Linear (Graphs) (07)**

Graphs: Concepts and terminology, Types of graphs: Directed graph, Undirected graph, Planar graph, Representation of graph using adjacency matrix, Adjacency list, Traversals: Depth First Search (DFS) and Breadth First Search (BFS). Minimal Spanning Tree (MST): Kruskal‟s algorithm, Prim‟s algorithm, Algorithm to find the shortest path: Dijktras algorithm

**Text Books:**

1. Seymour Lipschutz, “Data Structures with C”, Schaum‟s Outlines, McGrawHill Education (India) Pvt. Ltd, (1st Edition), (2017).
2. E Balgurusamy, “Programming in ANSI C”, McGraw-Hill, (8th Edition), (2019).

**Reference Books:**

1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M.Tenenbaum, “Data structures using C and C++”, PHI Publications, (2nd Edition), (2004)
2. Ellis Horowitz, Sartaj Sahni, “Fundamentals of Data Structures in C”, Universities Press, (2nd Edition), (2008)

Online Resources: 1. NPTEL Course “Programming, Data Structures and Algorithms using C” https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/

# 20EC303L DATA STRUCTURES AND ALGORITHMS LAB

| Teaching Scheme | Examination Scheme |
| --- | --- |
| Lectures: 2 Hours / Week | In Semester: 25 Marks |
| | Practical:25 Marks |
| | **Credits: 1** |

**Course Objectives**

1. To recall the concepts of procedural programming language paradigm
2. To understand the significance of data structures and its use
3. To understand and implement data searching and sorting methods
4. To understand and implement algorithms for solving given problems

**Course Outcomes**

After completion of the course, students will be able to

CO1 Utilize the principal algorithms of sorting and searching on the given data

CO2 Implement basic linear data structures like arrays, records and linked lists

CO3 Analyze the requirement and implement stacks and queues from the base models

CO4 Build, represent and traverse non-linear data structures

**List of Experiments:**

1. Write a program to reorder the data using sorting techniques like: bubble, selection, insertion, quick and merge sort.
2. Write a program to locate data using sequential and binary search techniques.
3. Create a database of students using an array of structures with attributes; roll no., name, program, course, marks obtained for different subjects with their total and average. Implement the following operations on the database:
   a) Display the database in a tabular form.
   b) Modify (should be able to modify each field of the database).
   c) Append (add a new record to the existing database).
   d) Search for a particular record from the database.
   e) Sort the records in the database.
4. Write a program to add two polynomials using array of structures. The display should include the polynomials that are added and the resultant polynomial in descending order of the exponents.

5. Write a program to create a singly linked list using dynamic memory allocation functions. Implement the following operations on the linked list:
   a) Display.
   b) Insert a node in the linked list (at front, at end, in the middle).
   c) Delete a node from the linked list (at front, at end, in the middle).
   d) Display the linked list in reverse.
   e) Revert the linked list.
6. Write a program to model an array as a stack (Static implementation of Stack) and perform the following operations on it:
   a) Push
   b) Pop
   c) Display
7. Write a program to model a singly linked list as a stack (Dynamic implementation of Stack) and perform the following operations on it:
   a) Push
   b) Pop
   c) Display
8. Write a program to evaluate a postfix expression using a stack. The input expression should be a postfix one.
9. Write a program to model an array as a queue (Static implementation of Queue) and perform the following operations on it:
   a) Add
   b) Delete
   c) Display
10. Write a program to model a linked list as a queue (Dynamic implementation of Queue) and perform the following operations on it:
    a) Add
    b) Delete
    c) Display
11. Create a Binary Search Tree and perform the following operations on it:
    a) Recursive traversals on the tree (display elements of the tree).
    b) Search a node in the tree.
12. Create a graph and represent it using an adjacency matrix.
    Implement BFS and DFS traversals.

# 20EC401 DIGITAL ELECTRONICS

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| Tutorial:1 Hour/Week | End Semester: 50 Marks |
| | **Credits: 4** |

**Prerequisite:** 20ES01: Basic Electrical and Electronics Engineering

**Course Objectives:**

1. To solve the Sum of Products (SOP) and Product of Sum (POS) equations using K-map
2. To design Combinational logic circuits such as Adder, Multiplexer, De-multiplexer, Decoder, Comparator
3. To design sequential circuits like Counters, Shift Registers
4. Study various types of Programmable Logic Devices (PLDs)

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Illustrate reduction of logical expressions using k-map and realize the functions using logic gates
CO2 Design combinational and sequential digital logic circuits
CO3 Design digital systems using Finite State Machines
CO4 Classify digital logic families and implement combinational logic circuits using PLD

**Unit I: Fundamentals of Digital Logic (08 )**

Number system: Hex Number, Standard representation of logic functions, Truth table, SOP and POS forms, Canonical form, Min and Max terms, Minimization of logical functions up to 4 variables using K-map, Don't care conditions.

**Unit II: Combinational Logic Design (08)**

Circuit designs using Adders, Subtractors, Code converters, Digital Comparators, Multiplexers, De-multiplexers, Decoders, Encoders, Parity generator and checker, Arithmetic logic unit.

**Unit III: Sequential Logic Design (08)**

1 bit memory cell, Clocked SR, JK, T, D and MS-JK flip-flop, Use of preset and clear terminals, Excitation table for flip-flops, Conversion of flip-flops, Applications of flip-flops: Registers, Shift registers, Sequence Generators, Counters: Synchronous and Asynchronous counters.

**Unit IV: State Machines (10)**

Mealy and Moore machines representation, State diagram, State table, State assignment, Design of State Machines using State assignment and State reduction, Design of sequence detector using Finite State Machine (FSM), Applications of FSM**:** Traffic light controller, Lift controller, Vending Machines.

**Unit V: Digital Logic Families and Programmable Logic Devices (08)**

## 20EC401 DIGITAL ELECTRONICS

Classification of logic families, Characteristics of digital ICs: Speed of operation, Power Dissipation, Figure of merit, Fan in, Fan out, Current and Voltage parameters, Noise immunity, Operating temperatures and Power supply requirements, Introduction to PLDs and their types: PAL, CPLD and FPGA, Interfacing of TTL to CMOS and CMOS to TTL, Comparison between CPLD and FPGA.

**Text Books:**

1. R .P Jain, **"Modern digital electronics"**, *TMH Publication*, (3rd Edition), (2007).
2. Anand Kumar, **"Fundamentals of digital circuits"**, *PHI Publication*, (1st Edition), (2001).
3. Stephen D. Brown and Zvonko G Vranesic, **"Fundamentals of Digital Logic with Verilog Design"**, *Pearson Education*, (2nd Edition),(2008).

**Reference Books:**

1. Wakerly, **"Digital Design Principles and Practices"**, *Pearson Education*, (3rd Edition), (2004).
2. M. Morris Mano, **"Digital Logic and Computer Design"**, *Pearson Education*, (3rd Edition), (2004).

**Online Resources:**

1. NPTEL Course **"Digital Circuits and Systems"**
   https://nptel.ac.in/courses /117/106 /117106086/

# 20EC401L DIGITAL ELECTRONICS LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral: 25 Marks
**Credits: 1**

**Course Objectives:**

1. To solve the SOP and POS equations using K-map
2. To design different Combinational logic circuits
3. To design different Sequential circuits
4. To study various types of PLDs

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Design and Implement digital circuits
CO2 Analyze combinational and sequential circuits
CO3 Implement Combinational Logic Circuits using PLDs
CO4 Utilize software tools for the simulation of digital circuits

**List of Experiments:**

1. Design and implement Full Adder and Full Subtractor circuit using Decoder IC.
2. a) Design and implement 8:1 Multiplexer.
   b) Design and analysis of logic functions using Multiplexer.
3. Design and implement 1- digit BCD adder using IC 7483.
4. a) Design and implement an 8-bit Magnitude comparator using IC 7485.
   b) Design and analyze the 5 bit Magnitude comparator using single IC 7485.
5. a) Design Asynchronous MOD-N counter using IC 7490.
6. a) Design and implement Synchronous Up/ Down counter.
   b) Design and analyze Synchronous MOD-NN up counter.
7. Implement Boolean expression using PLD.
8. Design and simulate Finite State Machines.

# 20EC402 ANALOG AND DIGITAL COMMUNICATION

**Teaching Scheme**
Lectures: 3 Hours / Week
Tutorial: 1 Hour / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 4**

**Prerequisite:** 20EC302 Signals and Systems

**Course Objectives:**
1. To introduce analog modulation and demodulation techniques
2. To study sampling process and pulse analog modulation techniques
3. To explore source coding techniques PCM, DPCM, DM, ADM
4. To explain conversion of digital data to digital signal
5. To explore binary and M-ary digital modulation techniques

**Course Outcomes:**
After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Interpret generation and detection of Amplitude modulation and Frequency modulation |
| CO2 | Apply sampling process and describe pulse analog modulation techniques with their generation and detection |
| CO3 | Apply source coding techniques and evaluate Bitrate, Bandwidth and Signal-to-noise ratio |
| CO4 | Interpret and apply data formats, Multiplexing, Synchronization and Intersymbol Interference and Matched filter for reliable baseband transmission |
| CO5 | Analyze bandpass modulation techniques and evaluate: Bit rate, Bandwidth and Euclidean distance |

**Unit I: Analog Modulation (06)**
Amplitude Modulation, Types of AM: DSB-SC, SSB-SC, DSB-FC, Spectrum of AM, Modulation Index, Technical AM standards, AM generation and detector, Super heterodyne radio receiver, Angle modulation, Bandwidth of FM, FM generation, FM detectors, FM- Superheterodyne radio receiver.

**Unit II: Pulse Analog Modulation (05)**
Sampling Process: Sampling theorem (time and frequency domain), Types of sampling, Aliasing, Aperture effect, Pulse analog modulation techniques - PAM, PPM, PWM.

**Unit III: Digital Transmission of Analog Signal (08)**
Block diagram of digital communication system, Pulse Code Modulation (PCM) Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, Delta Modulation (DM), Adaptive Delta Modulation(ADM), Differential Pulse Code Modulation(DPCM), Adaptive Differential Pulse-Code Modulation (ADPCM).

**Unit IV: Baseband Digital Transmission (08)**
Digital Multiplexing: Multiplexers and hierarchies, Data formats and their spectra, Synchronization: Bit Synchronization, Scramblers, Frame Synchronization, Inter-symbol Interference, Equalization, Eye diagram.

**Unit V: Bandpass Digital Techniques (09)**

Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), M-Ary PSK, Quadrature Amplitude Shift Keying (QASK), Binary Frequency Shift Keying (BFSK), M-Ary FSK, Minimum shift keying (MSK), Introduction to GMSK.

**Unit VI: Optimal Reception of Digital Signal (06)**

Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver, Error probability for BASK, BPSK and BFSK.

**Text Books:**

1. George Kennedy, **"Electronic Communication Systems"**, *McGraw-Hill*, (5th Edition), (2013).
2. Simon Haykin, Michael Moher, "**Communication Systems**", *Wiley*, (5th Edition), (2009).
3. Donald L. Schilling, GoutamSaha, Herbert Taub, "**Principles of Communication System**", T*ata McGraw-Hill Education Pvt. Ltd*, (4th Edition), (2015).

**Reference Books:**

1. B.P Lathi, **"Modern Digital and Analog Communication Systems"**, Oxford University Press, (3rd Edition), (2003).
2. Bernard Sklar, **"Digital Communications Fundamentals and Applications"**, *Prentice Hall P T R*, (2nd Edition), (2009).
3. A. B. *Carlson* and P. B. Crilly, **"Communication Systems"**, *McGraw-Hill*, (5th Edition), (2002).
4. T. L. Singal, **"Analog and Digital Communication"**, *Tata McGraw-Hill*, (1st Edition), (2012).

**Online Resources:**

1. NPTEL Course **"Principles of Communication Systems "**
   https://nptel.ac.in/courses /108/104/108104091/
2. NPTEL Course **"Principles of Digital Communications"**
   https://nptel.ac.in/courses /108/101/10810113/

# 20EC402L ANALOG AND DIGITAL COMMUNICATION LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral :25 Marks
**Credits: 1**

**Course Objective**

1. To demonstrate generation and detection of AM and FM signals
2. To comprehend PCM, DM, ADM waveform coding techniques
3. To observe data format along with spectral analysis
4. To explore binary and M-ary shift keying techniques

**Course Outcome**

After completion of the course, students will be able to

CO1 Measure and calculate modulation index, spectrum of AM and FM signal
CO2 Measure and compare bit-rate, signal-to-noise ratio, quantization error of waveform coding techniques
CO3 Plot and analyse spectrum of data formats
CO4 Measure and compare bandwidth, and bit-rate of digital modulation techniques
CO5 Interpret communication standards for analog and digital techniques with technical presentation

**List of Experiments:**

1. Measure modulation index and observe waveforms of AM and FM (generation and detection)
2. Simulate Super heterodyne radio receiver for FM on suitable software
3. For the given kit measure Bit-rate, Signal to noise ratio and Quantization error for PCM
4. Measure and plot slope overload and Granular noise in Delta modulation and ADM
5. Measure spectrum of BFSK signal
6. Measure and compare bit rate and bandwidth of BPSK and QPSK signals
7. Interpret spectral analysis of line codes (NRZ, RZ, Polar RZ, Bipolar (AMI), Manchester) generated on the given kit
8. Simulate and compare error probability for Binary and M-ary Shifting keying
9. Seminar presentation on Communication Standards

# 20EC403 MACHINE LEARNING WITH PYTHON

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20BS01 Linear Algebra and Univariate Calculus, 20BS03 Multivariate Calculus, 20BSEC301 Calculus and Probability

**Course Objectives:**

1. To explain the basics of Python Programming Language
2. To discuss and describe the concepts of Machine learning (ML)
3. To apply ML algorithms on real world datasets for regression and prediction
4. To apply and analyse ML algorithms on real world datasets for classification and clustering

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Apply Python for problem solving in ML applications
CO2 Explain the concepts of ML along with parametric and non parametric models
CO3 Apply and implement ML algorithms to solve classification, regression and clustering problems
CO4 Analyze performance of ML algorithms

**Unit I: Python Fundamentals and Libraries** **(08)**

Data Types, Operators, Indexing and Slicing, Strings, Lists, Arrays, Tuples, Conditional statements, Control Flow, Sets, Dictionaries, Arithmetic and Boolean Operations, Data frames, Python editors, Python libraries: Numpy, Matplotlib, Scikit learn, Pandas.

**Unit II: Fundamentals of Machine Learning** **(08)**

Basic concepts in machine learning, Parametric and non-parametric modeling, Overfitting and Underfitting, Feature selection, Dimensionality reduction techniques- PCA, LDA; Training, Testing and Validation errors, Confusion matrix and Evaluation Parameters.

**Unit III: Regression** **(09)**

Introduction to Regression, Simple linear regression, Multiple linear regression, Non-Linear Regression, Evaluation metrics in regression models.

**Unit IV: Classification** **(09)**

Introduction to Classification, K-Nearest Neighbours, Decision Trees and Random Forest Algorithm, Logistic Regression, Logistic regression vs Linear regression, Support Vector Machine, Introduction to Bayesian probability, Naive Bayes algorithm, Evaluation metrics in classification.

**Unit V: Clustering** **(08)**

Introduction to Clustering, K-Means Clustering, Hierarchical Clustering and Density-Based Spatial Clustering of Applications with Noise (DBSCAN) Clustering.

**Text Books:**

1. Vinod Chandra S. S., Anand Hareendran S., "**Artificial Intelligence and Machine learning**", *PHI*, (1st Edition) (2014).
2. U. Dinesh Kumar and Manaranjan Pradhan, "**Machine Learning using Python**", *John Wiley & Sons* (1st Edition), (2020).
3. Mark Lutz, "**Programming Python",** *O'Reilly Media, Inc.,* (4th Edition), (2010).
4. Ethem Alpaydın "**Introduction to Machine Learning**", *The MIT Press*, (2nd Edition), (2010).
5. Christopher Bishop, "**Pattern Recognition and Machine Learning**", *Springer,* (1st Edition), (2007).

**Reference Books:**

1. Chris Albon, **"Machine Learning with Python Cookbook",** *O'Reilly Media*, Inc., (1st Edition), (2018).
2. Aurélien Géron, **"Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow",** *O' Reilly Media, Inc.*, ( 2nd Edition), (2019).
3. Kevin Murphy, **"Machine Learning: A Probabilistic Perspective",** *MIT Press*, (1st Edition), (2012).

**Online Resources:**

1. NPTEL Course on **"Machine Learning"**
   https://nptel.ac.in/courses/106/106/106106202/
2. NPTEL Course on **"Introduction to Machine Learning"**
   https://onlinecourses.nptel.ac.in/noc21_cs85/preview
3. NPTEL Course on **"Introduction to Machine Learning"**
   https://onlinecourses.nptel.ac.in/noc21_cs70/preview

# 20EC403L MACHINE LEARNING WITH PYTHON LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral:25 Marks
**Credits: 1**

**Course Objectives:**

1. To explain the basics of Python Programming Language
2. To apply the concepts of Machine Learning (ML) for data visualization and analysis
3. To apply ML algorithms for regression and prediction problems
4. To apply ML algorithms for classification and clustering

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Apply Python programming to read and visualize datasets |
| CO2 | Develop an algorithm and write program for solving regression from real world applications |
| CO3 | Develop an algorithm and write program for classification of data from real world applications |
| CO4 | Develop an algorithm and write program using clustering algorithms |

**List of Experiments:**

1. A) Introduction to Python and Python libraries.
   B) Download/Access and read datasets (Kaggle) in Python.
2. Write a program in Python for data visualization and calculate statistical summary.
3. Develop an algorithm and solve real world regression/prediction problems using ML techniques such as linear regression.
4. Develop an algorithm and solve real world regression/prediction problems using ML techniques such as logistic regression.
5. Develop an algorithm and solve real world problems using Naive bayes Algorithm / SVM
6. Develop an algorithm and solve real world problems using Decision tree / Random Forest Algorithm.
7. Develop an algorithm and solve real world problems using K-means clustering algorithm.
8. Develop an algorithm and solve real world problems using Hierarchical clustering algorithm.

## 20EC404 EMBEDDED SYSTEMS

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Prerequisite:** 20ES01: Basic Electrical and Electronics Engineering, 20ES02 Fundamentals of Programming Language I

**Course Objectives:**

1. To explain the applications of microprocessors and microcontrollers.
2. To introduce the architecture and features of typical microcontrollers.
3. To interface real world I/O devices
4. To explain hardware and software development tools

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Describe architecture of microcontrollers
CO2 Develop program for on chip peripheral
CO3 Develop program for externally interfaced peripheral device
CO4 Design microcontroller-based system using sensors

**Unit I: Introduction to Embedded System (08)**

Embedded system: Need of Embedded System - Applications, Classification and working of Embedded System (block diagram), Embedded system characteristics, Microprocessors and Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Architecture of a Microcontroller, Microcontroller Family, Microcontroller selection process for application, Microcontroller Application Development tools: Simulator, Emulator, ISP, Cross assembler.

**Unit II: Microcontroller Architecture (06)**

Microcontroller architecture, Pin configuration, RESET, Crystal interface, Program Status Word (PSW), Internal memory organisation, Port Structure: GPIO (LED interface), Stack and Stack Pointer, Serial communication: Concept of RS 232C.

**Unit III: On-chip Peripherals (07)**

Microcontroller On-chip peripherals: Counters/Timers, ADC and DAC, Introduction to sensors and transducers - LM35 sensor interface, Calibration, Interrupts.

**Unit IV: Real World Interfacing – External Peripheral Interface (06)**

Interfacing LCD, switch, Stepper motor, Relays, buzzer and DC motor control using PWM.

**Unit V: Sensor Interface (06)**

Interface sensors: Accelerometer, Gas sensor, Temperature and Humidity Sensor: DHT-11, Float sensor, Gyro sensor.

**Unit VI: Design a Minimum System Using Microcontroller (09)**

Case Study: Temperature monitoring and controlling, Home automation system.

**Text Books:**

1. Mohammad Mazidi, Janice Mazidi and Rolin McKinlay, **"The Microcontroller and Embedded Systems using Assembly and C"**, Pearson Education, (2nd Edition), (2014).
2. C. Ravichandran, M. Arulalan, **"Microcontroller-based system design"**, *Suchitra Publication*, (1st Edition), (2017).

**Reference Books:**

1. Myke Predko, **"Programming and customizing the microcontroller"**, *Tata McGraw Hill*, (2nd Edition), (2014).
2. Kenneth Ayala **``The MICROCONTROLLER-Architecture, Programming and Applications",** *West Publishing Company*, (3rd Edition), (2014).

**Online Resources:**

1. www.intel.com
2. www.microchip.com

# 20EC404L EMBEDDED SYSTEM LAB

**Teaching Scheme**
Practical: 4 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Practical :25Marks
**Credits: 2**

**Course Objective**

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore students to development tools required for embedded system

**Course Outcome**

After completion of the course, students will be able to

CO1 Implement given problems using development tools required for embedded system
CO2 Develop program for on chip peripheral
CO3 Develop program for externally interfaced peripheral device
CO4 Design microcontroller-based system using sensors

**List of Experiments:**

1. Interfacing LEDs with different patterns (GPIO)
2. Interfacing switch, LED, relay and buzzer (GPIO)
3. Interfacing Stepper motor (GPIO)
4. Develop the program to generate different waveforms using DAC.
5. Write program to transmit and receive data serially
6. Interfacing LCD Display.
7. Interface ADC and display the data on LCD as well as on serial port.
8. Interface LM 35 sensor to internal ADC and display the value on LCD.
9. Toggle GPIO port with fixed time interval using On-chip timer (without interrupt).
10. Toggle GPIO port with fixed time interval using On-chip timer (with interrupt).
11. DC Motor Speed Control using PWM.
12. Interface following sensors to ADC of microcontroller.
    1. Accelerometer
    2. Gas sensor
    3. Temperature and Humidity sensor DHT-11
13. OPEN ENDED PROBLEM : Interface
    1. Float sensor
    2. Gyro sensor
    3. IR sensor for counting movement or open and close the door using DC motor

# 20EC405 OBJECT ORIENTED PROGRAMMING

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lecture: 3 hours/week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Prerequisite:** 20ES05 Fundamentals of Programming Language II

**Course Objectives:**

1. Recall the concepts and techniques of the OOP paradigm
2. Understand and utilize commonly used classes and object as superclass
3. Develop ability to understand and use interfaces, enums and Java collection framework
4. Understand the importance of streams, APIs and the concept and usage of multithreading

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Utilize common Java constructs such as Interfaces, Enums, Lambdas, Streams and built-in classes such as String, Arrays to develop programs |
| CO2 | Analyze the application requirement and choose appropriate collection from Java Collections Framework for storing data |
| CO3 | Apply the concepts of multithreading |
| CO4 | Analyze the design requirement and identify the appropriate design pattern to be applied |

**Unit I: Classes and Objects**

Basics of stack, heap, memory allocation (objects/primitives and instance/local variables). Nested classes, Inner classes, Method local classes, Anonymous classes, Object as superclass: Object class methods, importance and implementation of to String(), equals(), hashCode() methods, Immutability of objects, Wrapper classes like Byte, Double, Float, Integer, Long, Short, Autoboxing and unboxing. Commonly used classes: String, StringBuilder, Objects, Arrays, Math.

**Unit II: Interfaces, Enums and Annotations**

Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type, Common interfaces: Comparable, Comparator, Iterable, Iterator, Runnable, Enums: Declaring Enum, adding fields to Enum, Enum class in Java, Built in methods, Abstract method implementations in Enum, Annotations: Basics, Declaring annotation type, Predefined annotations, Annotation processing overview.

**Unit III: Generics and Collections**

Generics: Introduction to generics, Generic types, Generic methods, Bounded type parameters, generics and inheritance, Wildcards, Java Collection Framework (JCF): Introduction to JCF, Structure of JCF (program to interface, use of generics, Collection interface), Commonly used collections with implementations: Features, Methods offered and complexity analysis for: List (ArrayList, LinkedList), Set (HashSet, LinkedHashSet, TreeSet), Map (HashMap, LinkedHashMap, TreeMap), Queue (ArrayBlockingDeque, Priority Queue), Exploration of Javadocs to understand interface and implementations.

**Unit IV: Java 8 Useful Features**

Java 8 interfaces: Default and Static Methods, Lambdas, Method references, Streams: Introduction, Examples, Intermediate operations: filter, Map, Flat Map, Distinct, Limit, sorted, Terminal operations: for Each, to Array, Collect and reduce, Date Time APIs: Problems with existing Date and Calendar, Local Date, Local Time, Local Date Time, Zoned Date Time, Period and Duration.

**Unit V: Multithreading**

Multithreading vs multiprocessing, Thread, Runnable, memory model (Thread stack, frames, method stacking, stack overflow), Need for synchronization: race conditions, Happens before guarantee, Examples, Use of atomic classes, Deadlock, Starvation, Use of volatile, Publisher/Subscriber model: wait, notify/notify all.

**Unit VI: Design Patterns**

Purpose of using design patterns, types of design patterns: Creational, Structural, Behavioral, Common design patterns such as: singleton, Factory, Builder, Proxy, Façade, Observer, Model View Controller (MVC).

**Text Books:**


1. Herbert Schilt, **"JAVA Complete Reference"**, *Tata McGraw Hill*, (9th Edition), (2014).
2. Eckel B., **"Thinking in Java"**, *Pearson Education*, (3rd Edition), (2017).


**Reference Books:**


1. Joshua Bloch,**"Effective Java"**, Addison-Wesley Professional, (3rd Edition), (2017).


**Online Resources:**

1. NPTEL Course **"Programming in Java"**
   https://nptel.ac.in/courses/106/105/106105191/

# 20EC405L OBJECT ORIENTED PROGRAMMING LAB

| Teaching Scheme | Examination Scheme |
| --- | --- |
| Practical: 2 Hours / Week | In Semester: 25 Marks<br>Practical: 25 Marks<br>**Credits: 1** |

**Course Objectives**

1. To recall the concepts and techniques of the OOP paradigm
2. To utilize the commonly used classes and object as super class
3. To implement interfaces, enums and the Java collection framework
4. To understand the importance of streams, APIs and the concept and usage of multithreading

**Course Outcomes**

After completion of the course, students will be able to

CO1 Develop Java programs using common Java constructs

CO2 Develop Java programs by applying appropriate design pattern

CO3 Analyse the application requirement and write programs using appropriate collection from Java Collections Framework

CO4 Apply the concept of multithreading to solve given problems

**List of Experiments:**

1. Write a program to explore Object class methods (toString, equals, hashcode)
   a. Create an Employee class with fields first name and last name.
   b. Create and print Employee class objects.
   c. Create multiple Employee class objects and compare whether they are equal or not.
2. Declare an interface and create an anonymous class that implements it.
3. Write a program to create a Person class with fields; first name and last name and getter setters. Modify it to make it immutable. In the Person class, add a field of type Address, which has fields as city and pin code with getters and setters. Prove that the Person class is now mutable. Modify the classes such that Person becomes immutable again.
4. Write a program to concatenate two strings e.g. “hello” and “world” and check if the result of concatenation equals “helloworld” (using equals() and ==). Trim the strings to get the two strings back.
5. Write a program to declare an Enum representing days of the week. Add fields to indicate the day name and number. Print the days using values().
6. Write a program to implement basic arithmetic calculator using Enum. Calculator should support operations: addition, subtraction, multiplication and division.
7. Create a set of movies (Movie class having name and imdb rating). Print the list of movies in the ascending order of their names. Now print the movies in descending order of imdb rating, using comparator interface.

8. Create a list of names of your friends. Check if a name of a friend is present in the list. Remove a name from the list and add another. Print the list to see where the added name is appearing in the list.
9. Dissecting equals and hashcode contract - Create 4 objects from a student class (which has name and roll number as fields). All objects should have the same name and roll numbers. Add the objects to a set when – (i) the class does not have equals and hashcode overridden (ii) when the class has these methods overridden. Inspect what happens in these two cases and justify the contract.
10. Create a map of device ids and subscribers associated with it. Create a list of all device ids associated with a subscriber.
11. Given a stream of amplitude values of a sampled signal (as a List), filter out the samples having amplitudes above and below the threshold values (upper threshold: 4.5V and lower threshold: 0.5V). These filtered samples are to be passed through the multiplier system (multiplication factor = 2). Create a list of signal values at the output of the multiplier system. Find min and max amplitudes in the result.
    Example:
    Input: {0.45, 1.0, 2.2, 3.5, 4.7, 5.0, 0.21, 1.2}
    Output: {2.0, 4.4, 7.0, 2.4}
    Min: 2.0, Max: 7.0
12. Write a program to demonstrate deadlock using two threads and two locks. Hint: Threads need to acquire locks in opposite order.
13. Write a Maven project to generate a QR code. Hint: Use QRGen (https://github.com/kenglxn/QRGen) as dependency.

# 20EC501 DIGITAL SIGNAL PROCESSING

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| Tutorial : 1 Hour/ Week | End Semester: 50 Marks |
| | **Credits: 4** |

**Prerequisite:**20EC302 Signals and Systems

**Course Objectives:**
1. To introduce basics of Digital Signal Processing (DSP), Analog to Digital and Digital to Analog conversion
2. To apply transform techniques for analysis of signals
3. To compare analog and digital filters and design digital filters
4. To understand practical DSP systems and their applications

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Apply sampling theorem to obtain discrete time signals and sampling rate conversion for Multirate DSP systems |
| CO2 | Apply Discrete Fourier Transform and Short Time Fourier Transform on discrete time signals |
| CO3 | Design and build FIR, IIR and Multirate digital filters |
| CO4 | Analyze signals in frequency domain and performance of DSP algorithms |
| CO5 | Design and simulate real-world applications of DSP |

**Unit I: Introduction to Digital Signal Processing** **(08)**

Basic elements of Digital Signal Processing (DSP) and their requirement, Advantages of Digital over Analog Signal Processing, Sampling of analog signals, Sampling theorem in time domain, Recovery of analog signals, Mapping between analog to digital frequency, Block diagram representation of DT LTI systems: Direct form (I and II), Cascade form, Parallel form, Linear phase structure.

**Unit II: Discrete Fourier Transform** **(09)**

Overview of Discrete Time Fourier Transform (DTFT), Frequency domain sampling, Discrete Fourier Transform (DFT), Properties of DFT, Circular convolution, Computation of linear convolution using circular convolution, Decimation in Time (DIT) and Decimation in Frequency (DIF) Radix-2 FFT algorithms, Computational complexity of FFT algorithms, Bit-reversal, In-place computation, Introduction to Short Time Fourier Transform (STFT), Applications of FFT: Spectrum analyzer, Spectrum analysis of non-stationary signals.

**Unit III: FIR Filter Design** **(08)**

Ideal filter requirements, Comparison of analog and digital filters, Frequency response of Linear phase Finite Impulse Response (FIR) filters, Types of FIR filter, Design of linear phase FIR filter
using windowing method, Characteristics and comparison of different window functions, Finite word length effects in FIR filter design, Applications of FIR filter: Speech processing, Telecommunication systems.

**Unit IV: IIR Filter Design** **(09)**

Characteristics of ideal and practical frequency selective filters, Comparison of Butterworth, Chebyshev and Elliptic filters, Design of Infinite Impulse Response (IIR) filters from analog filters, IIR filter design by Impulse Invariance method, Bilinear Transformation, Frequency warping effect, Finite word length effects in IIR filter design, Applications of IIR filter: Biomedical Signal Processing, Image Processing.

**Unit V: Multirate Digital Signal Processing** **(08)**

Need of multirate systems, Interpolation by I factor, Decimation by D factor, Sampling rate conversion by I/D factor, Frequency domain analysis of multirate DSP system, Design of multirate filters, Polyphase implementation, Applications of multirate DSP: Audio systems, Sub-band coding.

**Text Books:**


1. John G. Proakis, D. G. Manolakis, **"Digital Signal Processing"**, *Pearson Prentice Hall*, (3rd Edition), (2007).
2. Emmanuel C. Ifeachor, B. W. Jervis, **"Digital Signal Processing-– A practical approach"**, *Pearson Education*, (2nd Edition), (2002).
3. S. Salivahanan, **"Digital Signal Processing"**, *McGraw Hill*, (3rd Edition), (2011).
4. Li Tan and Jean Jiang, **"Digital Signal Processing Fundamentals and Applications**", *Academic Press*, (2ndEdition), (2013).


**Reference Books:**


1. S. K. Mitra, **"Digital Signal Processing: A Computer Based Approach"**, *McGraw Hill*, (2nd Edition), (2013).
2. A. Nagoor Kani, **"Digital Signal Processing"**, *Tata McGraw Hill*, (2nd Edition), (2012).
3. Alan V. Oppenheim, **"Discrete-Time Signal Processing"**, *Pearson Education India*, (2nd Edition), (2013).
4. Vinay K. Ingale, John G. Proakis, **"Digital Signal Processing using MATLAB"**, *Cengage Learning*, (3rd Edition), (2009).


**Online Resources:**

1. http://freevideolectures.com/Course/2317/Digital-Signal-Processing-IIT-Delhi
2. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3. NPTEL Course **"Digital Signal Processing and its Applications"**https://nptel.ac.in/courses/108/101/108101174/
4. NPTEL Course on **"Digital Signal Processing"** https://nptel.ac.in/courses/108/105/108105055/

# 20EC501L DIGITAL SIGNAL PROCESSING LAB

**Teaching Scheme**

Practical: 2 Hours / Week

**Examination Scheme**

In Semester: 25 Marks

Oral: 25 Marks

**Credits: 1**

**Course Objectives:**

1. To apply sampling theorem on CT signals to find DT signals
2. To interpret the spectral representation of signals
3. To verify digital filter design and its performance
4. To perform sampling rate conversion on DT signals
5. To build programming skills for performing signal processing operations

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Apply sampling theorem and select the appropriate sampling to avoid aliasing |
| CO2 | Develop programs to implement DFT and convolution operation |
| CO3 | Analyze spectral representation of signals and window functions |
| CO4 | Simulate the design of digital filters for given specifications, verify with theoretical results and analyze finite word length effects on design of digital filters |
| CO5 | Demonstrate effect of sampling rate conversion |

**List of Experiments:**

1. Verify sampling theorem and study aliasing effects.
2. Implement a function to find the DFT of a discrete time sequence.
3. Compute linear and circular convolution between sequences.
4. Analyze characteristics of different window functions.
5. Design FIR filter (LP/HP/BP/BS) for the given specifications using windowing method.
6. Design Butterworth filter using impulse invariance/bilinear transformation method.
7. Analyze effects of finite word length on performance of digital filters.
8. Apply sampling rate conversion (up-sampling/down-sampling) on discrete time signals and analyze the time and frequency domain effects.

# 20EC501LD INTRODUCTION TO IOT LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
ISE: 25 Marks
Practical:25 Marks
**Credits: 1**

**Course Objectives**
1. To learn use of sensors and actuators in IOT
2. To learn IOT devices and protocols
3. To build an IOT application

**Course Outcome**
After completion of the course, students will be able to

CO1 Select sensors and actuators in IOT application
CO2 Interface sensors and actuators with IoT development module
CO3 Develop a program to monitor and control by using web server
CO4 Develop an IOT system for given application

**List of Experiments:**
1. Introduction to various sensors and various actuators & its Application.
   a) PIR Motion Sensor.
   b) Float Sensor.
   c) Moisture Sensor.
   d) Temperature Sensor.
   e) Touch Sensor.
   f) Infrared Sensor.
   g) Servo Motor
   h) RFID Sensor
   i) Humidity sensor
2. Introduction to ESP32 and Arduino IDE/Visual Studio Code.
3. Write a program to measure sensor data and display on serial monitor.
4. Write a program to control Actuators.
5. Write a program to control Actuators based on real time sensor data.
6. Implement a standalone web server using of ESP32.
7. Develop a web application through ESP32.
8. Mini Project: Develop an IoT system for given application.

# 20EC502 VLSI DESIGN

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Prerequisite:**20EC401 Digital Electronics

**Course Objectives:**
1. To introduce VLSI Design Flow
2. To explain the design hierarchy, syntax, lexical conventions, data types and modeling styles in Verilog
3. To illustrate the design and implementation of digital circuits using Verilog
4. To elaborate the FPGA architecture
5. To illustrate the design digital circuits using CMOS logic

**Course Outcomes:**
After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Explain VLSI design flow |
| CO2 | Design digital systems using Verilog HDL |
| CO3 | Analyze the architecture of FPGA for logic synthesis |
| CO4 | Realize digital circuits using CMOS logic |

**Unit I: Introduction to VLSI Design** **(07)**
Philosophy of VLSI, Evolution of IC Technology (SSI to VLSI), VLSI Design flow, VLSI Based Integrated Circuit Architecture (Overview of Mobile SoC or Microcontroller SoC, logic, control, memory, interconnect, etc.), EDA Tools used in VLSI, VLSI Design Consideration, Application of VLSI IC.

Unit II: **Physical IC Design Flow** **(07)**

Hierarchical Modelling, Top-down and Bottom-up design methodology, Module Based Physical Design Flow, Floor-planning Steps, Netlist Binding, Timing and Clock Tree synthesis, clock net shielding, Power Planning, Routing and Design Rule Check, Parasitic Extraction, IC Fabrication process.

**Unit III: Modeling Digital System using HDL** **(12)**
Modules and Ports, Lexical conventions, Data types, System tasks, Compiler directives, Delay specification, Expressions, Operators, Operands in Verilog, Gate-Level Modeling, Modeling using basic Verilog gate primitives, Dataflow Modelling, Continuous assignments, Delay specification, Behavioral Modeling, Structured procedures, Initial and always, Blocking and non-blocking statements, Delay control, Conditional statements, Multiway branching, Loops, Sequential and parallel blocks, Task and function.

**Unit IV: Design and Synthesis with FPGA (08)**

Spectrum of PLD's, ASIC Vs FPGA Design flow, Architecture of FPGA, Programming Technologies, Dedicated Components in FPGA, Implementing logic in FPGA, Metastability, Specification and Application of FPGA, Design for synthesis, Synthesis of Case statement, Unintentional latch creation, Synthesis of if statement, Synthesis of Arithmetic components.

**Unit V: Digital CMOS Circuit**

**(08)**

CMOS Inverter, Inverter VTC, Power Dissipation, Technology Scaling, MOSFET parasitic, Transmission gates, Lambda Design Rules, CMOS combinational logic design.

**Text Books:**

1. S. Palnitkar, **"Verilog HDL – A Guide to Digital Design and Synthesis",** *Pearson Publication*, (3rd Edition), (2010).
2. Neil H. E. Weste, David Money Harris, **"CMOS VLSI Design: A Circuit & System Perspective",** *Pearson Publication*, (4th Edition), (2010).
3. Pong P. Chu, "**FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version**", *Wiley-Interscience*, (1st Edition), (2008).

**Reference Books:**

1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "**Digital System Design using Verilog**", *Cengage India Private Limited*, (1st Edition), (2017).
2. Wyane Wolf, **"Modern VLSI Design (System on Chip)",** *PHI Publication*, (3rd Edition), (2002).
3. Stephen Brown, Zvonko Vranesic, **"Fundamentals of Digital Logic with Verilog Design"**, *McGraw-Hill Education*, (3rd Edition), (2013).
4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "**CMOS Digital Integrated Circuits, Analysis and Design**" *McGraw Hill Education*, (4thEdition), (2019).

**Online Resources:**

1. NPTEL Course **"Hardware modeling usingVerilog"**https://nptel.ac.in/courses/106/105/106105165/
2. NPTEL Course **" CMOS Digital VLSI Design"**https://onlinecourses.nptel.ac.in/noc21_ee09/preview
3. https://www.udemy.com/course/vlsi-academy-physical-design-flow/

# 20EC502L VLSI DESIGN LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral: 25 Marks
**Credits: 1**

**Course Objective**
1. To explore HDL based design approach
2. To simulate, synthesize and prototype design using PLD
3. To elaborate CMOS logic based design approach
4. To prepare layout using suitable CMOS process
5. To verify the DRC and simulate the layout for different performance parameter

**Course Outcomes**
After completion of the course, students will be able to
CO1 Model and simulate digital systems using Verilog HDL
CO2 Implement digital systems using suitable PLD
CO3 Design CMOS layout for given digital logic
CO4 Apply lambda rules to verify the designed layout

**List of Experiments:**
1. Model a Combinational circuit using Verilog HDL and implement it using PLD.
2. Model a Sequential circuit using Verilog HDL and implement it using PLD.
3. Model SRAM / FIFO using Verilog HDL and implement it using PLD.
4. Write a Verilog Code for LCD and interface it with PLD.
5. Design a layout for Inverter and Universal logic gates using selected CMOS technology.
6. Design a layout for Multiplexer using selected CMOS technology.
7. Design a layout for Boolean expression selected CMOS technology.
8. Design a layout for 1-bit RAM cell using selected CMOS technology.
9. Open Ended Assignment

## 20EC503 ADVANCED PROCESSOR

| **Teaching Scheme** | **Examination Scheme** |
| --- | --- |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Course Objectives:**

1. To introduce the architecture and features of ARM processor
2. To explain the applications of ARM based architecture
3. To interface I/O devices to ARM processor for real world applications
4. To explain hardware and software development tools

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Explain architecture of ARM core based processor

CO2 Develop algorithm and test the program for on chip peripheral of ARM based processor.

CO3 Develop algorithm and test the program for externally interfaced peripherals to the ARM based processor

CO4 Illustrate use of embedded operating system for CORTEX based processor and develop algorithm for the interfaced peripheral devices

**Unit I: Introduction to ARM CORE (09)**

ARM and RISC design philosophy, Introduction to ARM core and its versions, Multiple core concepts : dual, quad etc., ARM7, ARM9 and ARM11 features, Advantages and suitability in embedded applications, Registers : CPSR, SPSR, ARM7 data flow model, Programmers model, Modes of operations.

**Unit II: Introduction to ARM7 Based Microprocessor (07)**

ARM7 based processor: Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider), Memory Map, GPIO : Pin Connect Block (interfacing with LED), Serial communication programming for transmission and reception from computer, Programming for UART.

**Unit III: On Chip Peripherals (06)**

On chip ADC using with and without interrupt, On chip DAC for waveform generation, Interface EEPROM using I2C, LM35 sensor interface and calibration, Interrupts, Counters and Timers.

**Unit IV: Real World Interfacing – External Peripheral Interface (06)**

Interfacing of GSM, GPS, GLCD, KEYPAD, Bluetooth module, Wi-Fi module.

**Unit V: ARM CORTEX (07)**

Introduction to ARM CORTEX series, Improvement over classical series and advantages for embedded system design, CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, Need of operating system in developing complex applications in embedded system, Desired features of operating system and hardware support from processor, Firmware development using CMSIS standard for ARM Cortex.

**Unit VI: ARM Cortex based development Board (07)**

Introduction of ARM Cortex based development board: Features and processor used. Installing different OS on ARM cortex based board and its booting sequence. Interface external peripheral devices.

**Text Books:**

1. Andrew N. Sloss, Dominic Symes, Chris Wright, **"ARM System Developer's Guide-Designing and Optimizing Software"**, *Elsevier Publication*, (1st Edition), (2004).
2. Joseph Yiu, **"Definitive Guide to Arm Cortex-M23 and Cortex-M33 Processors"**, (1st Edition), (2020).

**Reference Books:**

1. Tammy Noergaard, **"Embedded Systems Architecture",** *Elsevier Publications*, (2nd Edition), (2004).
2. Dr. K. V. K. K. Prasad**, "Programming for embedded systems"**, *Wiley – Dreamtech India Pvt. Ltd*., (1st Edition), (2008).

**Online Resources:**

1. LPC 214x User manual (UM10139) :- www.nxp.com
2. LPC 17xx User manual (UM10360) :- www.nxp.com
3. ARM architecture reference manual: - www.arm.com
4. NPTEL course on, "**Embedded System Design with ARM",** https://onlinecourses.nptel.ac.in/noc20_cs15/preview
5. NPTEL course on, "**ARM based development",** https://nptel.ac.in/courses/117/106/117106111/

# 20EC503L ADVANCED PROCESSOR LAB

**Teaching Scheme**
Practical: 4 Hours / Week

**Examination Scheme**
ISE: 25 Marks
Practical :25 Marks
**Credits: 2**

**Course Objective**

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore cortex-based card size hardware system
5. To explore multicore programming

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Apply software development tools for embedded processor based applications.
CO2 Develop algorithm and test program for on chip peripherals.
CO3 Develop algorithm and test program for externally interfaced peripheral devices.
CO4 Develop an Embedded application using simulation tool

**List of Experiments:**

1 Introduction to ARM development board and KEIL Micro vision - 5 IDE development tools.
2 Write a program to flash LEDs interfaced to GPIO.
3 Write a program to receive and transmit data on serial communication.
4 Interface GSM with ARM processor for sending and receiving messages, call connection.
5 Interface GPS to ARM processor and extract Latitude and Longitude from the string.
6 Write a program to generate waveform using on chip DAC.
7 Interface GLCD module to GPIO of ARM processor and write a program to display images.
8 Interface sensor to ADC and write a program to display calibrated data on LCD as well as serial port.
9 Write a program to toggle GPIO port with fixed time interval using on chip timer (without interrupt).
10 Write a program to toggle GPIO port with fixed time interval using on chip timer (with interrupt).
11 Install OS in Raspberry Pi. Write C Program and compile using GCC.
12 Interface LCD to Raspberry Pi.
13 Interface camera and write program to capture images and create video.
OR
Multi-core programming in Raspberry Pi.
14 Open ended assignment *

# 20EC504L MINI PROJECT

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral: 25 Marks
**Credits: 1**

**Course Objectives:**

1. Explain the Product Development Cycle through the mini project
2. Inculcate electronic hardware implementation skills by:
   a) Learning PCB artwork design using an appropriate EDA tool
   b) Learning soldering and effective trouble-shooting practices
   c) Understanding the significance of aesthetics and ergonomics while designing electronic products
3. Demonstration and Technical documentation of mini project in a team

**Course Outcomes:**

After completion of the course, students will be able to,

| | |
|---|---|
| CO1 | Identify and formulate a real life problem statement |
| CO2 | Select an appropriate methodology to solve the identified problem |
| CO3 | Design and validate the solution by using EDA tools |
| CO4 | Estimate the time and cost budget required for developing the working model |
| CO5 | Build a working model by analyzing / troubleshooting and testing the circuit in a team. |
| CO6 | Draft a technical report, deliver a seminar and demonstrate/discuss the working model in a team |

## Guidelines:

1. Project group shall consist of not more than 3 students per group.
2. Project design ideas should be adopted from recent society/community based issues.
3. Application notes from well known component manufacturers may also be referred for designing.
4. Hardware components are mandatory.
5. Layout versus schematic verification is mandatory.
6. **Engineering Design Consideration(s) should be from one of these areas:-**
   - Societal
   - Environmental
   - Ethical
   - Health/Safety

Sustainability

## Domains for projects may be from the following, but not limited to:

- Electronic Communication Systems
- Power Electronics
- Biomedical Electronics
- Audio, Video Systems
- Mechatronics Systems
- Embedded Systems
- Instrumentation and Control

## Monitoring: ( for students and teachers both)

Suggested Plan for various activities to be monitored by the teacher.

** Formation of groups of students. Students should interact with the community/stakeholders to Identify the problem statements.

### Text Books:


1. Thomas C Hayes, Paul Horowitz, **"The Art of Electronics"**, *Cambridge University Press*, (3rd Edition), (2015).
2. Jim Williams, **"Analog Circuit Design: Art, Science and Personalities"**, *EDN series for Design Engineers*, (1st Edition), (2013).
3. M. Ashraf Rizvi, **" Effective Technical Communication"** ,*Tata McGraw Hill Education Pvt. Ltd.*, (1st Edition), (2005).


### Reference Books:


1. A.E. Ward, Angus, **"Electronic Product Design",** *Stanley Thorne Publishers, UK*, (1st Edition) (1996).
2. Meenakshi Raman, Sangeeta Sharma, **"Technical Communication, Principles and Practice"**, *Oxford University Press*, (2nd Edition), (2012).
3. C. Murlikrishna, Sunita Mishra, **"Communication Skills for Engineers"**, *Pearson Education India*, (2nd Edition), (2011).
4. Kim Fowler, **"Electronic Instrument Design"**, *Oxford University Press*, (1st Edition), (2015).
5. Kimmo Karvinen and Tero Karvinen,**"Make: Arduino Bots and Gadgets",** *O' Reilly Media, Inc.*, (1st Edition), (2011 ).


### Online Resources:

1. https://www.electronicsforu.com/
2. https://circuitcellar.com/category/article-materials-and-resources/
3. http://www.edn.com
4. Application notes of IC manufacturers

# 20EC601 WAVE THEORY AND ANTENNA

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| Tutorial :1 Hours / Week | End Semester: 50 Marks |
| | **Credits: 4** |

**Prerequisite:**20ES01 Basic Electrical and Electronics Engineering, 20BSEC301 Calculus and Probability

**Course Objectives:**
1. To study Electrostatic and Magnetostatic laws
2. To study Maxwell's equations and wave propagation in different media
3. To explain transmission line fundamentals and apply them to solve the problems using Smith chart
4. To study antenna fundamentals and analyze different types of antennas and antenna arrays

**Course Outcomes:**
After completion of the course, students will be able to
CO1 Apply the relevant laws for solving the problems of Electrostatics and Magnetostatics
CO2 Interpret Maxwell's equations for static and dynamic field and calculate the average power of Electromagnetic wave using Poynting theorem
CO3 Formulate the wave equation and solve it for uniform plane wave
CO4 Determine transmission line parameters using Smith chart
CO5 Analyze wire antenna and antenna arrays and identify the suitable antenna for a given communication system

**Unit I: Fundamentals of Electrostatics and Magnetostatics (09)**
Coulomb's law and Electric field intensity, Electric flux and flux density, Types of charge distributions and their Electric field, Gauss’s law, Biot Savart law, Ampere Circuital law, Magnetic field intensity and flux density, Boundary conditions.

**Unit II: Electromagnetic Waves (09)**
Faraday's law, Maxwell Equations in point form and integral form, Wave Equation, Uniform Plane wavesin free space, dielectric, and conducting medium, Linear, Circular & Elliptical polarization, Reflection of plane waves, Normal incidence, Oblique incidence, Electromagnetic power and Poynting vector.

**Unit III: Transmission Lines (08)**
Types of transmission lines, Dissipation less line, Voltage and Current on a transmission line, Input impedance, Open and short-circuited transmission line, Impedance mismatch, Standing waves, EMI, EMC, Smith chart and applications.

**Unit IV: Wire Antennas and Antenna Arrays (10)**
Antenna fundamentals, Types of antennas, Near and far field, Radiation mechanism, Antenna parameters, Infinitesimal dipole, Small dipole, Finite length dipole, Half wavelength dipole, Small circular loop antenna, Antenna arrays, Two element array, Array factor, Pattern multiplication, N-element linear array: Uniform amplitude and spacing, Broad side and End-fire array, N-element linear array: Non-uniform amplitude and uniform spacing, Binomial and Dolph Chebyshev-array.

**Unit V: LF to SHF Antennas (06)**

Hertz & Marconi antennas, electrically short antennas, Beverage antenna, medium frequency antennas, Resonant & non-resonant antennas, VAntenna, Rhombic antenna, TW antennas, Loop antenna, Ferrite rod antenna, Whip antenna, Yagi Uda, Helical, Horn, Parabolic reflector, Microstrip patch antenna.

**Text Books:**


1. Mathew N. O Sadiku**, "Principles of Electromagnetics",** *Oxford University Press*, (4th Edition), (2009).
2. C.A. Balanis**, "Antenna Theory- Analysis and Design",** *John Wiley*, (4th Edition), (2016).


**Reference Books:**


1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, **"Antennas for All Applications"**, *The McGraw Hill Companies*, (5rd Edition), (2017).
2. K. D. Prasad, **"Antenna and Wave Propagation"**, *Satya Prakashan New Delhi*, (2014).
3. John D Kraus, **"Antenna & Wave Propagation",** *McGraw Hill*, (4th Edition),(2010).


**Online Resources:**

1. Nptel Course **"Electromagnetic Theory**"
   https://nptel.ac.in/courses/108/104/108104087/
2. Nptel Course **"Antennas"**
   https://onlinecourses.nptel.ac.in/noc20_ee20/preview

# 20EC602 COMPUTER NETWORKS AND SECURITY

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Prerequisite:** 20EC401 Digital Electronics

**Course Objectives:**

1. To introduce network models and functions of each layer
2. To introduce networking protocols, architectures, and applications
3. To describe basic concepts of the threats for data and network and security mechanism
4. To provide theoretical and practical base regarding computer networks issues
5. To outline the basic network configurations

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Explain the principles of computer networking
CO2 Analyze networking protocols, inter-networking devices and their functions
CO3 Illustrate computer network applications based on Client-Server architecture
CO4 Identify the threats to the data and network and apply techniques to resolve them

**Unit I: Physical Layer and Data Link Layer (10)**

Networks models: OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Network performance measurement criterion, Data link control: Framing, Flow Control (Stop and Wait and Sliding Window Protocols), Error control (CRC), HDLC and PPP, Multiple access: Random access (Aloha, CSMA, CSMA/CD, CSMA/CA) protocols.

**Unit II: Wired and Wireless LANS (07)**

Wired LANS: Ethernet (IEEE 802.3), Ethernet standards (Ethernet, Fast Ethernet and Gigabit Ethernet) Wireless LANS: IEEE 802.11, Bluetooth IEEE 802.15, Connecting LANS, Connecting devices, VLAN, VxLANs, Ultra Wide Band.

**Unit III: Network Layer (09)**

Network layer functions, Logical addressing: IPv4, IPv6 addresses, IPv4 to IPv6 conversion , Unicast routing algorithms, Routers, L3 Switches, Network layer Protocols: ARP, RARP, ICMP and IGMP, Software Defined Networking.

**Unit IV: Transport layer and Application Layer (08)**

Process to Process Communication, Addressing, Transport layer protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Stream Control Transport Protocol (SCTP), Quality of service (QoS): data flow characteristics, Internet Applications and protocols: Domain Name System (DNS), E-mail, FTP, HTTP.

**Unit V: Data Security and Network Security (08)**

Security goals, Attacks and Defense strategies, Cryptography: Substitution cipher, DES, AES and RSA algorithms, Digital signatures, Authentication protocols: One-Way Authentication, Dictionary Attacks, Network, Transport and application layer security, Attacks: DoS and DDoS, Session Hijacking and Spoofing, ARP Spoofing and Attacks on DNS, Viruses, Worms and Malware,
Virus and Worm Features.

**Text Books:**

1. Behrouz A. Forouzan, **"Data Communication and Networking"**, *Tata McGraw-Hill*, (5th Edition), (2013).
2. Andrew S. Tannenbaum, **"Computer Networks",** *Pearson Education*, (4th Edition), (2003).
3. William Stallings**, "Cryptography and Network Security Principles and Practice"**, *Pearson Education*, (7th Edition), (2017).
4. Srilatha Vemula, Jason Gooley, Roddie Hasan, "**Cisco Software-Defined Access**" *Cisco Press* (1st Edition), (2020).

**Reference Books:**

1. Wayne Tomasi, **"Introduction to Data Communication and Networking"**, *Pearson Education*, (1st Edition), (2007).
2. James. F. Kurose and W. Ross, **"Computer Networking: A Top down Approach"**, Pearson *Education*, (3rd Edition), (2007).
3. Faranak Nekoogar, **"Ultra-Wideband Communications: Fundamentals and Applications"** Pearson *Education*, (1st Edition), (2005).
4. William Stallings, **"Data and Computer Communication"**, *Pearson Education*, (8th Edition), (2000).
5. Greg Tomsho, Ed Tittel, David Johnson, **"Guide to Networking Essentials"**, Thomson *India Learning*, (5th Edition), (2007).

**Online Resources:**

1. **NPTEL Course "Computer Networks"** https://nptel.ac.in/courses/106105081/
2. **NPTEL Course "Cryptography and Network Security"**https://nptel.ac.in/courses/106105031/
3. Yusnita Rahayu; Tharek Abd. Rahman; Razali Ngah, "Ultra wideband technology and its applications"in International Conf.on Wireless and Optical Communications Networks (WOCN '08).IEEE
4. Software-defined networking: The new norm for networks,Oct. 2012,[online] Available: https://www.opennetworking.org/images/stories/downloads/s dne resources/white-papers/wp-sdn-newnorm.pdf.

# 20EC602L COMPUTER NETWORKS AND SECURITY LAB

**Teaching Scheme**
Lectures: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Oral: 25Marks

**-Course Objective**

1. To configure network and client server applications
2. To use modern tools to analyse protocols
3. To implement routing algorithms
4. To implement encryption and decryption algorithms

**Course Outcome**

After completion of the course, students will be able to

| CO | Statement |
|---|---|
| CO1 | Demonstrate use of network commands |
| CO2 | Experiment with protocol analyzer tool to study TCP/IP protocols |
| CO3 | Utilize network simulation tool for studying IP routing protocols |
| CO4 | Develop a program for cryptography and routing. |

**List of Experiments:**

1. a. Study of network commands & IP address configurations.
   b. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable
   c. Implementation of LAN using star topology and connectivity between two computers using crossover UTP CAT5 cable.
2. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)
3. Study of any network simulation tools to create a network with three nodes & establish a TCP connection between node 0 & node 1 such that node 0 will send TCP packet to node 2 via node 1.
4. Study of Network simulation tools to configure and see behavior of IP routing protocols like RIP, BGP etc.)
5. a. Installation and configuration of Web Server and hosting web pages using HTML programming.
   b. Installation and configuration of FTP server for FTP communication.
6. Write C/Java code for socket programming.
7. Write a program for Encryption and Decryption(RSA, Substitution)
8. Write a program in C for the Shortest Path algorithm.
9. Simulate DDoS attacks on a server, in a lab environment.

# 20HS601 MANAGEMENT FOR ENGINEERS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** Nil

**Course Objectives:**
1. To develop understanding about the basics of management functions
2. To explain the concept of total quality management
3. To analyze cost and financial aspect of the business
4. To develop the strategic thinking and decision making abilities in the rapidly changing global business environment

**Course Outcomes:**
After completion of the course, students will be able to
1. Explain the principles and functions of management
2. Identify social responsibility and ethical issues involved in the Organization
3. Apply tools of quality management
4. Analyze the cost, financial aspects of business and the need of globalization

**Unit I: Basics of Management (08 )**
Introduction, Definition of management, characteristics of management, functions of management: Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making.

**Unit II: Organizational Environments and Cultures (06)**
External environments, Internal environments, Ethics and social responsibility.

**Unit III: Quality Management (10)**
Definition of quality, continuous improvement definition of quality, types of quality, quality of design, conformance and performance, phases of quality management, Quality Management Assistance Tools: Ishikawa diagram, Pareto Analysis, Pokka Yoke (Mi stake Proofing), Quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management, The ISO 9001:2015, Quality Management System Standard, Software quality management with respect to CMM level and ISO standard.

**Unit IV: Cost and Financial Accounting (10)**
Basic concepts of cost accounting, Classification and analysis of costs, Marginal costing, Break-even point, Cost Volume Profit analysis, key financial statements, financial analysis.

**Unit V: Globalization (06)**
Global trends and commerce, new opportunities offered by globalization, preparation for globalization, globalization drivers, implementation issues related to globalization, quality of global leadership.

**Text Books:**
1. Stephen P. Robbins, Mary Coulter, **"Management",** *Prentice Hall of India*, (8th Edition), (2014).
2. Charles W.L Hill, Steven L McShane, **"Principles of Management",** *McGraw Hill*

*Education, Special Indian Edition*, (2007).

**Reference Books:**

1. Freeman-Bell, James Balkwill, **“Management in Engineering”,** *Prentice Hall of India*, (2nd Edition), (2005).
2. T. R. Banga, S.C. Sharma, **“Industrial organization and Engineering Economic”,** *PHI Publication*, (25rd Edition), (2002).
3. M.C. Shukla, **“Business Organization and Management”,** *PHI Publication*, (2rd Edition), (2002).
4. C. M. Chang, **“Engineering Management: meeting the Global Challenges”,** Publisher: *CRC Press*, (2016).

# 20OE601E COMPUTER VISION

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20EC501 Digital Signal Processing

**Course Objectives:**
1. To introduce major ideas, methods and techniques of Computer Vision algorithms
2. To introduce fundamentals of Image formation
3. To explain concepts of Camera Calibration and Stereo Imaging
4. To explain different Background Subtraction techniques and Motion tracking algorithms

**Course Outcomes:**
After completion of the course, students will be able to

CO1 Explain the fundamentals of Image formation, Camera calibration parameters and Stereo Imaging
CO2 Apply camera calibration concepts to calculate intrinsic and extrinsic parameters of camera
CO3 Explain different Background Subtraction techniques and Calculate the Performance measures of it.
CO4 Select the appropriate feature extraction techniques according to the requirement of the applications
CO5 Analyze the appropriate Background Subtraction techniques and Object tracking algorithms according to the requirement of the applications

**Unit I: Camera Calibration (07)**
Geometrical primitives and transformations, 3D to 2D projections, Image Formation, Capture and Representation, Camera Calibration and parameters, Digital camera.

**Unit II: Stereo Imaging (08)**
Stereo Vision: Epipolar geometry, Rectification, Correspondence, triangulation, RANSAC algorithm, Dynamic programming.

**Unit III: Visual Features and Representations (09)**
Edge, Blobs, Corner Detection, SIFT, SURF, HoG.

**Unit IV: Background Subtraction Techniques for Moving Object Detection (09)**
Frame differencing, Mean and Median filtering, Gaussian Mixture Model (GMM), Kernel density estimation, Applications.

**Unit V: Motion Tracking (09)**
Motion tracking using Optical flow, blob tracking, Colour feature based mean shift, Kalman tracking, Applications.

**Text Books:**

1. D. Forsyth, J. Ponce, **"Computer Vision, A Modern Approach"**, *Prentice Hall*, ($2^{nd}$ Edition), (2003).

2. R. Szeliski, **“Computer vision algorithms and applications”,** *Springer-Verlag*, (2$^{nd}$ Edition), (2010).

**Reference Books:**

1. L. G. Shapiro, George C. Stockman**, “Computer Vision”**, *Prentice Hall*, (1$^{st}$ Edition), (2001).
2. E. Trucco, A. Verri, **“Introductory Techniques for 3-D Computer Vision”**, *Prentice Hall*, (1$^{st}$ Edition), (1998)
3. D. H. Ballard, C. M. Brown, **“Computer Vision”**, Prentice Hall, (1$^{st}$ Edition), (1982).
4. M. Sonka, V. Hlavac, R. Boyle, **“Image Processing, Analysis, and Machine Vision”,** *Thomson Press*, (3$^{rd}$ Edition), (2011).

**Online Resources:**

NPTEL Course **“Computer Vision”**

1. https://nptel.ac.in/courses/106/105/106105216/
2. http://www.ai.mit.edu/projects/vsam/Publications/stauffer_cvpr98_track.pdf
3. https://people.cs.rutgers.edu/~elgammal/pub/ieeeproc-paper-final.pdf
4. http://www.cs.cmu.edu/~16385/s15/lectures/Lecture24.pdf

# 20OE601K MULTIMEDIA SYSTEMS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
ISE: 50 Marks
ESE: 50 Marks
**Credits: 3**

**Prerequisite:**20EC402 Analog and Digital Communication

**Course Objectives:**
1. To introduce basic concepts and design of Colour TV and Digital TV
2. To explain advanced TV technologies like HDTV, CATV, CCTV, DTH, CAS and case study for live telecast
3. To introduce multimedia compression techniques, standards and multimedia over the internet
4. To familiarize the students with digital recording and playback systems, acoustic design, microphones and loudspeakers

**Course Outcomes:**
After completion of the course, students will be able to

CO1 Explain the concepts of colour TV design, systems and Digital TV
CO2 Discuss and compare advanced TV systems like CATV, CCTV, DTH, HDTV, CAS, Wi-fi TV, 3DTV and different display technologies
CO3 Apply and analyze multimedia compression standards for text, audio, image and video and explain multimedia over the internet
CO4 Compare optical recording techniques, microphones and loudspeakers
CO5 Design acoustics and PA system for auditorium, public meeting, debating hall, football stadium and college classrooms

**Unit I: Colour and Digital TV (11)**
Resolution, interlaced scanning, BW, CVS, Color TV systems, frequency interleaving, colour difference signals, colour TV receiver, NTSC, PAL, SECAM encoders and decoders, Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters and receivers.

**Unit II: Advanced TV Systems (10)**
HDTV standards and systems, HDTV transmitter and receiver, CCTV, CATV, Direct to Home TV (DTH), Set top box, Conditional Access System (CAS), 3D TV systems, Case study (Cricket match, Marathon, Football match), Wi-Fi TV, Video door phone systems, Display devices: LED, LCD, Plasma.

**Unit III: Multimedia Compression and Multimedia over Internet (11)**
Introduction, Overview, Concept of Multimedia, Multimedia Applications, Text: Types, Compression, Hypertext, Image Compression techniques: JPEG, Multimedia Audio: MIDI, MP3, Video: MPEG, Animation: Introduction, types, 3D animation, Virtual reality, Multimedia over Internet**:** Introduction to Multimedia Services, Transmission of Multimedia over the Internet, IP Multicasting, Explaining VOIP.

**Unit IV: Acoustics and Digital Audio Video (10)**

Optical recording, noise, CD, DVD, dual layer DVD, rewritable DVD, Blu Ray DVD, Studio acoustics and reverberation, acoustic chambers, PA system for : auditorium, public meeting, debating hall, football stadium, college hall, Advanced PA systems, Different types of speakers and microphones.

**Text Books:**


1. R. R. Gulati, **"Modern Television Practice",** *New Age International*, (5th Edition), (2015).
2. Ralf Steinmetz, Klara Nahrstedt, **"Multimedia: Computing, Communication and Applications"**, *Pearson Publication*, (8th Edition), (2011).
3. R.G. Gupta, **"Audio and Video Systems"**, *Tata Mcgraw Hills,* (2nd Edition), (2020).
4. Robert D. Finch, **"Introduction To Acoustics",** *PHI*, (2nd Edition), (2007).
5. Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, "**Advance Computer Network"**, *Wiley*, (2nd Edition), (2014).


**Reference Books:**


1. A. M. Dhake, "**Television and Video Engineering**", *Tata Mcgraw Hills*, (2nd Edition), (2003).
2. Ranjan Parekh, **"Principles of Multimedia**", *Tata Mcgraw Hills*, (2nd Edition), (2013).
3. Alec Nisbett , "**The Sound Studio**", *Focal Press*, (5th Edition) , (1993).


**Online Resources:**

**NPTEL Course " Multimedia Systems"**

1. https://nptel.ac.in/courses/117/105/117105083/

# 20PEEC501B MECHATRONICS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20ES 01Basic Electrical and Electronics, 20EC301Electronics Circuit and Applications

**Course Objectives:**

1. To discuss the concepts and key elements of Mechatronics system
2. To explain principles and characteristics of Sensors and Transducers
3. To describe working principle of Hydraulic and Pneumatic systems and its applications
4. To give example of applications of Mechatronics Systems

**Course Outcomes:**

After completion of the course, students will be able to:

| | |
|---|---|
| CO1 | Classify , Compare and Explain functionality of components used to develop Mechatronics systems |
| CO2 | Select specific component such as sensors/transducers and actuators used to develop Mechatronics systems |
| CO3 | Analyze performance, approaches, procedures and results related to components used in Mechatronics System |
| CO4 | Design signal conditioning circuit from the given components for specific task |
| CO5 | Interface Hydraulics and Pneumatics circuit from the given components for specific task |
| CO6 | Design a Mechatronics system for a given task |

**Unit I: Elements of Mechatronics Systems (07 )**

Introduction to Mechatronics, Key element/components, Level of Mechatronics system, Phases of Mechatronics design process, Integrated design approach, Advantages, and Disadvantages of Mechatronics systems, Mechanical components: Cam, Gears, Gear-train, Servomechanism and its application.

**Unit II: Sensors and Transducers (12)**

Overview of Sensors and Transducers, Classification and their Characteristics, Temperature measurement using Thermistor, RTD, Themocouple, Semiconductor (AD590, LM35, LM75), Force and Pressure measurement using Strain gauge, Load Cell, Piezoelectric, Differential Pressure Sensor, Displacement and Position measurement using Potentiometer, LVDT, RVDT, Proximity, Optical Encoder, Ultrasonic transducer, LDR and IR Sensors, Level and Flow measurement using Float Level, Capacitive Level sensor, IR Level Sensor, Ultrasonic transducer, Turbine type and Ultrasonic transducer, Vibration and acceleration measurement using Piezoelectric accelerometer, MEMS ICs.

**Unit III: Signal Conditioning (08)**

Signal conditioning: its necessity, Amplification, Filtering and Impedance Matching, Protection, 4-20mA Transmitters and receivers. Design of signal conditioning circuits for sensors and transducers.

**Unit IV: Hydraulic and Pneumatic System** **(06)**

Introduction to Hydraulic and Pneumatic Actuating system, Physical Components of Hydraulic and Pneumatic systems, Types of Actuators/Cylinders and their applications, Comparison of hydraulic and pneumatic systems, Pressure relief Valve, Pressure regulator valve and Directional Control Valve.

**Unit V: Electric Actuators** **(05)**

Selection criteria and specifications of stepper motors, DC motors, Servomotors, Solenoid valves, Solid State relays and Electromechanical relays, Electro-Pneumatic and Electro-Hydraulics Directional Control Valve, Driving circuit for electric actuators and interfacing with microcontrollers.

**Unit VI: Mechatronics Systems Applications** **(04)**

Mechatronics Systems in Automobile, Engine Management systems, Antilock Brake systems (ABS), Washing machine, Pick and place robot, Mobile robot, and Case studies on real life application.

**Text Books:**


1. Bolton W., **"Mechatronics - Electronic systems in Mechanical and Electrical Engineering"**, *Pearson Education Ltd.*, (6th Edition), (2016).
2. K. P. Ramachandran, G. K. Vijayaraghavan and M.S. Balasundaram, **"Mechatronics-Integrated Mechanical Electronic Systems"**, *Wiley Publication*, (1st Edition), (2008).
3. David Alciatore and Maichael B. Histand, **"Introduction to Mechatronics and Measurement Systems"**, *Tata McGraw Hill*, (4th Edition), (2013).


**Reference Books:**


1. Doeblin E.O., **"Measurement System-Application and Design",** *Tata McGraw Hill, New Delhi*,(4th Edition), (2004)
2. Mahalik N. P., **"Mechatronics - Principles, Concepts and Applications",** *Tata McGraw Hill, New Delhi,* (2th Edition), (2014)


**Online Resources:**

1. **NPTEL Course "Mechatronics"**
   http://nptel.ac.in/courses/112103174/
2. **NPTEL Course " Mechatronics"**
   https://nptel.ac.in/courses/112/107/112107298/

## 20PEEC501C DIGITAL IMAGE PROCESSING

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20BSEC301 Calculus and Probability. 20EC302 Signals and Systems.

**Course Objectives:**

1. To understand the basic concepts of image processing like relations between pixels, distance measures, statistical parameters, colour models, noise models and operations on images
2. To study different image enhancement, segmentation, representation and restoration techniques
3. To study image analysis in spatial and transform domains for image compression and filtering
4. To study different applications of Image processing

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Explain basic concepts of image processing, transform domain filtering, image restoration, color models and compression basics |
| CO2 | Compute distance measures and perform arithmetic, logical, geometric, set and spatial transformation operations on images |
| CO3 | Apply and analyze spatial domain image enhancement and compression techniques |
| CO4 | Perform image representation, image segmentation and image classification techniques |
| CO5 | Apply morphological operations on an image and select appropriate image processing modules to develop an image processing application |

**Unit I: Digital Image Fundamentals and Operations on Images (08)**

Components of Image Processing System, Basic image processing classes, Element of Visual Perception, Sampling and Quantization, Relationship between pixels and Distance Measures, Statistical parameters, Basic operations on images, Morphological image processing, dilation, erosion, opening, closing.

**Unit II: Image Enhancement (09)**

Image Enhancement in Spatial Domain, Point, mask and global operations, Basic Gray Level transformations, Histogram, histogram equalization, Basics of Spatial Filtering, Smoothing, linear and non-linear filters, Sharpening filters, First and Second order derivatives, Image filtering in Frequency Domain, Low pass, High pass, Correspondence between Filtering in Spatial and Frequency Domain.

**Unit III: Image Transforms and Colour Models (08)**

Colour Image Processing, Colour Fundamentals, Colour Models, Pseudocolouring, Converting Colours to different models, Need for compression, Data Redundancies, Image Compression Model, Lossy and Lossless compression, 2-D Discrete Fourier Transform, Discrete Cosine Transform, JPEG compression.

**Unit IV: Image Segmentation, Representation and Classification (09)**

Image analysis, Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, image representation, boundary representation by chain codes, Fourier descriptors, Shape number, Signatures, Types of classification algorithms, K-Nearest Neighbours, K-means, Decision Tree.

**Unit V: Image Restoration and Applications of Image Processing (08)**

Image restoration, Restoration model, Degradation causes, Noise models, Inverse filter, Weiner filter, Fingerprint recognition, Character recognition, Face recognition, Medical applications, Remote sensing, CBIR.

**Text Books:**


1. Rafael C. Gonzalez and Richard E. Woods, "**Applications of Image Processing and Morphological Image Processing**", *Pearson Education*, (2nd Edition), (2012).
2. S. Jayaraman, Esakkirajan, Veerakumar, **"Digital Image Processing"**, *McGraw Hill Education*, (1st Edition,), (2012).


**Reference Books:**


1. Anil Jain, **"Fundamentals of Digital Image Processing"**, *Prentice Hall*, (1st Edition), (1989).
2. Pratt W. K**, "Digital Image Processing",** *John Wiley*, (2nd Edition), (2001).


**Online Resources:**

1. **NPTEL Course "Digital Image Processing"**
   http://nptel.ac.in/courses/117/105/117105135/
2. **NPTEL Course " Digital Image Processing"**
   https://nptel.ac.in/courses/117/105/117105079/

## 20PEEC501D INTRODUCTION TO INTERNET OF THINGS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20EC404 Embedded Systems

**Course Objectives:**

1. To explore various components of Internet of Things such as Sensors, internetworking and cyber space
2. To design Internet of Things circuits and solutions

**Course Outcomes:**
After completion of the course, students will be able to

CO1 Apply concepts to explain Internet of Things (IoT) architecture, protocols, models and devices used to develop IoT systems
CO2 Identify appropriate protocols, models and devices to develop IoT system
CO3 Compare and contrast IoT and M2M, IoT physical devices, networking and protocols techniques
CO4 Design IoT system for the given application

**Unit I: Introduction to Internet of Things (07)**
Internet of Things fundamentals: Sensing, Actuation, Internet of Things (IOT) Architecture and protocols: Communication Protocols, Sensor Networks, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Challenges in IOT, Communication models and APIs; IoT Enabling Technologies.

**Unit II: Machine to Machine to Internet of Things (08)**
The Vision-Introduction, From machine to machine (M2M) to Internet of Things (IoT), M2M towards IoT-the global context, Case study, Differing characteristics between M2M and IoT, Definitions, M2M Value Chains, Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards consideration, IoT Value Chains, Industrial IoT (IIoT).

**Unit III: IOT Physical Devices and Objects (08)**
Introduction to IoT tools, Implementation of IoT with Arduino and Raspberry-Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

**Unit IV: IOT Networking and Addressing techniques (07)**
RFID technology, Wireless Sensor Networks, IPv6 Protocol Overview, comparison of IPv4 and IPv6, IPV6 tunneling, IPsec in IPv6, Quality of Service in IPv6

**Unit V: IOT Protocols and Cloud offerings (07)**
IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN, MQTT protocol, Introduction to cloud storage models and communication API’s, web services for IoT.

**Unit VI:** **Domain Specific Applications of Internet of Things** **(05)**

Home automation - hardware approach - Industry applications, Surveillance applications.

**Text Books:**

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** *Academic Press*, **(**$1^{st}$ Edition), (2014).
2. Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** *VPT* , ($1^{st}$ Edition), (2014).
3. Francis da Costa, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** *Apress Publications*, ($1^{st}$ Edition), (2013).
4. Cuno Pfister, "**Getting Started with the Internet of Things**", *O'Reilly Media*, ($1^{st}$ Edition), (2011).

**Reference Books:**

1. Honbo Zhou, **"The Internet of Things in the Cloud: A Middleware Perspective",** *CRC Press*, ($1^{st}$ Edition), (2012)
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), **"Architecting the Internet of Things",** *Springer*, ($1^{st}$ Edition), (2011)
3. Olivier Hersent, David Boswarthick, Omar Elloumi , **"The Internet of Things – Key Applications and Protocols",** ($1^{st}$ Edition), *Wiley*, (2012)

**Online Resources:**

1. NPTEL Course "**Introduction to IOT"**
   https://nptel.ac.in/courses/106/105/106105166/

# 20PEEC501LC DIGITAL IMAGE PROCESSING LAB

**Teaching Scheme**
Lectures: 2 Hours / Week

**Examination Scheme**
In Semester: 25 Marks
Practical :25 Marks
**Credits: 1**

**Course Objective**
1. To practice the basic image processing techniques
2. To explore digital image enhancement techniques in spatial and transform domain
3. To understand image compression, colour model conversions, segmentation and restoration techniques
4. To explore the applications using image processing techniques

**Course Outcome**
After completion of the course, students will be able to

CO1 Perform basic operations and computations on images
CO2 Implement algorithms for image enhancement and image filtering
CO3 Perform image compression and colour model conversion
CO4 Apply image segmentation and restoration techniques
CO5 Develop an algorithm/application using various image processing techniques

**List of Experiments: Matlab/Python**
1. Perform basic operations on images (Create image/ operations/ distance measures).
2. Perform a) Histogram equalization b) Spatial domain filtering.
3. Perform a) DCT of an image b) Colour model conversion.
4. Perform Image segmentation (thresholding/region based) techniques
5. Perform Morphological operations on images / Wiener filtering.
6. Implement a Mini project (Application/algorithm) in image processing.

# 20PEEC601A ROBOTICS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks

**Prerequisite:** 20BS01Linear Algebra and Univariate Calculus, 20ES01: Basic Electrical and Electronics Engineering

**Course Objectives:**

1. To explain fundamentals of robotic system
2. To introduce kinematics, dynamics and control for robotics systems
3. To introduce trajectory planning for motion
4. To describe application of robots in automation

**Course Outcomes:**
After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Classify, Compare and Explain functionality of components used to develop robots |
| CO2 | Select sensors, actuators and grippers for developing robots. |
| CO3 | Apply formulations to obtain kinematics, dynamics and trajectory planning of manipulator |
| CO4 | Explain path planning algorithms for robotic system |
| CO5 | Analyze components, robot mechanics and algorithm used to develop robots |
| CO6 | Build a Robotic system to perform a given task. |

**Unit I: Introduction to Robotics (06 )**
Definition of robotics, Components of Robot system, Classification of robots based on co-ordinate systems, Degrees of freedom, Links and Joints, Robot Specifications

**Unit II: Robotic Sensors, Actuators and End Effectors (10)**
Classification of sensors, Internal and External sensors, Position, Acceleration sensors, Proximity, Velocity sensors, Force sensors, Tactile sensor, Camera and Robot vision, Overview of actuators: Electric, Pneumatic and Hydraulic actuators, Classification of End Effectors and Types of Gripper.

**Unit III: Transforms and Kinematics (07)**
Pose of rigid body, Position and orientation description, Coordinate transforms, Homogeneous transform, Denavit and Hartenberg (DH) parameters, Forward and Inverse Kinematic Analysis.

**Unit IV: Dynamics and Trajectory (07)**
Dynamics and Inverse Dynamics of robots, Link inertia tensor and manipulator inertia tensor, Newton – Eller formulation. Trajectory planning, Joint space planning, Cartesian space planning and Position and Orientation trajectories.

**Unit V: Robot Programming Methods (08)**
Robot language classification, Robot language structure, Online and Offline Programming, Line Following Algorithms, Robot Navigation, Path planning algorithms based on Simultaneous Localization and Mapping (SLAM) algorithm.

**Unit VI: Application of Robot in Automation** **(04)**

Application in Manufacturing: Material Transfer, Material handling, loading and unloading processing, spot and continuous arc welding & spray painting, Robot application in Medical, Progressive advancements in robots, Present trends and future trends in robotics.

**Text Books:**


1. S.K. Saha, **"Introduction to Robotics",** *Tata McGraw Hill*, (2nd Edition), (2014).
2. R. K. Mittal, I. J. Nagrath**, "Robotics and Control",** *Tata McGraw Hill, New Delhi"***,** (1st Edition), (2003).
3. K.S. Fu, R.C .Gonzalez, C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence",** *Tata McGraw Hill* **,** (2nd Edition), (2008).
4. R. Siegwart, I. R. Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, *The MIT Press*, (2nd Edition), (2011).


**Reference Books:**


1. Robert Schilling, **"Fundamentals of Robotics: Analysis and Control",** *PHI. New Delhi*, (1st Edition), (2003).
2. S. R. Deb**, "Robotics Technology and Flexible Automation",** S. Deb, Tata McGraw Hill, (1st Edition), (2010).
3. Francis X. Govers, **"Artificial Intelligence for Robotics",** *Packt Publishing Ltd., United Kingdom*, (1st Edition), (2018).


**Online Resources:**

1. **NPTEL Course " Mechanics and Control of Robot Manipulator"**https://onlinecourses.nptel.ac.in/noc21_me108/
2. NPTEL Course **" Wheeled Mobile Robot"** https://nptel.ac.in/courses/112/106/112106298/

# 20PEEC601B BIOMEDICAL ELECTRONICS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20EC302Signals and systems, 20EC404Embedded Systems, 20EC302Digital signal processing

**Course Objectives:**

1. To explain and analyse important organ systems in a human body
2. To understand different diagnostic and lifesaving biomedical equipment
3. To introduce AI/ML techniques used in Biomedical Applications
4. To explore signal conditioning and processing system for real life biosignals

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Explain and analyse important organ systems in a human body
CO2 Compare different diagnostic and lifesaving biomedical equipment
CO3 Develop a signal conditioning and processing system for real life biosignals
CO4 Select the appropriate AI/ML techniques for Reference biomedical signals

**Unit I: Human Anatomy and Biomedical Electronic System (04 )**

Organ systems: Cardiovascular System, Nervous System and Respiratory System, Cell, Nerve cell, Action Potential, Introduction to Biomedical Electronics system, its advantages and applications.

**Unit II: Biomedical Sensors, Signal Acquisition and Processing (10)**

Transducers and Sensors: Temperature transducers, Infrared radiation thermometers, Clinical thermometers, Pressure transducers: Strain Gauge for pressure measurement, SpO2 sensor, Sources of Biomedical Signals, Classification of Biomedical Signals, Bioelectric signals like ECG, EEG, EMG and EOG. Recording Electrodes, Motion artefacts, Electrodes for EEG, ECG and EMG, Isolation amplifiers, Differential Amplifiers, Instrumentation Amplifiers, Analysis of non-stationary signals, Time-variant system, Short time Fourier transform, Multi resolution Analysis (Wavelet), Introduction to Adaptive filters and its applications.

**Unit III: Cardiovascular System (06)**

Anatomy of Heart, Conducting system of the heart, Lead Configuration to acquire ECG, Einthoven Triangle, ECG Machine, Normal rhythm and Rhythm Abnormality (Arrhythmia), Heart Sounds (Phonocardiograph), Blood Pressure Measurement, Echocardiography.

**Unit IV: Central Nervous System(CNS) and Peripheral Nervous System(PNS) (06)**

Functional Components of a Human Nervous System, Electroencephalogram (EEG), Types and Significance of EEG Signal, 10-20 Electrode Placement System, Evoked Potential, EEG Machine, EEG Amplifier and Filters, EEG applications: Epilepsy, Sleep disorder and Human Brain-Computer Interface (HCI/BCI), Sensory (Pain, temp, touch, pressure) and Motor components , Muscles and EMG.

**Unit V: Biomedical Equipment (08)**

ICU equipment: Bedside Monitors, Central Monitoring System, Diagnostic Equipment: Block diagram of X-Ray machine, CT Scan and MRI machines, Ultrasound Imaging, Life saving equipment: Pacemakers, Defibrillators and Ventilators

**Unit VI: Applications of AI and ML Techniques in Biomedical Field (08)**

Overview of AI/ML (SVM, Clustering, KNN) techniques and Neural Networks, Representation of biomedical signals, Data exploration and processing, Applications to image analysis (X-rays) and Time-series (ECG and EEG signals)

**Text Books:**


1. Joseph J. Carr and John M. Brown, **"Introduction to Biomedical Equipment Technology"**, *Prentice Hall India*, (4th Edition), (2000).
2. R. Rangayyan, **"Biomedical Signal Analysis"**, *Wiley India Pvt. Limited*, (1st Edition), ( 2002).
3. R. S. Khandpur**, "Handbook of Biomedical Instrumentation",** *Tata McGraw Hill*, (2nd Edition), (2003).


**Reference Books:**


1. D. C. Reddy **"Biomedical Signal Processing: Principles and techniques",** *Tata McGraw*, (1st Edition), (2005).
2. Bruce, **"Biomedical Signal Processing & Signal Modeling",** *Wiley India Pvt. Limited*, (Wiley student edition), (2009).
3. John L. Semmlow, **"Bio-signal and Medical Image Processing",** *CRC Press*, (2nd Edition), (2009).


**Online Recources:**

1. NPTEL Course **"Biomedical Signal Processing"** https://nptel.ac.in/courses/108/105/108105101/:

# 20PEEC601C POWER ELECTRONICS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20ES01: Basic Electrical and Electronics Engineering

**Course Objectives:**

1. To explain the power devices structure and characteristics
2. To study electrical motors and use power converters to control motor speed
3. To analyze the power converters
4. To calculate the performance parameters of power converters
5. To explain power converter applications

**Course Outcomes:**
After completion of the course, students will be able to

CO1 Describe the structure of power devices and their characteristics
CO2 Explain the construction and characteristics of electrical motors
CO3 Analyse power converters and determine their performance parameters
CO4 Select and justify the use of suitable power converter for the given application

**Unit I: Power Devices (07)**
SCR, Power MOSFET, IGBT: Construction, Turn on mechanism, Static and Dynamic Characteristics, Gate drive circuits, Isolation techniques, SCR specifications and ratings, Gate-cathode characteristic, Line and Forced commutation.

**Unit II: Introduction to Motors (06)**
DC motors (Shunt and Series): Working principle, Load characteristics, Speed-torque characteristic, Field control of series motor, Motoring and braking principle, Induction motor: Speed-torque characteristic, Operation of induction motor from non-sinusoidal supply, Basic blocks of drives.

**Unit III: Phase Controlled Rectifiers (10)**
Analysis of single-phase semi converters and full converters for R and R-L, R-L-E load, Quadrant operation of converter, Effect of freewheeling diode, Performance parameters, Fourier analysis of supply current, Three phases converters for R load, Speed control of dc motor using phase-controlled rectifiers.

**Unit IV: AC Voltage Controllers (05)**
Single Phase AC voltage controller for R and R-L load, Three Phase AC voltage controller for R load, Light dimmer, Induction heating.

**Unit V: Inverters (08)**
Single-phase half bridge and full bridge inverters for R and R-L load and their performance parameters, Three phase bridge inverters for R load (120° and 180° mode operation),
PWM inverters, Single pulse and multiple pulse inverters, Stator voltage control and variable frequency control of induction motors using VSI, ONLine and OffLine UPS.

**Unit VI: Choppers** **(06)**

Step-down chopper with R and R-L load, Step-up chopper for R load, Control strategies for output voltage control, Two quadrant and Four quadrant choppers, Motoring and braking of dc motor using chopper, SMPS.

**Text Books:**

1. M. H. Rashid, **"Power Electronics Circuit, Device and Application",** *Prentice Hall (PHI),* (3rd Edition), (2009).
2. M. D. Singh and K. B. Khanchandani, **"Power Electronics",** *Tata McGraw-Hill,* (2nd Edition), (2008).
3. Nagarath, D. P. Kothari, "**Electrical machines"**, *Tata McGraw-Hill,* (3rd Edition), (1998).
4. Ned Mohan, T. M. Undeland, and W.P. Robbins, **"Power Electronics Converter Application and Design",** *John Wiley and Sons,* (3rd Edition), (2009).
5. Vedam Subramhanyam, **"Electric drives-Concepts and Applications",** *Tata McGraw-Hill,* (2nd Edition), (2011).

**Reference Books:**

1. M. S. Jamil Asghar, **"Power Electronics",** *Prentice Hall* **(***PHI), New Delhi,* (1st Edition), (2011).
2. P. C. Sen, **"Power Electronics"**, *John Wiley and Sons,* (1st Edition), (2008).

**Online Resources:**

1. **NPTEL Course "Power Electronics"** https://nptel.ac.in/courses/108/105/108105066/
2. **NPTEL Course "Fundamentals of Electric Drives"**https://nptel.ac.in/courses/108/104/108104140/

# 20PEEC601D DEEP LEARNING

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Prerequisite:** 20EC403 Machine Learning with Python

**Course Objectives:**

1. To introduce basic concepts and learning algorithms of Artificial Neural Networks
2. To become familiar with feedforward and recurrent neural networks
3. To build CNN model and elaborate effects of hyperparameters on its performance
4. To get detailed insight of deep learning algorithms and their applications to solve real world problems

**Course Outcomes:** *

After completion of the course, students will be able to

CO1 Explain basic concepts of neural network and its learning algorithms
CO2 Calculate feature map dimensions and learnable parameters in Convolutional Neural Network (CNN)
CO3 Analyze effects of hyperparameter tuning on the performance of L-layer deep networks and interpret results
CO4 Solve image recognition and classification problems using pretrained CNN architectures
CO5 Compare recurrent neural networks, their types for sequence data processing and explain gradient issues
CO6 Design a deep neural network architecture to solve real-world problems

**Unit I: Basics of Artificial Neural Network (09)**

Biological neuron, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron learning algorithm, Linear separability, Activation functions, Feedforward networks: Multilayer Perceptron, Gradient Descent, Backpropagation

**Unit II: Deep Neural Networks (09)**

Deep feedforward networks, Architecture design, Gradient based learning, Vanishing and exploding gradients, Regularization, Optimization methods (AdaGrad, AdaDelta, RMSProp, Adam, NAG) for training deep models, Hyperparameters.

**Unit III: Convolutional Neural Networks (09)**

Building blocks of Convolutional Neural Network (CNN), Convolution operation and layer, Kernels and Filters, Pooling layer, Stacking of layers, Cross-validation, Data augmentation, Transfer learning, Modern CNN architectures: AlexNet, VGGNet, GoogLeNet, ResNet, Autoencoder.

**Unit IV: Sequence Modeling (09)**

Recurrent Neural Network (RNN), Types of RNN, Bidirectional RNNs, Back propagation through time (BPTT), Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM).

**Unit V: Applications of Deep Learning (06)**

Applications of CNN: Object recognition, Image classification.
Applications of RNN: Speech, language, and text processing.

**Text Books:**

1. Laurene Fausett, **“Fundamentals of Neural Networks: Architectures, Algorithms and Applications”**, *Pearson Education*, ($1^{st}$ Edition), (2008).
2. S. N. Sivanandan and S. N. Deepa, **“Principles of Soft Computing”**, *Wiley India*, ($2^{nd}$ Edition), (2011).
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, **“Deep Learning”**, *MIT Press*, ($1^{st}$ Edition), (2016).
4. Josh Patterson and Adam Gibson, **“Deep Learning- A Practitioner’s Approach”**, *O’Reilly Media*, ($1^{st}$ Edition), (2017).

**Reference Books:**

1. Francois Chollet, **“Deep Learning with Python”**, *Manning Publications*, ($1^{st}$ Edition), (2018).
2. Phil Kim, **“MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”**, *Apress*, ($1^{st}$ Edition), (2017).

**Online Resources:**

1. NPTEL Course **“Fuzzy Logic and Neural Networks”**
   https://onlinecourses.nptel.ac.in/noc21_ge07/preview
2. NPTEL Course **“Deep Learning”**
   https://onlinecourses.nptel.ac.in/noc21_cs76/preview

# 20PEEC601LA ROBOTIC LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester : 25Marks
Practical: 25 Marks
**Credits: 1**

**Course Objectives:**

1. To demonstrate robot working and degree of freedom using physical components
2. To demonstrate robot functioning using simulation software
3. To design microcontroller based robotic system for specific task

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Explain mechanical configuration of robot manipulation
CO2 Select sensors and actuators used in robot manipulation
CO3 Apply formulation to simulate to obtain work space, kinematics, Dynamics and trajectory path of robot manipulator
CO4 Develop robot for specified task

**List of Experiments:**

1. Velocity and Position measurement using optical encoder.
2. Interface Pneumatic system component to actuate single acting and double acting cylinders.
3. Plot of work space of 2-link planer arm using simulation software.
4. Simulation of Forward Kinematics and Inverse Kinematic of
    1. 3-Link Robot
    2. PUMA 560 Robots.
5. Simulation of Dynamics of 3 link robot
6. Simulation of Trajectory and Path planning of :
    1. 3-Link Robot
    2. PUMA 560 Robots.
7. Hardware simulation of 3 Link robotic arm.
8. Design Robot for any application.

# 20PEEC601LB BIOMEDICAL ELECTRONICS LAB

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Practical: 2 Hours / Week | In Semester : 25Marks |
| | Practical: 25 Marks |
| | **Credits: 1** |

**Course Objectives:**

1. To understand signal acquisition of some of the bio signals
2. To explore and select appropriate signal conditioning techniques
3. To study different AI/ML techniques for analysis and automatic classification

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Compare the performances of different sensors used in Biomedical Applications

CO2 Select and Apply appropriate signal conditioning techniques to the different biomedical signals

CO3 Implement spectral analysis techniques on Biomedical signals

CO4 Develop a microcontroller based system to acquire the real life biosignal and perform analysis of the same

**List of Experiments:**

1. Temperature measurement using AD590 / LM35/Digital sensor
2. Measure ECG and Heart rate (photoelectric transducers/ finger plethysmography) : Normal and after exercise, Raw signal and after signal conditioning
3. Measure EMG for different muscles while performing any actions
4. Measurement of unknown resistance by using a Strain Gauge/Load cell in the Wheatstone bridge and finding the sensitivity of the bridge
5. Measurement of blood pressure using sphygmomanometer and automatic digital BP instrument (Test points on a Trainer kit). Finding the systolic and diastolic values and calculate Mean Arterial Pressure (MAP)
6. Use of AI/ML techniques for analyzing the spectrum of ECG/EEG/PCG signals
7. Open ended assignment

# 20PEEC601LC POWER ELECTRONICS LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
In Semester : 25Marks
Practical: 25 Marks
**Credit: 1**

**Course Objectives:**

1. To demonstrate torque-speed characteristic of dc and ac motors
2. To analyze synchronization in gate drive circuits of the power converters
3. To demonstrate the applications of power converters
4. To compare the output voltage waveforms of power converters for R and R-L loads
5. To examine the power converter using simulation tool

**Course Outcomes:**

After completion of the course, students will be able to

CO1 Test synchronization in gate drive circuits of power converters
CO2 Analyse the output of power converters for different values of firing angles and duty cycles
CO3 Apply power converters for speed control of motors
CO4 Analyse the power converter performance using simulation tool

**List of Experiments:**

1. Plot torque-speed characteristics of the DC motor and Induction motor.
2. Simulation of half controlled bridge rectifier and testing the effect of firing angle change on the output.
3. Speed control of a DC motor using a half controlled bridge rectifier circuit.
4. Analysis of the output of a single phase fully controlled bridge rectifier for R, R-L load and R-L with flywheel diode.
5. Test the gate drive circuit and analyse the effect of change of duty cycle on the output of Step-down chopper. Analyse the effect of using a filter at the output.
6. Simulation and analysis of full bridge inverter.
7. Analyse the waveforms of the triggering circuit, output of power circuit and measure the output voltage of ac voltage controller.
8. Speed control of induction motor using ac to ac converter/ inverter.

# EC 4101 VLSI DESIGN

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**
1. To design combinational, sequential circuits using Verilog HDL
2. To describe behavioral and RTL modeling of digital circuits
3. To explain and compare Programmable Logic Devices
4. To introduce the concepts and techniques of digital CMOS design

**Course Outcomes:**
After completion of the course, students will be able to
1. Explain the fundamentals of Verilog HDL
2. Design digital systems using Verilog
3. Analyze the architecture of PLD's according to technology and application change
4. Analyze the impact of non ideal effects on MOSFETs
5. Design digital circuits using CMOS transistors

**Unit I: Introduction to Verilog HDL (08 )**
Trends in HDL, Design Flow, Hierarchical Modeling Concepts, Modules and Ports, Instances, Lexical Conventions, Data Types, System Tasks and Compiler Directives.

**Unit II: Verilog Constructs and Modeling Styles (08)**
Continuous Assignments, Procedural Assignments, Operators in Verilog, Conditional Statements, Loop Statements, Task and Functions. Gate-Level Modeling, Gate Type, Gate Delay, Dataflow Modeling, Delays, Expressions, Operators, and Operands, Operator Types, Behavioral Modeling, Structured Procedures, Timing Controls, Sequential and Parallel Blocks, Generate Blocks.

**Unit III: Modeling of Combinational and Sequential Logic (12)**
Adder, ALU, Multiplexer, De-multiplexer, Decoders, Comparator, Parity Generator and Checker, Flip-flops, Counters, Shift registers, Memory, modeling of FSM.

**Unit IV: Programmable Logic Devices (06)**
CPLD Architecture, features, specifications and applications. FPGA Architecture, features, specifications and applications.

**Unit V: Digital CMOS Circuits (08)**
CMOS, MOSFET parasitics, Technology scaling, Channel length modulation, Body Effect, Latch Up effect, Hot electron effect, Velocity saturation, Power dissipations, CMOS Inverter, CMOS combinational logic design, Transmission gates, Layout Design Rules.

**Text Books:**

1. S. Palnitkar, **“Verilog HDL – A Guide to Digital Design and Synthesis”,** *Pearson*, (3rd Edition), (2010).
2. Neil H. E. Weste, David Money Harris, **“CMOS VLSI Design: A Circuit & System Perspective”,** *Pearson Publication* (4th Edition), (2010).

**Reference Books:**

1. J Bhaskar, **“A Verilog HDL Primer (3/e)”,** *Kluwer*, (3rd Edition), (2005).
2. Wyane Wolf, **“Modern VLSI Design (System on Chip)”,** *PHI Publication,* (3rd Edition), (2002).

**Online Recourses:**

1. https://onlinecourses.nptel.ac.in/noc18_cs48/

# EC 4102 COMPUTER NETWORKS AND SECURITY

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. Introduce network models and functions of each layer
2. Describe basic concepts of the threats for data and network
3. Introduce the fundamentals of cryptography and network security

**Course Outcomes:**

After completion of the course, students will be able to

1. Describe and analyze the functions of layers of OSI model and compare with the TCP/IP model
2. Explain and evaluate networking protocols, inter-networking devices and their functions
3. Explain the Quality of Service parameters for Internet applications
4. Describe the threats to the data and network and the techniques to resolve them

**Unit I: Physical layer and Data Link layer (07 )**

Networks models: OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Data Transfer: DSL, Cable TV Networks. Data link control: Framing, Flow Control (Stop and Wait and Sliding Window Protocols), error control (CRC), HDLC and PPP, Multiple access: Random access (Aloha, CSMA, CSMA/CD) protocols.

**Unit II: Wired and Wireless LANS (07)**

Wired LANS: Ethernet (IEEE 802.3), Ethernet standards (Ethernet, Fast Ethernet and Gigabit Ethernet) Wireless LANS: IEEE 802.11, Bluetooth IEEE 802.15, Connecting LANS, Connecting devices, Network emulation demonstration with NIC card and MAC address on Ubuntu platform.

**Unit III: Network Layer (08)**

Network layer functions, Logical addressing: IPv4, IPv6 addresses, IPv4 to IPv6 conversion unicast routing algorithms with the protocols (RIP, OSPF and BGP), Network layer Protocols: ARP, RARP, ICMP and IGMP, demonstration of Ipconfig/all, ping, tracert commands and analysis of IPv4, IPv6, ARP and ICMP protocols using wireshark.

**Unit IV: Transport layer and Application Layer (06)**

Process to Process Communication, addressing, Transport layer protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Stream Control Transport Protocol (SCTP), Quality of services (QoS): data flow characteristics, traffic shaping, Internet Applications and protocols, Domain Name System (DNS), E-mail, FTP, HTTP, demonstration of TCP, UDP, HTTP and DNS using wireshark.

**Unit V: Data Security (06)**

Security goals, Attacks and Defense strategies, Cryptography: Substitution cipher, DES, AES and RSA algorithms, Digital signatures, Authentication protocols: One-Way Authentication, Mutual Authentication, Dictionary Attacks, Centralized Authentication, Needham-Schroeder Protocol, Kerberos.

**Unit VI: Network Security (08)**

Network, transport and application layer security, Attacks: DoS and DDoS, Session High jacking and Spoofing, ARP Spoofing and Attacks on DNS, Viruses, Worms and Malware, Virus and Worm Features.

**Text Books:**


1. Behrouz A. Foruzan, **"Data communication and Networking"**, *Tata McGraw-Hill*, (5th Edition), (2013).
2. Andrew S. Tannenbaum, **"Computer Networks"**, *Pearson Education*, (4th Edition), (2003).
3. William Stallings **"Cryptography and Network Security Principles and Practice'",** *Pearson Education* **(**7th Edition), (2017).
4. Leon-Garcia, Widjaja, **"Communication Networks",** *Tata McGraw Hill,* (2nd Edition**), (**2004).


**Reference Books:**


1. Wayne Tomasi, **"Introduction to Data Communication and Networking"**, *Pearson Education*, (1st Edition), (2007).
2. James. F. Kurouse and W. Rouse, **"Computer Networking: A Top down Approach Featuring",** *Pearson Education*, (3rd Edition), (2007).
3. William Stallings, **"Data and Computer Communication"**, *Pearson Education*, (8th Edition), (2000).
4. Greg Tomsho, Ed Tittel, David Johnson, **"Guide to Networking Essentials"**, Thomson *India Learning*, (5th Edition), (2007).


**Online Recourses:**

1. https://nptel.ac.in/courses/106105081/
2. https://nptel.ac.in/courses/106105031/
3. https://trai.gov.in/
4. https://www.itu.int/online/mm/scripts/gensel9?_ctryid=1000100560

# EC 4103 VLSI DESIGN LAB

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
Oral : 50 Marks
**Credits: 1**

**Course Objectives:**

1. To draw the layout of digital CMOS circuits using Microwind
2. To simulate, synthesize and implement combinational and sequential circuits using Verilog HDL on PLD

**Course Outcomes:**

After completion of the course, students will be able to

1. Draw and analyze the digital CMOS circuits layout
2. Design CMOS layout for any Boolean expression
3. Simulate digital circuits using Verilog and analyze its synthesis report
4. Implement digital circuits on PLD

**List of Experiments:**

A. To prepare CMOS layout in selected technology for:
   1. Inverter, NAND, NOR gates.
   2. Half Adder.
   3. 2:1 Multiplexer using transmission gates.
   4. Four variable Boolean expression.

B. To write, simulate , synthesize and implement Verilog code for:
   5. Mux and DeMux.
   6. Four bit ALU.
   7. 4 bit Up-Down Counter.
   8. Traffic light controller using FSM.

# EC4104 PROJECT PHASE I

**Teaching Scheme**
Tutorial: 02 Hours / Week

Practical: 14 Hours / Week

**Examination Scheme**
In Semester: 100 Marks
Oral: 50 Marks

**Credits: 9**

**Course Outcomes:**
After completion of the course, students will be able to
1. Identify a problem in a real-life application
2. Select an appropriate methodology to solve identified problem
3. Plan the stages for executing the project
4. Discuss and present methodology
5. Develop and test the modules

**Guidelines:**

A. **Approval of the Project Concept: -** The project should be done in a group. The Synopsis of Project's concept should be drafted and submitted for approval to the departmental committee, at the beginning of the academic year. Only after obtaining the approval, the students should start working on the Project.

B. **Guidance: -** One Guide will be assigned to each Project Group. In case of Industry-Sponsored Projects, one Guide is required to be assigned by the concerned Industry, in addition to the College Guide.

C. **Documentation of the Project-related work: -** A Log-book is required to be maintained by the students for the relevant technical documentation and logging of the tasks / activities.

D. **Reporting: -** The students should report to their Guide regularly and the Logbook should be checked and authenticated by the Guide.

E. **Expected Deliverables:-** System Design and its Simulations.

F. **Evaluation: -** A Report consisting of Literature Survey, Design Methodology etc., is required to be submitted prior to the evaluation process. The said report needs to be certified by the Guide and the department authority. The evaluation should be based on the presentation of Project's Concept and 50 percent completion of work. The said evaluation should be done by TWO EXAMINERS (Internal and External).

G. **Evaluation Criteria : -** Innovation, Depth of Understanding, Individual member's contribution, Presentation skills, Internal Guide's assessment for the work done during the semester and Report of the Project work as mentioned above.

# EC 4201 BROADBAND COMMUNICATION SYSTEMS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. To explain different components of Broadband communication system
2. To identify system design issues and the role of WDM components in advanced optical fiber communication system
3. To describe the basics of orbital mechanics and the look angles from ground stations to the satellite
4. To illustrate the satellite subsystems
5. To design Satellite Link for Up Link and Down Link

**Course Outcomes:**
After completion of the course, students will be able to
1. Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers
2. Describe optical sources and detectors and determine their performance parameters
3. Calculate link power budget and rise time budget of optical link and describe WDM components
4. Describe satellite subsystems and compute orbital parameters for satellite
5. Design of satellite uplink and downlink

**Unit I: Fiber optic communications system (07 )**
Electromagnetic Spectrum and Optical spectral bands, Key elements of fiber optic communications system, Ray theory of propagation: Fiber types, Transmission characteristics of optical fibers, Intra modal Dispersion, Intermodal dispersion.

**Unit II: Optical Sources & Detectors (06)**
Introduction to optical sources: Wavelength and Material Considerations, LEDs and semiconductor LASERs: principle of working and their Characteristics, Material Considerations, PN, P-I-N, Avalanche photodiodes and photo transistors: Principle of working and characteristics.

**Unit III: Design considerations in optical links & WDM (07)**
Point to point Links: System design considerations, Link Power budget, Rise Time budget, Analog Links: CNR, Multichannel transmission techniques, Overview of WDM, WDM Components: 2 x 2 Fiber Coupler, Optical Isolators and Circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, Diffraction Gratings, Overview of Optical Amplifiers: SOA, EDFA in brief.

**Unit IV: Orbital Mechanics and Launchers (07)**

History of Satellite Communication, Orbital Mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and Launch Vehicles, Orbital effects in Communication system performance.

**Unit V: Satellites subsystems (06)**

Satellite Subsystems, Attitude and control systems (AOCS), Telemetry, Tracking, Command and Monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment Reliability and space qualification.

**Unit VI: Satellite Communication Link Design (07)**

Introduction, Basic transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design of Specified C/N: Combining C/N and C/I values in Satellite Links, System Design Examples.

**Text Books:**

1. Gerd Keiser, **"Optical Fiber Communications",** *Tata McGraw Hill*, ($5^{th}$ Edition), (2013).
2. John M. Senior, **"Optical Fiber Communications: Principles and Practice",** *PHI,* ($3^{nd}$ Edition), (2008).
3. Timothy Pratt, Charles Bostian, Jeremy Allnutt "**Satellite Communications**", *John Wiley &Sons*, ($3^{rd}$ Edition), (2002).

**Reference Books:**

1. Djafar K. Mynbaev and Lowell L. Scheiner, **"Fiber Optic Communications Technology",** *Pearson Education*, ($1^{st}$ Edition), (2000).
2. Govind P. Agrawal, **"Fiber Optic Communication Systems",** *Wiley India*, ($3^{rd}$ Edition), (2002).
3. Dennis Roddy, "**Satellite Communications**", McGraw Hill, ($4^{th}$ Edition), (2017).

**Online Recourses:**

1. https://onlinecourses.nptel.ac.in/noc18_ee28

## PEEC 4201 MOBILE COMMUNICATION

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Lectures: 3 Hours / Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | **Credits: 3** |

**Course Objectives:**

1. To introduce the fundamentals of cellular system design and the techniques used to maximize the capacity of cellular network
2. To describe the basics of multi-path fading and various parameters used to characterize small scale fading
3. To explain various multiple access techniques
4. To explore the architecture and call processing of GSM and CDMA system

**Course Outcomes:**

After completion of the course, students will be able to

1. Explain the basics and design challenges of cellular networks
2. Analyze signal propagation issues and their impact on the communication system performance
3. Compare and determine capacity of different multiple access techniques
4. Describe the architecture, operation and call processing of GSM system
5. Describe CDMA system and analyze it's design parameters

**Unit I: Cellular Fundamentals (10)**

Introduction to wireless Communication Systems, Evolution in cellular standards, Cellular concepts, Introduction, Frequency reuse, Channel assignment, Handoff, Interference and System capacity, Trunking and Grade of service, Improving coverage and capacity.

**Unit II: Mobile Radio Propagation (10)**

Propagation Mechanism, Free space loss, Reflection, Diffraction, Scattering, Fading and Multipath, Small scale multipath propagation, Impulse response model of multipath channel, Parameters of mobile multipath channels, Types of small scale fading, Equalization techniques.

**Unit III: Coding and Multiple Access Techniques for Wireless Communications (06)**

Vocoders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec, Multiple Access Techniques, FDMA, TDMA, FHMA, CDMA, SDMA, OFDM.

**Unit IV: Global System for Mobile Communications (GSM) (07)**

Evolution of Mobile standards, System Overview, The air interface, Logical and Physical channels, Synchronization, GMSK modulation, Call establishment, Handover.

**Unit V: CDMA (07)**

System overview, Air interface, Coding, Spreading and modulation, Logical and physical channels, Handover, Comparison of WCDMA and CDMA 2000, Overview of LTE, Introduction to 5G, Comparison between 4G and 5G.

**Text Books:**


1. Theodore S Rappaport**, "Wireless Communications Principles and Practice",** *Pearson Education,* (2nd Edition), (2014).
2. Andreas F Molisch**, "Wireless Communications**"**,** *Wiley India***,** (2nd Edition), (2013)**.**


**Reference Books:**


1. Vijay K Garg, Joseph E Wilkes, "**Principles and Applications of GSM"**, *Pearson Education ,* (5th Edition), (2014).
2. *Vijay K Garg, Joseph E Wilkes,* "**IS-95CDMA and CDMA 2000 Cellular/PCS Systems Implementation"**, *Pearson Education,* (5th Edition), (2014).
3. R. Blake, "**Wireless Communication Technology",** *Thomson Delmar,* (1st Edition), (2015).
4. W.C.Y. Lee, "**Mobile Communications Engineering: Theory and applications"**, *McGraw-Hill International*, (2nd Edition), (2015).


**Online Recourses:**

1. https://onlinecourses.nptel.ac.in/noc18_ee29/

# EC 4202  BROADBAND COMMUNICATION SYSTEMS LAB

| | |
|---|---|
| **Teaching Scheme** | **Examination Scheme** |
| Practical: 2 Hours / Week | Oral : 50 Marks |
| | **Credits: 1** |

**Course Objectives:**

1. Interpret performance parameter of optical fiber
2. Describe characteristics of optical sources& detectors
3. To design optical fiber communication link
4. To understand satellite communication link

**Course Outcomes:**

After completion of the course, students will be able to

1. Compute parameters of optical fiber  NA , attenuation and bending losses
2. Illustrate characteristics of optical sources& detectors
3. Calculate link power budget and rise time budget of the optical link
4. Demonstrate satellite communication link

**List of Experiments:**

1. To measure the numerical aperture of optical fiber
2. To determine attenuation and bending loss of optical fiber
3. To Plot VI characteristics of LED used in optical fiber communication
4. Compare the performance of APD for different load resistor and biasing voltage
5. Tutorial on Power budget and time budget analysis of optical fiber system
6. Establish a direct communication link between Transmitter and Receiver for tone signal.
7. To establish satellite link between Transmitter and Receiver for audio-video signal.
8. Tutorial on satellite link design

# EC 4203 PROJECT PHASE II

**Teaching Scheme**
Tutorial: 02 Hours/Week

Practical: 16 Hours / Week

**Examination Scheme**
In Semester: 100 Marks
Oral: 50 Marks

**Credits: 10**

**Course Outcomes:**
After completion of the course, students will be able to
1. Build and Test the hardware and/or software modules
2. Achieve the intended outcome through a systematic work plan
3. Draft the report and present the outcome of project
4. Demonstrate the working project and analyze the process to achieve the results

**Guidelines:**

A. Verification of the technical design using simulation tools and other appropriate methods. The verification results should be documented in the Logbook and authenticated by the respective guide. Weekly attendance should be logged in with the respective guide and will be monitored.

B. Assembly of the system by taking into account the appropriate design considerations.

C. Testing of the assembled system and validation of the objective proposed in the Project's Synopsis. The validation results should be documented in the Logbook and authenticated by the respective guide.

D. A report mentioning the project work done during the entire academic year, is required to be submitted. The said report should be certified by the respective guide and the college Authority. The same should be presented during the exam.

E. The working of the Project's set-up should be demonstrated during the exam. The exam should be conducted by TWO Examiners (Internal and External).

# EC 4204 PROJECT BASED ONLINE COURSE

**Teaching Scheme**
Tutorial: 02 Hours/Week

**Examination Scheme**
In Semester: 50 Marks
**Credits: 02**

**Course Objective:**
To obtain the domain knowledge as required for the completion of the project

**Course Outcome:**
1. Explain the basics concepts as required to complete the project
2. Apply domain knowledge to implement the project

# HS 4101 MANAGEMENT FOR ENGINEERS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. To develop understanding about the basics of management functions
2. To explain the concept of total quality management
3. To analyze cost and financial aspect of the business
4. To develop the strategic thinking and decision making abilities in the rapidly changing global business environment

**Course Outcomes:**

After completion of the course, students will be able to

1. Explain the principles and functions of management
2. Identify social responsibility and ethical issues involved in the Organization
3. Apply tools of quality management
4. Analyze the cost, financial aspects of business and the need of globalization

**Unit I: Basics of Management** **(08 )**

Introduction, Definition of management, characteristics of management, functions of management: Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making.

**Unit II: Organizational Environments and Cultures** **(06)**

External environments, Internal environments, Ethics and social responsibility.

**Unit III: Quality Management** **(10)**

Definition of quality, continuous improvement definition of quality, types of quality, quality of design, conformance and performance, phases of quality management, Quality Management Assistance Tools: Ishikawa diagram, Pareto Analysis, Pokka Yoke (Mi stake Proofing), Quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management, The ISO 9001:2015, Quality Management System Standard, Software quality management with respect to CMM level and ISO standard.

**Unit IV: Cost and Financial Accounting** **(10)**

Basic concepts of cost accounting, Classification and analysis of costs, Marginal costing, Break-even point, Cost Volume Profit analysis, key financial statements, financial analysis.

**Unit V: Globalization (06)**

Global trends and commerce, new opportunities offered by globalization, preparation for globalization, globalization drivers, implementation issues related to globalization, quality of global leadership.

**Text Books:**


1. Stephen P. Robbins, Mary Coulter, **"Management",** *Prentice Hall of India*, (8th Edition), (2014).
2. Charles W.L Hill, Steven L McShane, **"Principles of Management",** *McGraw Hill Education, Special Indian Edition*, (2007).
3. M.Y Khan, P. K Jain, **"Financial Management"**, *McGraw Hill Education*, (8th Edition), (2018).


**Reference Books:**


1. Gail Freeman-Bell, James Balkwill, **"Management in Engineering",** *Prentice Hall of India*, (2nd Edition), (2005).
2. T. R. Banga, S.C. Sharma, **"Industrial organization and Engineering Economic",** *PHI Publication*, (25rd Edition), (2002).
3. M.C. Shukla, **"Business Organization and Management",** *PHI Publication*, (2rd Edition), (2002).
4. C. M. Chang, **"Engineering Management: meeting the Global Challenges",** Publisher: *CRC Press*, (2016).

# OE 4101 DIGITAL VIDEO PROCESSING

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**

1. To provide basic knowledge of Digital Video Processing concepts and its standards.
2. To extend numerous concepts from still 2-D images to dynamic imagery 3-D images.
3. To introduce new concepts unique to spatio-temporal data such as timeline, motion, tracking etc.

**Course Outcomes:**
After completion of the course, students will be able to

1. Analyze the importance of digital video standards over analog video standards
2. Explain the modeling of video image formation using projection theory
3. Compare the Block matching and Optical flow estimation algorithms
4. Compare different background subtraction techniques and tracking algorithms
5. Apply digital video processing concepts for development of the specific application

**Unit I: Basics of Video** **(06 )**

Analog video signal and standards, Digital video signal and standards and need of digital video, sampling of video signals

**Unit II: Time-Varying Image Formation Models** **(08)**

Three-dimensional motion models ,Rigid motion in the Cartesian Coordinates, Rigid motion in the Homogeneous Coordinates, Deformable motion, Geometric Image Formation, Perspective projection, Orthographic projection, Photometric Image Formation, Lambertian Reflectance model, Photometric effects of 3-D motion

**Unit III: 2D Motion Estimation Techniques** **(12)**

2 D motion Correspondence and Optical Flow, 2-D Motion Estimation-The Occlusion Problem, Aperture Problem, 2-D Motion Field models methods using the Optical Flow Equation-The Optical Flow Equation, Second-Order differential methods, Block motion model, Horn and Schunck method, Estimation of the Gradients, Adaptive Methods. Generalized Block motion, Block matching Method, Motion estimation.

**Unit IV: Background Subtraction techniques for moving object detection** **(06)**

Frame differencing, Mean and Median filtering, Gaussian Mixture Model (GMM), Kernel density estimation.

**Unit V: Motion Tracking** **(04)**

Basic Principles, Motion Tracking using Optical flow, blob tracking, colour feature based mean shift, Kalman tracking.

**Unit VI: Applications of Video Processing** **(06)**

Video Surveillance, Object tracking, Video Watermarking etc.

**Text Books:**

1. A. Murat Tekalp, **"Digital Video Processing"**, *Prentice Hall*, (2nd Edition), *(*2015).

**Reference Books:**

1. Yao Wang, Jorn Ostermann, Ya-Qin Zhang, **"Video Processing and Communications",** *Prentice Hall*, (2nd Edition), 2002
2. Alan C. Bovik, **"The Essential Guide to Video Processing"**, *Elsevier Science*, (2nd Edition), (2009).

**Online Recourses:**

1. Fundamentals of Digital Image and Video Processing - coursera

## OE 4201 COMPUTER VISION

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50Marks
**Credits: 3**

**Course Objectives:**

1. To explain the mapping from 3D world to 2D world
2. To describe hands on Camera calibration techniques and basics of stereo imaging
3. To describe the concepts of feature analysis and extraction techniques such as Corner detector, Scale Invariant Feature Transform
4. To introduce the concepts of machine learning

**Course Outcomes:**

After completion of the course, students will be able to

1. Analyze the image formation and working of camera as an image sensor
2. Analyze the procedure of camera calibration
3. Analyze the importance of stereo imaging
4. Compare different feature detectors and descriptors techniques
5. Apply machine learning algorithms for computer vision applications
6. Apply computer vision concepts for development of the specific application

**Unit I: Camera Calibration and Stereo Imaging (12)**

Camera calibration: pin hole, thin lens equations, FOV, DOF, CCD and COM sensor, camera parameters, camera calibration Stereo imaging: epipolar geometry, rectification, correspondence, triangulation, RANSAC algorithm, Dynamic programming.

**Unit II: Feature Detection and Descriptors (08)**

Corner detector, Edge Detector, Histogram of Gradient, Scale Invariant Feature Transform.

**Unit III: Introduction to Machine Learning for Computer Vision (13)**

Supervised and Non supervised learning, KNN, Machine learning framework, Classifiers, Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network, CNN.

**Unit IV: Applications (07)**

Non-visible-light Imagery: Infrared imaging applications, Applications of computer vision: Image mosaiking, Pedestrian classification, Image in painting.

**Text Books:**


1. M. Shah, "**Fundamentals of Computer Vision**", *Online book*, (1997).
2. D. A. Forsyth, J. Ponce**, "Computer Vision, A Modern Approach",** *Prentice Hall*, (2nd Edition), (2003).
3. R. Szeliski, "**Computer vision algorithms and applications**", *Springer-Verlag*, (2nd Edition), (2010).
4. Tom Mitchell**, "Machine Learning.. First Edition",** *McGraw- Hill*, (1st Edition), (2017).

**Reference Books:**

1. L. G. Shapiro, George C. Stockman, "**Computer Vision**", *Prentice Hall*, (1st Edition), (2001).
2. E. Trucco, A. Verri, "**Introductory Techniques for 3-D Computer Vision**", *Prentice Hall*, (1st Edition), (1998).
3. D. H. Ballard, C. M. Brown, "**Computer Vision**", Prentice Hall, (1st Edition), (1982).
4. M. Sonka, V. Hlavac, R. Boyle, "**Image Processing, Analysis, and Machine Vision**", *Thomson Press*, (3rd Edition), (2011).

# OE 4201 AUTOMOTIVE ELECTRONICS

**Teaching Scheme**
Lectures: 3 Hours / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 3**

**Course Objectives:**
1. To explain the operation of basic Automotive system components
2. To explain various sensors and their interfacing in Automotive applications
3. To describe the system view of various Automotive Control and Communication systems
4. To introduce the diagnostic methodologies and safety aspects in Automotive system

**Course Outcomes:**
After completion of the course, students will be able to
1. Explain the functioning of automotive system components and compare I. C. Engines
2. Discuss the working principle of sensors and their use in automotive applications
3. Discuss the role of automotive control systems to improve the fuel efficiency and emission quality
4. Explain diagnostic tools and their operation
5. Discuss the safety norms, standards and safety systems in modern automobiles

**Unit I: Fundamentals of Automotive Systems (10)**
Overview of Automotive System, System Components, Basics of Petrol, Diesel and Gas Engines, Evolution of Electronics in Automotive, Engine configuration and its associated components, Ignition system, Drive Train, Suspension system, Braking system, Steering system, Fuel Delivery system, Alternator and battery charging circuit, Alternative fuels, Overview of Hybrid vehicle, Introduction to autonomous Car.

**Unit II: Automotive Sensors, Actuators, Control systems (10)**
Systems approach to Control and Instrumentation : Concept of a system, Analog and Digital system, Basic Measurement system, Analog and Digital Signal Processing, Sensor characteristics, In-vehicle Sensors :Air flow sensing, Crankshaft Angular Position sensing, Throttle angle sensing, Temperature sensing, EGO sensor, Vibration sensing (in Air Bags ) , Actuators : Fuel injector, EGR actuator, Ignition system, VVT, BLDC motor, Electronic Engine Control, Engine Management System strategies and Methods of improving engine performance and efficiency.

**Unit III: Microcontrollers / Microprocessors in Automotive domain (08)**
Critical review of Microcontroller/Microprocessor, Architecture of 8-bit/16-bit Microcontrollers with emphasis on Ports, Timers / Counters, Interrupts, Watchdog Timer, PWM, Criteria to choose the appropriate microcontroller for automotive applications, Automotive grade processors.

**Unit IV: Automotive Communication Protocols (06)**
Overview of Automotive Communication Protocols, CAN, LIN, FLEXRAY, MOST,

Communication Interface with ECUs, Interfacing techniques and interfacing with infotainment gadgets, Applications of telematics in automotive domain - GPS and GPRS.

**Unit V: Safety systems in Automobiles and Diagnostics (08)**

Active Safety Systems-- Anti-lock Braking System, Traction Control System, Electronic Stability Program, Passive Safety systems – Airbag System, Advanced Driver Assistance System (ADAS), Fundamentals of Diagnostics, Self Diagnostic System, On-Board Diagnostics and Off-Board Diagnostics.

**Text Books:**

1. Williams. B. Ribbens, **"Understanding Automotive Electronics"**, *Elsevier Science, Newnes Publication*, ($6^{th}$ *Edition), (2003).*
2. Robert Bosch, **"Automotive Electronics Handbook",** *John Wiley and Sons*, (2004).

**Reference Books:**

1. Ronald K Jurgen, **"Automotive Electronics Handbook"**, *McGraw-Hill*, ($2^{nd}$ Edition), (1999).
2. James D Halderman, **"Automotive Electricity and Electronics"**, *PHI Publication* (2005).
3. Tom Denton, **"Automobile Electrical & Electronic Systems",** *Routledge*,($4^{th}$ Edition).
4. Jack Erjavec, **"A Systems Approach to Automotive Technology",** *Cengage Learning.*
5. V.A.W.Hillier, **"Fundamentals of Automotive Electronics ",** *Nelson Thornes.*
6. Tom Denton, **"Advanced Automotive Diagnosis",** *Elsevier,* ($2^{nd}$ Edition), (2006).

**Online Recourses:**

1. https://nptel.ac.in/downloads/108103009/
2. http://www.ignou.ac.in/upload/Unit-3-61.pdf

**M. Tech (E&TC)**

**Semester and Year: 1st sem 2021-22**

**Fundamentals of Artificial Intelligence Lab (20ECAI 03L)**

**List of Experiments**

| Course Outcomes | |
|---|---|
| **CO1** | **Explain the components of intelligent agents and expert systems.** |
| **CO2** | **Apply knowledge representation techniques and problem-solving strategies to AI applications.** |
| **CO3** | **Explain and analyze the search and learning algorithms** |
| **CO4** | **Describe the code of ethics for the AI systems** |

| Sr. No. | Title |
|---|---|
| 1 | Implement Tic-Tac-Toe game |
| 2 | Implement water Jug problem |
| 3 | Implement Breadth first search algorithm |
| 4 | Implement Depth first search algorithm |
| 5 | Implement A-star algorithm |
| 6 | Implement Forward Chaining for Knowledge Representation |
| 7 | Implement Ensemble Learning Algorithms (Bagging and Boosting) |
| 8 | Study and implementation of ML algorithm on Weka tool |
| 9. | Study on Code of Ethics for AI |

Dr. Mrudul Dixit

Dr. Prachi Mukherji
HOD

# 20ECAI 01: Mathematics for Artificial Intelligence

**Teaching Scheme**
Lectures: 3 Hours / Week
Tutorial:1 Hour / Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
**Credits: 4**

**Course Objectives:**

1. To interpret the types and operations on matrices and various methods of solving systems of linear equations
2. To recognize the concepts of vector space, linear independence, basis, dimension and its applications
3. To explore probability to analyze and test data
4. To explore statistical methods to analyze and test data
5. To learn multivariate calculus

**Course Outcomes:**
After completion of the course, students will be able to

1. Determine and analyze transformations of matrices and apply multiple methods to solve the systems of linear equations
2. Apply and analyze the concepts of vector space and subspace
3. Apply probability and Statistical methods for Data Analysis
4. Apply multivariate calculus to solve given problems

**Unit I: Linear Algebra (08)**
Scalars, Vectors, Matrices and Tensors, Rank of a matrix, use of echelon form and canonical form of a matrix to find rank, Inverse matrix to solve system of linear equations, Types of Matrices, classification of real and complex matrices, trace, quadratic form, Lower-Upper decomposition (LDU).

**Unit II: Vector Spaces (09)**
Vector Space, vector sub-space, basis and dimension, Linear dependence and independence of vectors, orthogonality, Orthogonal Projections, Gram-Schmidt orthogonalization Procedure, Eigen values and Eigen vectors, Principal Component Analysis (PCA), Singular Value Decomposition (SVD).

**Unit III: Probability and Random Variables (10)**
Probability, conditional probability, marginal probability, Bayes‟ theorem, Maximum Likelihood Estimation (MLE), Maximum A Posteriori estimation (MAP), Random variables, variance, expectation, Probability density function, histogram, Cumulative distribution function, standard probability density functions, probability distributions.

**Unit IV: Multivariate Calculus (09)**
Differential and Integral Calculus, Partial Differentiation, chain rule, Vector-Values Functions, Gradient, Jacobian and Hessian approach.

**Reference Books:**


1. Howard A, Chris R, **"Elementary Linear Algebra Applications Version"**, *Wiley-India*, (10th Edition), (2016).
2. Gilbert Strang, **"Linear Algebra and its Applications"**, (4th Edition), (2008), (10th Indian reprint), (2011) *Cengage Learnin.*
3. David C. Lay, **"Linear Algebra and Its Application"**, *Pearson Education*, (3rd Edition), (2002).

4. P. Z. Peebles, **“Probability, Random Variables and Random Signal Principles”**, *Tata McGraw- Hill*, (4th Edition), (2013).
5. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, **“Mathematics for Machine Learning”**,*Cambridge University Press*, (1st Edition), (2020).
6. Seymour Lipschutz, Marc Lars Lipson, **“**Linear Algebra**”**, Schaum's Outline, *McGraw-Hill*, (4th Edition), (2009).
7. S. M. Ross, **“**Introduction to Probability and Statistics for Engineers and Scientists**”**, *Academic Press*, (3rd Edition), (2005).

## 20ECAI 03 Fundamentals of Artificial Intelligence

**Teaching Scheme Examination Scheme**

Lectures: 3 Hrs / Week | In Semester: 50 Marks

End Semester: 50 Marks

**Credits: 3**

**Course Objective:**

1. To explain the basics of Artificial Intelligence (AI)
2. To introduce various types of algorithms useful in AI
3. To explain the concepts of machine learning, pattern recognition and their applications in the field of AI
4. To explain the code of ethics for AI

**Course Outcomes:**

After completion of the course, students will be able to

1. Explain the components of intelligent agents and expert systems
2. Apply knowledge representation techniques and problem solving strategies to AI applications
3. Explain and analyze the search and learning algorithms
4. Describe the code of ethics for the AI systems

**Unit I : Basics of AI (04)** Categories of AI, applications of AI, intelligent agents, agents and environments, good behavior, the nature of environments, structure of agents.

**Unit II : Problem Solving and Constraint Satisfaction Problems (07)**

Problem solving agents, searching for solutions, uninformed search strategies, Informed search strategies, heuristic function, local search algorithms and optimistic problems, optimal decisions in games, Alpha Beta Pruning, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP.

**Unit III : Knowledge Representation (07)**

Logic, Propositional logic, First order logic, Knowledge engineering in first order logic, inference in first order logic, prepositional versus first order logic, forward chaining, backward chaining, resolution, knowledge representation, uncertainty and methods, Bayesian probability and belief network, probabilistic reasoning, Bayesian networks, inferences in Bayesian networks.

**Unit IV : Learning** **(06)**

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Statistical learning methods, Learning with hidden variable, EM algorithm, Neural networks

**Unit V : Expert Systems** **(07)**

Introduction to Expert System, Architecture and functionality, Examples of Expert system, Basic steps of pattern recognition system, Feature Extraction- Principal Component Analysis, Linear Discriminant Analysis, Object Recognition- Template Matching theory, Prototype Matching Theory, Pattern Mining.

**Unit VI: Code of Ethics for AI** **(05)**

Privacy and Surveillance, Manipulation of Behavior, Opacity of AI Systems, Bias in Decision Systems, Human-Robot Interaction, Automation and Employment, Autonomous Systems, Machine Ethics, Artificial Moral Agents Privacy.

**Reference Books:**


1. Stuart Russell, Peter Norvig, **'Artificial Intelligence", A Modern Approach '**, *Pearson Education/Prentice Hall of India,* (3rd Edition), (2010)
2. Elaine Rich, Kevin Knight and Shivshankar Nair, **'Artificial Intelligence'**, *Tata McGraw Hill,* (3rd Edition), (2009)
3. Paula Boddington**, „Towards a Code of Ethics for Artificial Intelligence", ***Springer international Publishing***,** (1st Edition), (2017)
4. Nils J. Nilsson, **'Artificial Intelligence: A new Synthesis'**, *Morgan Kaufmann Publishers,* (1st Edition) (1998)
5. George F. Luger, **'Artificial Intelligence: Structures and Strategies for Complex Problem Solving ',** *Pearson Education,* (6th Edition), (2008)
6. NPTEL Lectures on AI : http://nptel.ac.in/courses/106105077/

**7.** https://plato.stanford.edu/entries/ethics-ai/

**8.** https://intelligence.org/files/EthicsofAI.pdf

## 20ECAI 04 Machine Learning

**Teaching Scheme:**

Lectures: 3 Hrs./Week

**Examination Scheme:**

In-Semester: 50Marks

End-Semester: 50 Marks

**Credits: 3**

**Course Objectives:**

1. To learn machine learning paradigms used for regression and classification.
2. To analyze various machine learning algorithms.
3. To know use of software tools for implementation of machine learning algorithms

**Course Outcomes:**

After completion of the course, students will be able to-

1. Make use of the software tool to handle univariate and multivariate data.
2. Apply suitable data pre-processing and data visualization method to interpret data and select suitable features.
3. Compare and contrast different supervised and unsupervised machine learning techniques with their advantages and limitations.
4. Select a suitable classifier to build classification and recognition system.
5. Apply various dimensionality reduction methods to extract important features from the input data.
6. Apply various machine learning techniques for real-world prediction, classification and clustering problems.

**Unit – I: Foundations of Machine learning (07)**

Machine-Learning Problem, Designing a learning system, Examples of Machine Learning, Machine Learning Applications across different industries, Types of machine learning. Basic concepts in machine learning- parametric and non-parametric methods, Overfitting and Underfitting, Bias and Variance, Optimization and Cost function, Performance measures.

Tools for ML, Python essentials: Editors, Primitive Data types, Data structures, Numpy, Scipy, Pandas, Matplotlib, Scikit-learn.

**Unit –II: Data Interpretation (10)**

Machine learning pipeline, Feature Engineering for ML, Data types- numerical and categorical, Data wrangling- filtering, pre-processing, typecasting, transformation, feature selection, Data visualization- Descriptive statistics, Frequency tables, Creating graphs, Data analysis- Univariate and Bivariate analysis, Statistical methods- Central tendencies and variance, Boxplot, Outliers; Applications of ML in Predictive modelling.

**Unit – III: Supervised learning** **(10)**

Two-class and Multiclass learning problems, Regression- linear and logistic, Model selection and generalization, Outlier detection, Cross Validation. Classification, K-Nearest Neighbour algorithm, Support Vector Machines, Decision trees, Random Forests; Naïve Bayes classifier, Neural Networks, Applications of ML in Classification.

**Unit – IV: Unsupervised learning** **(09)**

Dimensionality reduction- Principal Component Analysis (PCA), Independent Component Analysis (ICA), Singular Value Decomposition (SVD); Clustering: k-Means, Mean-shift, Hierarchical Clustering, Expectation–Maximization (EM) using Gaussian Mixture Models (GMM), Applications of ML in Clustering.

**Reference Books:**

1. Christopher Bishop, '**Pattern Recognition and Machine Learning'**, *Springer*, ($1^{st}$ Edition), (2007).

2. Tom Mitchell, '**Machine Learning'**, *McGraw Hill Education Ltd., Ed*., ($1^{st}$ Edition), (2013).

3. Ethem Alpaydin, '**Introduction to Machine Learning**', *MIT Press*, ($2^{nd}$ Edition), (2010).

4. Kevin Murphy, '**Machine Learning: A Probabilistic Perspective'**, *MIT Press*, ($1^{st}$ Edition), (2012).

5. Andreas C. Miller and Sarah Guido, '**Introduction to Machine Learning with Python- A Guide for Data Scientists**', *O'Reilly Media, Inc*., ($1^{st}$ Edition), (2017).

| 20ECAI 04L MACHINE LEARNING LAB | | | |
|---|---|---|---|
| **Teaching Scheme** | | | **Examination Scheme** |
| **Practical**: 2 Hours/Week | | | **Practical**:25 Marks |
| | | | **Credits: 1** |

**Course Objectives:**

| | |
|---|---|
| 1. | To explain the basics of Python Programming Language |
| 2. | To learn the concepts of Machine Learning (ML) for data visualization and analysis |
| 3. | To examine ML techniques for regression and prediction problems |
| 4. | To apply ML algorithms for classification and clustering problems |

**Course Outcomes:**

After completion of the course, students will be able to

| | |
|---|---|
| CO1 | Apply Python programming for reading and visualizing real-world data |
| CO2 | Analyze clean data by preprocessing raw data and perform descriptive statistical computations |
| CO3 | Develop an algorithm to apply regression analysis on real world datasets |
| CO4 | Analyze performance of classification and clustering algorithms on real world datasets |
| CO5 | Examine dimensionality reduction on various types of data |

**List of Experiments:**

| | |
|---|---|
| 1. | A) Introduction to Python programming, and editors,<br>B) Visualize the given data using various plotting techniques |
| 2. | A) Calculate the central tendencies for the given data and select the suitable measure to describe the data,<br>B) Calculate the dispersion and select the suitable measure of dispersion |
| 3. | Apply data preprocessing, data cleaning on the given .csv data using Pandas |
| 4. | Perform regression analysis on the randomly generated data/ real-world data |
| 5. | Apply SVM on real-world dataset, perform classification and evaluate the performance |
| 6. | Implement k-Nearest Neighbor and Naive Bayes on Iris dataset and compare performance |
| 7. | Perform dimensionality reduction on the given data using Principal Component Analysis |
| 8. | Apply unsupervised learning to perform clustering on the given dataset |

# 20ECAI 05L Natural Language Processing Lab

**Teaching Scheme**
Practical: 2 Hours / Week

**Examination Scheme**
Oral: 25 Marks
**Credits: 1**

**Course Objectives:**

1. Understand stages of Text pre-processing
2. Describe Sequential networks
3. Implement language models

**Course Outcomes:**

After completion of the course, students will be able to

1. Describe the fundamental concepts and techniques of natural language processing.
2. Apply preprocessing techniques to text
3. Describe parsing techniques for text processing
4. Apply sequential network for language modeling

**List of Experiments:**

1. To apply Tokenization for a given sentence by using the NLTK library
2. Apply NLTK pos tag for sample text
3. Apply TF-IDF vectorization for a given text
4. Apply the word2vec model for a given text
5. Implement sequential network

Case studies:

6. Time series forecasting
7. Language models

20ECAI 05 Natural Language Processing

Teaching Scheme: Examination Scheme:
Lectures: 3 Hrs/Week In-Semester: 50 Marks
End-Semester: 50 Marks
Credits: 3

Course Objectives:
1. To understand various aspects of Natural Language Processing
2. To learn Phonological, Morphological, Syntactic and Semantic processing
3. To understand issues related to ambiguity of Natural Language
4. To understand the advanced applications of Natural Language Processing

Course Outcomes:
After completion of the course, students will be able to
1. Explain the importance of Natural Language Processing
2. Identify the fundamental concepts and techniques of Natural Language Processing
3. Analyze ambiguous structure of Natural Language
4. Summarize the advanced applications of Natural Language Processing

Unit I: Introduction to Natural Language Processing Fundamentals of Phonetics (09)
The Study of Language, Evaluating language Understanding Systems, Different levels of Language Analysis, Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Phonological Categories and Pronunciation Variation, Phonetic Features

Unit II: Fundamentals of Syntax (09)
The elements of Noun Phrases, Verb Phrases, Adjective Phrases, Adverbial Phrases and

SimpleSentences, Grammars and Sentence Structure, Construction of a Good Grammar, A Top-DownParser, A Bottom-Up Chart Parser, Top-Down Chart Parsing, Part-of-Speech Tagging.

Unit III: Fundamentals of Semantics and Discourse (10)
Word Senses, Relations between Senses, WordNet, Word Sense Disambiguation, The Need forDiscourse Structure, Segmentation and Cue Phrases, Discourse Structure and Reference, Relating Discourse Structure and Inference, Discourse Structure, Tense and Aspect, Managingthe Attentional Stack, Concept of Pragmatics.

Unit IV: Applications of Natural Language Processing (08)
Machine Translation, Sentiment Analysis, Question Answering Systems, Cross LingualInformation Retrieval, Natural Language Interface to Database, Extractive and AbstractiveSummarization Systems, Indian Language WordNets.

Reference Books:
1. Jurafsky, David, James H. Martin, „Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition‟, Pearson Education Limited, Dorling Kindersley(India) Pvt. Ltd., (2014)
2. James Allen, „Natural Language Understanding‟, Pearson Education Limited, Dorling indersley (India) Pvt. Ltd. (Indian Subcontinent Version)(2007)
3. Manning, Christopher D., Hinrich Schütze, „Foundations of Statistical Natural Language Processing‟, Cambridge Publication,(1999)
4. Steven Bird, ewan Klein, and Edward Loper, „Natural Language Processing with Python‟, O'Reilly Media, (2009)

# 20ECAI 07 Artificial Intelligence in Wireless Communications

**Teaching Scheme:**

Lectures: 3 Hrs/Week

**Examination Scheme:**

In-Semester: **50**Marks

End-Semester: **50** Marks

**Credits: 3**

**Course Objectives:**

1. To understand the cognitive radio systems in wireless communication
2. To understand artificial intelligence techniques applied in Wireless Communications
3. To understand functions of the software defined radio.
4. To understand multi-objective optimization of Radio Resources.

**Course Outcomes:**

After completion of the course, students will be able to

1. Describe Cognitive radio architecture, Cognitive engine design and its components
2. Discuss artificial intelligence techniques applied in Wireless Communications
3. Interpret basics of Software Defined Radio
4. Discuss Multi-objective Optimization of Radio Resources.
5. Analyse an algorithm to perform the multi-objective analysis.

**UNIT I: Overview of Cognitive Radio and the Cognitive Engine**: **(07)**

Concept of Cognitive Radio, Cognitive Radio history. The Cognitive Engine: Cognitive Radio Design, Cognitive Engine Design, Component Descriptions – Sensors, Optimizer, Decision Maker, Policy Engine, Radio Framework, User Interface, Cognitive Controller Configuration.

**UNIT II: Artificial Intelligence in Wireless Communications:** **(07)**

Artificial Intelligence Techniques- Neural Networks, Hidden Markov Models (HMM), Fuzzy Logic, Evolutionary Algorithms, Case-Based Reasoning

**UNIT III: Overview and Basics of Software Defined Radios:** **(07)**

Background, Benefits of Using SDR, Problems Faced by SDR, GNU Radio Design - The Universal Software Radio Peripheral, The USRP Version 2, Flow Graphs, Parallel Programming in GNU Radio, Flow Graph for Simulation and Experimentation.

**UNIT IV: Optimization of Radio Resources:** **(07)**

Objective Space, Multi-objective Optimization: Objective Functions, Bit Error Rate (BER), Bandwidth (Hz), Spectral Efficiency (bits/Hz), Interference, Signal to Interference Plus Noise Ratio (SINR), Throughput, Power, Computational Complexity. Multi-objective Optimization: A Different Perspective, Multi-objective Analysis- Utility Functions, Population-Based Analysis

**UNIT V: Genetic Algorithms for Radio Optimization:** **(08)**

Example: The Knapsack Problem, Multi-objective GA, Wireless System Genetic Algorithm –Details of Chromosome Structure, Objective Function Definition, Optimal Individual Selection.

**REFERENCES BOOKS:**


1. Thomas W.Rondeau and Charles W. Bostian, **'Artificial Intelligence in Wireless Communications'**, *Artech House*, (1st Edition), 2009
2. Joseph Mitola III, **'Software Radio Architecture: Object-Oriented Approaches To Wireless System Engineering'**, *John Wiley & Sons Ltd.*, (1st Edition), 2000
3. Simon Haykin, **'Cognitive Radio: Brain –Empowered Wireless Communications'**, *IEEE Journal on Selected Areas in Communications*, (Feb 2005)
4. D. E. Goldberg, **'Genetic Algorithms in Search, Optimization, and Machine Learning, Reading',** *MA: Addison-Wesley*, (1st Edition), 1989

# 20ECAI 08  Deep Learning

**Teaching Scheme:**

Lectures: 3 Hrs./Week

**Examination Scheme:**

In-Semester: 50 Marks

End-Semester: 50 Marks

**Credits: 3**

**Course Objectives:**

1. To learn basics of neural networks and deep learning.
2. To understand training of deep neural networks and L-layers.
3. To know various CNN architectures and perform transfer learning.

**Course Outcomes:**

After completion of the course, students will be able to-

1. Apply modern software tools and libraries for deep learning to train on large data.
2. Build and train L-layer deep neural network.
3. Make use of hyperparameter tuning and regularization methods for optimized model performance.
4. Design a convolutional neural network for image recognition, classification applications.
5. Apply transfer learning to train deep neural network for real-world applications.
6. Evaluate the performance of trained models using cost function and cross validation.

**Unit – I: Introduction to Deep learning (08)**

Machine learning Vs. Deep learning, Feedforward neural networks, Multi-layer perceptron (MLP), Shallow neural networks and Deep neural networks, Activation functions, Gradient descent and Backpropagation algorithm, Deep learning frameworks (Keras, TensorFlow, PyTorch, Caffe, Theano), Tensor representation, Building neural network architecture using TensorFlow; Role of GPU in deep learning.

**Unit –II: Tuning Deep Networks (10)**

L-Layers of Deep NN, Effect of adding hidden layers, Preparation of dataset, Bias and Variance, Dataset Augmentation, Overfitting, Regularization, Dropout, Early Stopping, Parameter Tying and Parameter Sharing, Weight initialization, Learning rate, ReLU and Softmax Function, Stochastic Gradient Descent (SGD), Batch and Mini Batch, Optimizers- Momentum, RMSProp, Adam; Cost functions.

**Unit – III: Convolutional Neural Network** **(10)**

Convolutional Neural Network (CNN) architecture, Building blocks of CNN, Convolution operation and layer, Kernels and Filters, Pooling layer, Stacking of layers, Vanishing/Exploding Gradients, Training of CNN, Accuracy and loss, Cross-validation, Image classification examples using Deep Convolutional Neural Network.

**Unit – IV: Transfer learning and Applications of Deep learning** **(08)**

Understanding and visualizing Convolutional Neural Networks, Modern CNN architectures- LeNet, AlexNet, VGG, GoogleNet, Inception, ResNet, U-Net; Transfer learning from modern CNN architectures.

Deep learning for medical image interpretation, Deep learning for computer vision- object detection and recognition, Deep learning for sequence data and text data- Introduction to RNN, LSTM.

**Reference Books:**

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, **'Deep Learning'**, *MIT Press*, (1st Edition), (2016).

2. Francois Chollet, **'Deep Learning with Python',** *Manning Publications,* (1st Edition), (2018).

3. Phil Kim, '**MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence'**, *Apress*, (1st Edition), (2017).

4. Josh Patterson and Adam Gibson, '**Deep Learning- A Practitioner's Approach**', O'Reilly Media, (1st Edition), (2017).

5. Laurene Fausett, **'Fundamentals of Neural Networks: Architectures, Algorithms and applications'**, *Pearson Education*, (1st Edition), (2008).

# 20ECAI 08L DEEP LEARNING LAB

| | | | |
|---|---|---|---|
| **Teaching Scheme** | | | **Examination Scheme** |
| Practical: 2 Hours /Week | | | Practical: 25 Marks |
| | | | **Credits: 1** |

**Course Objectives:**

| | |
|---|---|
| 1. | To apply python programming for implementing Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) |
| 2. | To learn deep learning frameworks and Python libraries used for deep learning |
| 3. | To apply ANN, CNN and RNN algorithms to solve real-world problems |

**Course Outcomes:**

After completion of the course, students will be able to-

| | |
|---|---|
| CO1 | Train neural networks and apply hyperparameter tuning for deep neural networks |
| CO2 | Select and apply a suitable Convolutional Neural Network architecture to solve real-world image classification, object recognition problems |
| CO3 | Develop an algorithm for text processing and time series prediction using Recurrent Neural Networks and Long Short-Term Memory |
| CO4 | Analyze performance of deep learning models using different evaluation metrics |

**List of Experiments:**

| | |
|---|---|
| 1. | Develop a neural network model (Feed-forward/Perceptron neural network) and apply the model for class prediction problem |
| 2. | Develop a multi-layer feed-forward neural network to solve binary classification problem |
| 3. | Analyze neural network performance through visualization |
| 4. | Develop a multi-layer feed-forward neural network to solve multi-class classification problem |
| 5. | Develop an algorithm and write a program for object recognition using Convolutional Neural Network (CNN) |
| 6. | Develop an algorithm and write a program for IMDb review classification using RNN and LSTM |
| 7. | Mini Project on Applications of CNN: Image classification/ Object recognition/ Image segmentation |
| 8. | Mini Project on develop an application for Semantic segmentation/ Face recognition/ Object detection using transfer learning |
| 9. | Mini Project on applications of RNN and LSTM for Image captioning/ Sentiment analysis/ Stock prediction |

20ECAI 09 Research Methodology

Teaching Scheme: Examination Scheme:

Tutorial: 1 Hr /Week In-Semester: 25Marks

Credits: 1

Course Objectives:

1. To understand basic concepts of research and research methodology
2. To understand principles behind Research Problem formulation
3. To study Instrumentation schemes for Data collection
4. To prepare a research/ project proposal

Course Outcomes:

After completion of the course, students will be able to

1. Formulate Research Problems
2. Design and Analyze schemes for Data collection
3. Write research proposals
4. Write Technical Papers

Unit I: Research Problem (03)

Research and research problem, sources of research problem, criteria / Characteristics of a good research problem, Literature Review, Scope and objectives of research problem, Hypothesis its importance and construction, Selecting a sample.

Unit II: Data Collection Design (03)

Data Collection, Form design and Data processing.

Unit III: Research Proposal (04)

Developing a Research Proposal and writing a research report. Format of research proposal, Individual research proposal, Institutional proposal, Report writing, Technical Paper writing.

Reference Books:

1. S. Melville, W. Goddard, „Research Methodology: An introduction for Science & Engineering students‟, Juta and Company ,(1st Edition), (1996)

2. R. Kumar, „Research Methodology: A Step by Step Guide for Beginners‟, Pearson Education, (2nd Edition), (2005)

3. Dr. C. R. Kothari, „Research Methodology: Methods and Techniques‟, New Age Publication, (2nd Edition), (2010)

4. R. Panneerselvam, „Research Methodology‟, PHI Learning, (2nd Edition), (2014)

## 20ECAI 06 Data Analytics

**Teaching Scheme**: Lectures: 3 Hrs/Week

**Credits: 3**

**Examination Scheme:**

In-Semester: **50** Marks

End-Semester: **50** Marks

**Course Objectives:**

1. To understand the concepts, challenges and techniques of Big Data and Big Data Analytics
2. To introduce the concepts of Hadoop, Map Reduce framework and "R" for Big Data Analytics
3. To teach students to apply skills and tools to manage and analyze Big Data

**Course Outcomes:**

After completion of the course, students will be able to

1. Design and manage a Big Data application using Hadoop technology framework
2. Collect, manage, store, query and analyze various forms of Big Data using Map-Reduce and other Big Data tools
3. Apply Big Data Analytics tools for business decisions and strategy definition
4. Implement solutions to some of the open Big Data problems using R
5. Compare various Data Analytic Methods and trends

**UNIT I: Introduction (06)**

Database Management Systems, structured data, SQL, Big data overview, characteristics of Big Data, applications of Big Data, Unstructured data, NOSQL, advantages of NOSQL, Comparative study of SQL and NOSQL.

**UNIT II: Big Data Architecture, Hadoop (06)**

Challenges enabling real time big data processing, Hadoop – Introduction, building blocks of hadoop, Installing and configuring Hadoop.

**UNIT III: MapReduce Fundamentals (06)**

Components of Hadoop, HBASE, HIVE, Map Reduce Working, the Mapper and Reducer, InputFormats and OutputFormats, Introduction to HBASE, Sqoop, Spark.

**UNIT IV: Big Data Analytics (06)**

Data Analytical architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach, Data Analytic Life Cycle: Discovery, Data preparation, Model planning, Model Building, Communicate results, Operationalize, Case Study: Global Innovation Network And Analysis (GINA).

**UNIT V: Analytics using R (06)**

R Fundamentals: Math, variables, strings, vectors, factors, vector operations, Data structures in R: Arrays and amp, Matrices, lists, data frames, R programming fundamentals: Conditions and loops, functions in R, Objects and Classes, Working with data in R: Reading CSV and Excel files, reading text files, writing and saving data objects to file in R.

**UNIT VI: Data Analytic Methods and Trends (05)**

Statistical Methods, Machine learning methods – supervised, unsupervised, Recommendation systems, Big data visualization, Open source Tools / Techniques / Languages (R, Python)

**Reference Books:**

1. Vignesh Prajapati, "**Big Data Analytics with R and Hadoop**", *Packt Publishing*, (November 2013)

2. "**Data Science and Big Data Analytics**", *Wiley*, ($1^{st}$ Edition), (January 2015)

3. Abraham Silberschatz, Henry Korth, S. Sudarshan, "**Database Systems Concepts**", *McGraw Hill Education (India) Pvt Ltd,* ($6^{th}$ Edition), (December 2013)

4. Arvind Sathi, "**Big Data Analytics: Disruptive Technologies for Changing the Game**", *MC Press* (November 2012)

5. Viktor Mayer-Schonberger, Kenneth Cukier, "**Big Data: A Revolution that will transform how we live, work, and think**", *Hodder and Stoughton*, (October 2013)

6. J. Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "**Big Data for Dummies**", *John Wiley & Sons, Inc.* ($1^{st}$ Edition), (April 2013)

7. Tom White, "**Hadoop: The Definitive Guide**", *O'Reilly*, (3rd Edition), (June 2012)

# 20PEECAI01AL Digital Image Processing lab

| Sr. No. | Title |
|---|---|
| 1 | To create a digital image using matlab |
| 2 | To perform colour model conversions using matlab |
| 3 | To perform Histogram Equilization using python |
| 4 | To apply smoothing filters on images using python |
| 5 | To perform segmentation using edge detection using python |
| 4 | Image segmentation using thresholding |
| 5 | To perform a) Image segmentation using k-means algo<br>b) Harris corner detection<br>c) HOG feature detection<br>d)GLCM of an image |
| 6 | (Continued) To perform a) Image segmentation using k-means algo<br>b) Harris corner detection<br>c) HOG feature detection<br>d)GLCM of an image |
| 7 | Mini project to develop an application in DIP |
| 8 | Mini project to develop an application in DIP |

## 20PEECAI 01 Digital Image Processing

Teaching Scheme: Examination Scheme:
Lectures: 3 Hrs /Week In-Semester: 50 Marks
End-Semester: 50 Marks
Credits: 3

Course Objectives:
1. To understand image fundamentals and mathematical operations performed on images
2. To learn image enhancement techniques
3. To understand different image segmentation techniques
4. To study image Representation and Description techniques
5. To study applications of image processing and AI applications of Image Processing

Course Outcomes:
After completion of the course, students will be able to
1. Describe image processing fundamentals and implement basic mathematical operations on digital
images
2. Apply image enhancement techniques in spatial and frequency domain
3. Implement segmentation techniques
4. Implement and analyze feature extraction and feature description techniques
5. Apply image processing and AI techniques to develop different applications

Unit I: Digital Image Fundamentals (03)
Elements of visual perception, Human Visual system, Image sensing and acquisition, image sampling
and quantization, Basic relationship between pixels, neighbors of a pixel, Types of images, Color
models – RGB, CMY, YIQ, HSI, Statistical parameters.

Unit II: Image Enhancement (04)
Image Enhancement: Spatial domain methods, intensity transformations, histogram processing, Spatial filtering - smoothing filter, sharpening filter. Frequency domain filtering: low pass filtering, high pass filtering.

Unit III: Image Segmentation (10)
Thresholding, histogram based segmentation, Edge based segmentation, Clustering, Region growing,
region splitting, watershed algorithm.

Unit IV: Image Feature Detectors and Descriptors (10)
Corner detectors, blob detector, SIFT, HOG, GLCM.

Unit V: Applications of Image Processing (09)
Face detection using Viola Jones algorithm, QR code recognition, Applications of AI in Image restoration, photo editing, old image colouring.

Reference Books:

1. R.C. Gonzalez, R.E. Woods, „Digital Image Processing‟, Pearson Education, (3rd Edition), (2014)
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar „Digital Image Processing‟, McGraw-Hill, (1st Edition), (2009)
3. K. Jain, „Fundamentals of Digital Image Processing‟, Prentice Hall, (3rd Edition), (2004)
4. W.K. Pratt, „Digital Image Processing‟, John Wiley & sons, (3rd Edition), (2006)
5. Narendra Kumar Kamila, „Handbook of Research on Emerging Perspectives in Intelligent Pattern Recognition, Analysis and Image Processing‟, IGI Global, (1st Edition), (2016)

## 20PEECAI 02 Computer Vision

**Teaching Scheme:**
Lectures: 3 Hrs./Week

**Examination Scheme:**
In-Semester: **50**Marks
End-Semester: **50** Marks
Credits: **3**

**Course Objectives:**

1. To understand computer vision fundamentals and applications
2. To understand feature detection, matching and image recognition applications
3. To learn image segmentation, motion estimation, activity recognition tasks

**Course Outcomes:**

After completion of the course, students will be able to-

1. Describe the computer vision system and its applications
2. Identify image features and apply feature detection and matching methods
3. Detect objects and pedestrian for autonomous vehicles
4. Apply image segmentation techniques for medical imaging applications
5. Apply motion estimation algorithms to detect and track motion in video
6. Build a computer vision system for gesture recognition

**Unit I: Computer Vision for Autonomous vehicles (09)**

Self-Driving cars, Advanced Driver Assistant System- Tasks and Challenges, Case study- Lane detection, Pedestrian detection from the road scene..

**Unit II: Computer Vision for Disease Diagnosis (09)**

Medical imaging- X-ray, CT and MRI; Case study- Medical image segmentation for Tumour detection, Tumour classification as cancerous or non-cancerous.

**Unit III: Computer Vision for Video Surveillance (10)**

Surveillance and vision based tasks, Foreground-Background Separation, Background Subtraction and Modelling, Motion tracking- Optical Flow. Case study- Human activity recognition.

**Unit IV: Computer Vision for Gesture Recognition (08)**

Human Computer Interaction (HCI), Hand gestures, Detection- color and shape features, Tracking, feature matching, Gesture Recognition system using Convolutional Neural Networks.

**Reference Books:**


1. Richard Szeliski, „Computer Vision: Algorithms and Applications", Springer-Verlag London Limited, (1 st Edition), (2011)
2. D. A. Forsyth, J. Ponce, „Computer Vision: A Modern Approach", Pearson Education, (1st Edition), (2003)
3. L. G. Shapiro, George C. Stockman, „Computer Vision", Prentice Hall, (1 st Edition), (2001)
4. E. Trucco, A. Verri, „Introductory Techniques for 3-D Computer Vision", Prentice Hall (1st Edition), (1998)
5. 5. M. Shah, "Fundamentals of Computer Vision," Online book (1997)

MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

**Autonomous Program Structure of**
**Second Year B. Tech. Third Semester**
**(Instrumentation & Control Engineering)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Oral | Practical | | |
| 20BSIN301 | Transform Calculus and Statistics | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN301 | Sensors and Transducers | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN302 | Industrial Instrumentation | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN303 | Analog and Digital Electronics | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20HS301 | Universal Human Values-II | 2 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN301L | Sensors and Transducers Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IN302L | Industrial Instrumentation Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20IN303L | Analog and Digital Electronics Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IN304L | Programming Practice Lab | 0 | 0 | 4 | 25 | 0 | 0 | 25 | 50 | 2 |
| 20AC301 | Audit Course | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | No Credit |
| | **Total** | **14** | **5** | **11** | **350** | **250** | **25** | **75** | **700** | **24** |
| | **Grand Total** | **30** | | | **700** | | | | **700** | **24** |

**APPROVED BY**
Secretary Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

CUMMINS COLLEGE OF ENGINEERING FOR WOMEN
KARVE NAGAR, PUNE-411 052

**APPROVED BY**
Chairman Governing Body
MKSSS's Cummins College of Engineering
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## 20BSIN301 Transform Calculus and Statistics

**Teaching Scheme:**
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

**Prerequisites:**
1. Basics of integral and multiple integral.
2. Beta function, Gamma function.
3. Partial fractions.
4. First order linear differential equation.
5. Basic statistics and basic probability

**Course Objectives:**
Mathematics is a necessary path to scientific knowledge which opens a new perspective of mental activity. Our aim is to provide sound knowledge of engineering mathematics to make the students think mathematically and strengthen their thinking power to analyze and solve engineering problems in their respective areas.

**Course Outcomes:**
On completion of this course the students will be able to,
1. Obtain Laplace Transform of given functions, solve differential equations using Laplace Transform.
2. Obtain Fourier transform and Z transform for discrete sequences.
3. Obtain the solution of higher order Linear differential equations
4. Apply concepts of Statistics to interpret given data, calculate probabilities of random events.

**Unit 1: Laplace Transforms (07)**
Definition of Laplace Transform, Inverse Laplace transforms (LT), Properties and theorems, LT of standard functions, LT of some special functions viz. periodic, unit step, unit impulse, application of LT for solving Differential Equations, electrical circuits,

**Unit 2: Fourier Transforms (07)**
Periodic functions, Dirichlet's condition, Complex form of Fourier series, Introduction to continuous Fourier Transforms, basics of Sequences, Discrete Fourier Transforms (DFT) of standard sequences, Existence of DFT, Properties of DFT, Inverse DFT.

**Unit 3: Z- Transform (07)**
Definition, standard properties, Z- Transform of standard sequences, Inverse Z – Transform using standard results, Inversion integral method, solution of difference equation, Relation between Fourier , Z and Laplace Transforms.

**Unit 4: Higher Order Linear Differential equation and application (07)**
Higher order linear differential Equation with constant coefficients, complementary function, Particular integral, short cut methods, Method of variation of parameter. Cauchy's and Legendre's D.E., Modelling of electrical circuits.

**Unit 5: Statistics** **(06)**
Measures of central tendency, Standard deviation, Coefficient of Variation, Covariance, Correlation and Linear Regression, Moments, Skewness, Kurtosis

**Unit 6: Probability and Probability Distribution** **(08)**
Theorems on probability, Random Variables – Discrete & continuous, Mathematical expectations, Probability density functions, Standard discrete and continuous distributions like Binomial, Poisson, Normal, Introduction to Testing of hypothesis, Chi-square distribution test.

**Text Books:**

1. B. V. Ramana, 'Higher Engineering Mathematics', Tata McGraw Hill Publications, (2007).
2. B.S. Grewal, 'Higher Engineering Mathematics', Khanna publishers, Delhi (40th edition), (2008)
3. S.C. Gupta, V. K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition), (2002).

**Reference books:**

1. C.R.Wylie, L.C. Barrette, 'Advanced Engineering Mathematics', McGraw Hill Publications, New Delhi (6th edition), (2003).
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley Eastern Ltd. (8th Student Edition), (2004).
3. Peter V. O'neil, 'Advanced Engineering Mathematics', Thomson Brooks / Cole, Singapore (5th edition ), (2007).

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20IN301 Sensors and Transducers

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs/Week | In-Semester: 50 Marks |
| Tutorial: 1 Hr/Week | End-Semester: 50 Marks |
| | Credit: 4 |

**Prerequisites:**
Electrical and Electronics Measurement
Methods of Measurement, Measurement System

**Course Objectives:**
1. To acquire the knowledge of basic principles of sensing various parameters
2. To study principles, working, mathematical relation characteristics, advantages and limitations of various sensors and transducers
3. To select appropriate transducer for the particular application

**Course Outcomes:**
By the end of the course, students should be able to
1. Students will be able to define and list performance characteristic of different sensors
2. Students can compare features of different sensors and transducers.
3. They can select sensors and transducers for particular applications.
4. Analyze the performance of sensors and transducers for various applications.

**Unit 1: Temperature sensors (07)**
Scope of sensors and transducers, concepts and terminology of measurement system, classification and selection criteria of transducers, temperature scales, units and relations, classification of temperature sensors, various Mechanical and Electrical temperature sensors, Non Contact temperature sensors - Radiation and optical.

**Unit 2: Pressure and Level sensors (08)**
Pressure scales, units and relations, types of manometers, various types of elastic pressure sensors, Calibrating Instruments, various types of Gauges, Direct and Indirect types of pressure measurement
Various level measurement techniques, Direct and Indirect types of level measurement, Electrical: Float, displacer (torque tube unit), ultrasonic, radioactive, radar , thermal. Capacitive, resistance. Optical level sensor, Inductive level sensor. Level switch.

**Unit 3: Flow sensors (08)**
Classification of Flow transducers, types of flow, Bernoulli‟s equation for incompressible flow, Head type flow meters,Variable area type, Other flow meters like Turbine, Target, Electromagnetic, Ultrasonic (Doppler, transit time), Vortex shedding, Positive displacement.

**Unit 4: Force and Torque Measurement: (07)**
Basic methods of force measurement, elastic force transducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer.

**Unit 5: Allied sensors** **(06)**
pH and conductivity, leak detector, flame detector, smoke detector, humidity, density, viscosity and Sound sensors, Displacement transducers-LVDT, RVDT, Encoders.

**Unit 6: Smart and MEMS sensors:** **(06)**
Principles of Smart Sensing, Classification and Terminology of Smart Sensors. MEMS (Piezoresistive, capacitive, conductive, optical), Introduction to sensor modeling.

**Text Books:**

1. A.K. Sawhney, "Electrical & Electronic Instruments & Measurement", Dhanpat Rai and Eleventh ed., 2000.
2. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis", Tata McGraw Hill Education, Second ed., 2004.
3. D.V.S. Murty, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed 2003
4. R. K. Jain, "Mechanical and Industrial Measurement", Khanna Publications - 9th print
5. C.S. Rangan ,G..R.Sharma, V.S.V Mani , "Instrumentation Devices and Systems"
6. HKP Neubert. 'Instrument Transducers'

**Reference Books:**

1. E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990.
2. D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed.,1999
3. Sabrie Soloman, "Sensors Handbook", McGraw Hill Publication, First ed., 1998.
4. B.G. Liptak, "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20IN302 Industrial Instrumentation

**Teaching Scheme**
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

**Examination Scheme**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

**Prerequisites:**
Basics of Electrical measurements and Network Theory

**Course Objectives:**
1. To explain the concept of different characteristics of measurement systems.
2. To use different types of ADC and DAC used for various applications.
3. To measure different parameters using different modes of measurement instruments.
4. To use and design analog filters based on different applications.

**Course Outcomes:**
At the end of this course, students will be able to:
1. Define different characteristics of instruments.
2. Choose ADC and/or DAC for a given application.
3. Differentiate different modes of operation in a given measuring instrument.
4. Measuring different parameters by selecting appropriate testing and measuring instruments for given application.

**Unit 1: Introduction (08)**
Introduction to Instrumentation System, General Measurement System, Classification of Instruments, Static and Dynamic characteristics of instruments, Error: limiting error, Types of Errors, Loading effect, Calibration: Definition, calibration report & certification, traceability

**Unit 2: ADC and DAC (08)**
Sampling Theorem, Sample and Hold Circuit, ADC characteristics definition, ADC Specifications, Various types of analog to digital converters (ADC), Various types of digital to analog conversion (DAC) techniques, Pulse Width Modulation Technique, Interpretation of ADC and DAC ICs, their specifications and selection for a given application.

**Unit 3: Digital Panel Meter and Virtual Instrumentation (07)**
Digital Panel Meters, Scale adjustment, Digits and display, Significance of ½ and ¾ digit. Need of VI, Advantages of VI, Define VI, block diagram and architecture of a virtual instrument, Application of Virtual Instrumentation

**Unit 4: Measuring Instruments and Test Equipment (07)**
RMS definition, RMS measurement, RMS value of sine and pulse, True RMS meter, DMM, Standard AC and DC sources, Automation in DVM, Universal Counter and different modes, Digital Storage Oscilloscope, Measurement of voltage, frequency, phase difference, sampling rate, bandwidth, roll mode

**Unit 5: Signal Sources and Signal Analyzers (06)**
Sine wave generator, sine wave synthesis, audio and function generator, arbitrary waveform generator and its applications in instrumentation.

Introduction to total harmonic distortion, wave analyzer and its applications, FFT analyzer and their applications

**Unit 6: Filters and application** **(06)**
Introduction to filters, Characteristics, Definition, Realization of filters, Butterworth filters, applications of filters

**Text Books:**

1. A K Sawhney: A course on electrical and electronic measurements and instrumentation, Dhanpat Raj & Co, 2005
2. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill, New Delhi 2004
3. John P.Bentley: Principles of measurement systems, 3rd edition, Addison Wesley Longman, 2000.
4. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India
5. M.M.S.Anand: Electronic instruments and instrumentation Technology, Prentice-Hall of India, 2004.

**Reference Books:**

1. Alan S.Morris: Principles of measurement and instrumentation, 2nd edition, Prentice-Hall of India,2004.
2. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner IEEE press.
3. Measurement Fundamentals, National Instruments, www.ni.com
4. Elements of Electronic Instrumentation and Control, J.J.Carr, Prentice Hall, 3rd edition
5. Electronic Instrumentation and Measurement Techniques, W.Cooper, A.Helfric, PHI, 3rd edition
6. Handbook of Electronic Instrumentation, Coombs,

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20IN303 Analog and Digital Electronics

**Teaching Scheme:** **Examination Scheme:**

Lectures: 3 Hrs/week — In Semester: 50 Marks
Tutorial: 1 Hr/week — End Semester: 50 Marks

Credit: 4

**Prerequisites**:
1. Concepts in basic electrical and electronics engineering
2. Concept of logic gates, number systems, Transistor theory and application

**Course Objectives:**
1. To illustrate the concepts of the basic characteristics, construction, open loop & close loop operations of Operational-Amplifier (Op-amp)
2. To enable students to analyze and design different linear and non-linear circuits using Op- amp and to introduce applications of various configurations of amplifiers.
3. To enable students to demonstrate different digital circuits.
4. To design different applications using digital circuits.

**Course Outcomes:**
At the end of this course, students will be able to:
1. Define different characteristics of operational amplifier (op-amp).
2. Select proper configuration of op-amp for different analog circuits.
3. Design counters, multiplexers, demultiplexers using the various building blocks.
4. Implement and test the performance of designed digital circuits.

**Unit 1: Operational Amplifier Fundamentals (05)**
Block diagram of Operational amplifier, Characteristics of Operational amplifier, comparative study of different amplifiers (LM741, LM324, OP07)

**Unit 2: Linear Applications of Op Amps (08)**
Introduction to feedback, Non-inverting, Inverting and differential amplifier, Instrumentation amplifier, Equation solving with Op-amp, I/V and V/I, Current booster converter, voltage regulator, SMPS, Signal conditioning circuits

**Unit 3: Non-Linear Applications of Op Amp and timer LM555 (07)**
Comparator, Zero Crossing Detector (ZCD), Schmitt trigger, window detector,: Wein bridge, LM555 timer, Signal conditioning circuits

**Unit 4: combinational and clocked logic circuits (08)**
Universal logic circuit: Mux, Demux. Decoders, Encoders, Interfacing TTL-CMOS and CMOS-TTL, Flip-flops: SR, JKMS, DFF and their truth table

**Unit 5: Counters and timers (07)**
Sequential and non-sequential counters: Ring, Johnson, BCD, Binary counters, programmable counters, shift registers

**Unit 6: Applications of flip-flops, Counters and shift registers (07)**

Digital Display, Digital clock, Alarm annunciator, Digital timer, call bell system and similar applications

**Text Books**:

1. Ramakant Gaikwad, "Operational Amplifiers" PHI, 3 rd ed., 1992.
2. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th edition, Pearson Education India, 2002.
3. Malvino and Leach, "Digital Principles & Applications", 4th Edition, Tata-McGraw-Hill
4. Gothman, "Digital Electronics", 2nd Edition, PHI

**Reference Book:**

1. Paul Horowitz, Winfield Hill , "The Art of Electronics", 2nd Ed., Cambridge University press,
2. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, "Digital Systems, Principles and Applications", 10th Edition, Pearson Education International.

**Tutorials:**

**Minimum 8 assignments based on the course contents**

**20HS301 Universal Human Values-2:
Understanding Harmony**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| Lectures: 2 Hrs/week | In Semester: 50 Marks |
| Tutorial: 1 Hr/week | End Semester: 50 Marks |
| | Credit: 3 |

**Prerequisites**: -

**Course Objectives:**

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

**Course Outcomes:**

After completion of the course, students will be able to

1. Understand human values which are only the solution of most of the present-day problems and a sustained solution could emerge only through understanding of value-based living.
2. Compare desires of 'I' and 'Body' distinctly. If any desire appears related to both, students are able to see that the feeling is related to I while the physical facility is related to the body.
3. Develop Natural acceptance which is always for living in harmony which leads to fulfillment in relationship.
4. Understand the whole existence to see the interconnectedness in the Nature.
5. Make use of sustainable solutions to the problems in the society and the Nature.

**Unit 1: Introduction to Value Education (06)**

Understanding Value Education ,Self exploration as the Process for Value Education, Continuous Happiness and Prosperity which is the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Current Scenario for Happiness and Prosperity, Method to Fulfill the Basic Human Aspirations.

**Unit 2: Harmony in the Human Being (06)**

Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Program to ensure self-regulation and Health.

**Unit 3: Harmony in the Family and Society (06)**

Harmony in the Family, Family being the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Trust which is the Foundational Value in Relationship, Respect as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.

**Unit 4: Harmony in the Nature or Existence (04)**
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels and the Holistic Perception of Harmony in Existence.
**Unit 5: Implications of the Holistic understandings, a look at professional ethics (06)**
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models, Typical Case Studies with Strategies for Transition towards Value-based Life and Profession.

**Text Books**:

1. R. R. Gaur, R. Asthana, G. P. Bagaria, "The Textbook A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, (2nd Revised Edition), (2019).
2. R. R. Gaur, R. Asthana, G. P. Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, (2nd Revised Edition), (2019).

**Reference Books**:

1. A.Nagaraj,"Jeevan Vidya: EkParichaya", Jeevan Vidya Prakashan, Amarkantak, (1999).
2. A.N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, (2004).
3. Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", Prakash books
4. Publishers, Daryaganj, New Delhi, (1983).
5. E. F. Schumacher, "Small is Beautiful", Harper CollinsPublishers, Noida, Uttar Pradesh,
6. (2010).
7. Cecile Andrews, "Slow is Beautiful", New Society Publishers, Canada, (2006).
8. J. C. Kumarappa, "Economy of Permanence", Sarva Seva Sangh Prakashan, Wardha,
9. Sevagram, (2017).
10. Pandit Sunderlal ,"Bharat Mein Angreji Raj", Prabhat Prakashan, New Delhi (2018).
11. Dharampal,"Rediscovering India", Society for Integrated Development of Himalayas, (2003).
12. Mohandas Karamchand Gandhi, " Hind Swaraj or Indian Home Rule", Navajivan Publication House, Ahemadabad (2003).
13. Maulana Abdul Kalam Azad, "India Wins Freedom", Orient BlackSwan, (1989)
14. Romain Rolland, " Swami Vivekananda", Advaita Ashram Publication Ramkrishna Math, (2nd Edition), (2010).
15. Romain Rolland, "Gandhi", Srishti Publishers & Distributor, (2002).
16. Annie Leonard, "The story of stuff", Little, Brown Book Group, (2005).

**Online Resources**:
NPTEL course on Humanities and social sciences
https://nptel.ac.in/courses/109/104/109104068/

**Tutorials:**
**Minimum 8 assignments based on the course contents**

**20IN301L Sensors and Transducers Lab**

**Lab Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** by the end of the course, students should be able to
1. Students will be able to do characterization of sensors
2. Students can compare characteristics of different sensors and transducers.
3. They can select sensors and transducers for particular applications.
4. Analyze the sensors and transducers for various applications.

**List of Practical Assignments:**
1. Study the working of Dead weight pressure gauge tester and calibration of pressure gauge using it
2.Study the working of a vacuum gauge tester and calibration of vacuum gauge using it
3. Plot the characteristics of RTD and Thermistor calculate its time constant.
4. Plot the characteristics of Thermocouple and study cold junction compensation.
5. Design and Test Air purge probe/capacitive for Level Measurement.
6. Flow measurement using Rotameter, orifice and Electromagnetic flow meter.
7. Measurement of viscosity of various liquids using Red wood Viscometer.
8. Water level measurement using Piezoresistive MEMS sensor.
9. Weight measurement using cantilever beam/load cell.
10. Conductivity measurement using virtual lab platform.

**Or similar type of practical assignments based on the course contents**

## 20IN302L Industrial Instrumentation Lab

| **Lab Scheme:** | **Examination Scheme:** |
|---|---|
| Practical: 2 Hrs/Week | In Semester: 25 Marks |
| | Oral: 25 Marks |
| | Credit: 1 |

**Course Outcomes:** at the end of this course, students will be able to

1. Measure/Test various parameters using appropriate measuring/testing instruments
2. Use appropriate ADC and/or DAC for given application.
3. Calibrate the instruments for minimizing errors in the measurement.
4. Develop Virtual instrumentation systems for practical applications

**List of Practical Assignments:**

1. Study and implementation of ADC IC 0809
2. Study and implementation of DAC IC 0808
3. Measurement of True RMS value using True RMS meter
4. Study and verify different modes of Universal Counter
5. To measure time constant of relay using Digital Storage Oscilloscope
6. To build a function generator using IC
7. Hand-on on Lab View software
8. Design and realization of filter
9. Study and application of distortion meter

**Or similar type of practical assignments based on the course contents**

**20IN303L Analog and Digital Electronics Lab**

**Teaching Scheme**
Practical: 2 Hrs/week

**Examination Scheme**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** the student will be able to
1. Verify and compare the performance characteristics of different configurations of OPAMP.
2. Design and implement linear and non-linear circuits using OPAMP.
3. Select appropriate components for given application
4. Design and test signal conditioning circuits for industrial application.

**List of Practical Assignments:**

**(Any 3 from)**
1. Measurement of CMRR, Slew rate and output offset voltage.
2. Verification of gain for inverting and non- inverting amplifier.
3. Designing and implementation of Instrumentation amplifier using IC LM324.
4. Designing and implementation of Wien bridge oscillator.
5. Designing and implementation of Comparator, Schmitt trigger and Zero Crossing Detector.

**(Any 1 from)**
1. Designing and implementation of buzzer using LM555.
2. Designing and implementation of flasher light using LM555
3. Designing and implementation of porch-light control unit using LM555

**(Any 2 from)**
1. Study and implementation of logic circuit using Mux/Demux
2. Study and implementation of Johnson and Ring Counter using D-FF IC 7474 or Shift Register IC 7495
3. Study of Presettable Up/Down Counter using IC 74193.
4. Design of Non Sequential Counter using flip –flop ICs.

**(Any 2 from)**
1. Implementation of running light using shift register
2. Alarming annunciator circuit using Mux. for 3 conditions stated in process
3. Implementation of digital timer using IC 74193
4. Simulation of Digital Clock using digital ICs

**Or similar type of practical assignments based on the course contents**

## 20IN304 Programming Practice Lab

**Teaching Scheme:**
Practical: 4 Hrs/week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 2

**Course Outcomes:** the student will be able to
1. List and identify the steps for the given problem statement.
2. Apply different programming tools for logic development.
3. Implement the developed logic in the given programming language.
4. Develop and design appropriate programs for practical applications.

**List of Practical Assignments-**:
**Group A: [Any 3 minimum]**
1. Write a Python program to enter marks of five subjects and calculate total and percentage.
2. A. Write a Python program to swap two numbers/digits in a number.
   B. Write a python program to find the greatest number among three given numbers by using ternary operator.
3. Write a Python program to perform the sum of digits of a 3 digit number.
4. Write a Python program to calculate DA and HRA on the following conditions
   Enter basic salary as user input user.

| *Salary* | *DA as per salary* | *HRA as per salary* |
|---|---|---|
| *<=2000* | *10%* | *20%* |
| *>2000* | *20%* | *30%* |
| *&&* | | |
| *<=5000* | | |
| *>5000* | *30%* | *40%* |
| *&&* | | |
| *<=10000* | | |
| *>10000* | *50%* | *50%* |

5. Write a Python program to find out the average and median among three given numbers.

**Group B: [Any 5 minimum]**
6. Write a Python program to print all alphabets (Capital and small) using while loop
7. Write a Python program to find the sum of all even numbers between 1 to n.
8. Write a Python program to find the sum of the first and last digit of the entered number.

9. Write a Python program to check whether the entered number or string is palindrome or not.
10. Write a Python program to print the following pattern
2 3 5 7 11 13… till 100
11. Write a Python program to find the power of a number using a for loop.
12. Write a Python program to find all factors of a number.
13. Write a Python program to find the sum of all prime numbers between 1 to n.

**Group C: [Any 4 minimum]**

14. Write a Python program to get a string made of the first 2 and the last char from a given string. For eg: Input : beautiful Expected Output : bel
15. Write a Python program to get a string from a given string where all occurrences of its first char have been changed to '#', except the first char itself. For eg: Input: abracadabra Expected Output : abr#c#d#br#
16. Write a Python program to add 'ing' at the end of a given string (length should be at least 3). If the given string already ends with 'ing' then add 'ly' instead. If the string length of the given string is less than 3, leave it unchanged. For eg: Input: test Expected Output: testing If the Input : testing Expected Output: testingly
17. A.Write a Python program to get the largest number from a list
    B. Write a Python program to multiply all the items in a list.
18. Write a program to remove all the duplicate elements from the list.
19. Write a Python program to count the number of strings where the string length is 4 or more and the first and last character are the same from a given list of strings.

**Group D: [Any 4 minimum]**

20. Write a Python program to find common items from two lists.
21. Write a Python script to add a key to a dictionary.
22. Write a Python program to concatenate following dictionaries to create a new one. d1={1:110, 2:210}
d2={3:301, 4:401}
d3={5:5010, 6:6010}
23. A.Write a Python program to check if a given key already exists in a dictionary.
B. Write a Python script to print a dictionary where the keys are numbers between 1 and 10 (both included) and the values are squares of keys.
24. A.Write a Python program to sum all the items in a dictionary.
    B. Write a Python program to remove a key from the given dictionary.
    D = {'a':9,'b':8,'c':7,'d':6}
25. A.Write a Python program to sort a dictionary by key.
    B. Write a Python program to remove duplicate values from the Dictionary.
26. Write a program to determine the occurrence of numbers in a list of numbers.

**Autonomous Program Structure**
**Second Year B. Tech. Fourth Semester**
**(Instrumentation and Control)**
**Academic Year: 2021-2022 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Oral | Practical | | |
| 20IN401 | Fundamentals of Computer Networks | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN402 | Control Systems | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN403 | Micro controller Techniques | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN404 | Power Electronic and Drives | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN405 | Unit Operations | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN402L | Control Systems Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IN403L | Micro controller Techniques Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20AC401 | Audit Course | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | No Credit |
| | **Total** | **15** | **3** | **6** | **300** | **250** | **0** | **50** | **600** | **20** |
| | **Grand Total** | **24** | | | **600** | | | | **600** | **20** |

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# 20IN401 Fundamentals of Computer Networks

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites: -**

**Course Objectives:**
1. To define computer networks and describe their purpose
2. To understand the types and components of networks
3. To understand the functions of each layer in a network

**Course Outcomes:** the students will be able to
1. Identify components and methods in networks
2. Compare the functions of layers in a network
3. Identify models and issues in networks
4. Compare protocols and standards

**Unit 1: Introduction to Computer Networks (08)**
Type of Networks LAN, WAN, MAN, Ad-hoc Networks. Networking Topologies: Bus, Mesh, Star, Ring and Hierarchical. Types of Connection- Point to Point, Point to Multi Point, Network Standards. Network components: Switches, Routers, Hubs, Gateways, Repeaters, Modems, Cables, NIC and access points.

**Unit 2: Network Models and Physical Layer (08)**
ISO-OSI 7-layer model, Functions of each layer, TCP/IP model.
Protocol Data Units, encapsulation and decapsulation
Digital modulation and multiplexing methods: FDM, TDM, PCM, FSK, GFSK, Spread Spectrum Technique
Transmission Media: Twisted pair cable, coaxial cable, Fiber Optic cable

**Unit 3: Data Link Layer (08)**
Data Link Layer Design Issues, Error Detection and Error Correction, Medium Access Control Sub layer, Ethernet MULTIPLE ACCESS PROTOCOLS, ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols

**Unit 4: Ethernet Basics (06)**
Ethernet Basics, Collision Domain, Broadcast Domain, CSMA/CD, Half- and Full-Duplex Ethernet, Ethernet at the Data Link Layer, Ethernet Addressing, Ethernet Frames, Channel Bonding, Ethernet at the Physical Layer.

**Unit 5: Network Layer (06)**
IP Addressing, Communication from Host to Host, Network Layer Protocol, Packaging the Transport Layer PDU, IPv4 and IPv6 Packet Header, Comparison of IPv4 and IPv6, Subnetting, Static Routing, Dynamic Routing, Routing Protocols
Introduction to NFV (Network Function Visualization)

**Unit 6: Protocols and QoS framework in Networks** **(06)**

UDP, HTTP, FTP, SMTP and equivalent
Internet QoS: Introduction, Architecture, Traffic Policing, Traffic Shaping, Traffic Scheduling, Integrated and Differentiated Service Architecture
Network Security

**Books:**

1. Mark A. Dye, Rick McDonald, Antoon W. Rufi, "Network Fundamentals", Cisco Press, 2008
2. Behrouz A. Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw- Hill, Publications, 2017.
3. William Stallings "Data and computer communication", Pearson, 10th Edition, 2015
4. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet",6th edition (March 5, 2012), Pearson , ISBN-10: 0132856204.

1. Andrew S. Tenenbaum, "Computer Networks", 5th Edition, PHI, ISBN 81-23- 2175-8

**20IN402 Control Systems**

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of Linear Algebra and Laplace Transform

**Course Objectives:**
1. Understand the basic components of control system and types of control systems.
2. Learn and develop the relationship between system input and output.
3. Learn to develop systems mathematical models.
4. Understand the basic mathematical tools for analysis of control systems.

**Course Outcomes:** students will be able to
1. Analyze & predict systems behavior based on time and Frequency Domain Analysis.
2. Design Control System that meets design specifications.
3. Develop a Mathematical Model of the Control System.
4. Compare the Classic Control System with the Modern Control System.

**Unit 1: Introduction to Control System (07)**
Introduction and brief classification of Control System, Representation of Electrical, Mechanical, Electromechanical, Thermal and Pneumatics Control System with Differential Equations, Concept of Transfer Function

**Unit 2: Transfer Function, Block Diagram Algebra & Signal Flow Graph (08)**
Representation of Electrical and Mechanical Control System with Force to Voltage and Force to Current Analogy, Block Diagram Algebra, Signal Flow Graph

**Unit 3: Time Domain Analysis (07)**
Standard Test Signal, Dynamic Error Constants, First and Second Order System and Its Response to the Standard Test Signals, Time Domain Specifications, Static Error Constants – kv, kp, ka and ess.

**Unit 4: Stability Analysis (07)**
Concept of Stability in S – Domain, Concept of Relative Stability and Absolute Stability, Classification of Stability, Stability Analysis by Routh Hurwitz Criteria.

**Unit 5: Frequency Domain Analysis (07)**
Introduction to Bode Plot, Bode Plot, Nyquist Plot, Nyquist Stability Criterion, Gain and Phase Margins, Robustness.

**Unit 6: Compensation Techniques (06)**

Introduction to Compensation, Compensation via Root Locus, Compensator Configurations, Commonly used Compensators, Effect of Adding Poles and Zeros to Root Locus.

**Text Books:**

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 5th Edition, 2009.
2. B. C. Kuo, "Automatic Control Systems", John Wiley and Sons, 8th Edition, 2003.
3. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education.
4. D. Roy Choudhury, "Control System Engineering", PHI.

**Reference Books:**

1. N. K. Sinha, "Control Systems", New Age International (P) Limited Publishers, 3rd Edition, 1998.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd Edition, 1998.
3. M. N. Bandyopadhyaya, "Control Engineering, Theory & Practice", PHI.
4. Norman Nise, "Control System Engineering", 3rd Edition, John Wiely and Sons.
5. R.C. Dorf & R.H. Bishop, "Modern Control System", 11th Edition, Pearson Education.
6. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, "Control System Design", PHI.
7. Christopher T. Kilian, "Modern Control Technology Components & Systems", 3rd Edition, Cengage Learning.
8. Ajit K. Mandal, "Introduction to Control Engineering", New Age International.
9. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.
10. Samarjit Ghosh, "Control Systems Theory and Applications", Pearson Education.

## 20IN403 Microcontroller Techniques

**Teaching Scheme:**
Lectures: 3 Hrs/week
Tutorial: 1 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

**Prerequisites:**
1. Concepts of Digital Electronics
2. Hexadecimal number systems and their arithmetic/ logical operations
3. Basics of C programming

**Course Objectives:**
1. To introduce the architecture and features of microcontrollers
2. To provide an understanding of hardware and software design and integration for
3. Microcontroller based system development
4. To develop small application system with AVR microcontroller.

**Course Outcomes:**
The students will be able to
1. Select appropriate features of AVR microcontroller for given application.
2. Identify detailed hardware structure and software model of the AVR for the given application.
3. Develop configuration of on-chip peripherals.
4. Design microcontroller-based system

**Unit 1: Introduction to 8 bit microcontrollers (08)**
Microprocessors and Microcontroller architecture, Overview, Family and Features of AVR ATMega8535, Concepts of Memory (RAM and ROM), Buses, AVR Pin diagram, AVR Memory Organization, Program Counter and Program ROM space

**Unit 2: Architecture and Programming -I (08)**
A. Microcontroller Application Development Tools: Simulator, Emulator, ISP, Cross assembler
B. AVR architecture, Programming techniques for ATMega8535, data types, writing loops and subroutines in C, Time Delays, logic operations, data conversion and memory allocation in C.
C. System Clock and Clock Options, Reset Sources

**Unit 3: Architecture and Programming -II (08)**
A. AVR Port Structure, Alternate Port Functions, I/O configurations, I/O Port programming and Bit manipulations in C
B. Introduction to interfacing display and keyboard
C. Watch Dog Timer and Stack Memory concepts and use
D. AVR Fuse bits

**Unit 4: Integrated Timers and Counters (06)**
A. 8 bit Timer/ Counter 0 with PWM, Modes, Prescaling and Programming in C
B. 16 bit Timer/ Counter 1, Modes, Prescaling and Programming in C
C. Input Capture and Wave generation using timers

**Unit 5: Interrupts and ADC** **(06)**

A. External and Internal Interrupts, Programming, Configuring and Priority
B. ADC Features, Operation, Programming and Configuring
C. Introduction to sensor interfacing
D. Power Management in AVR microcontrollers

**Unit 6: Other integrated features** **(06)**

A. Introduction to serial interfaces: SPI, $I^2C$ and USART
B. Introduction to RS232C, RS485
C. Introduction to Features and capabilities of Arduino Systems

**Text Books:**

1. 'The AVR microcontroller and Embedded Systems Using Assembly and C', Mazidi, Naimi, Naimi, Prentice Hall
2. 'Arduino, the complete beginners guide', Bryon Francis
3. 'Embedded Systems, Architecture Programming and Applications', Raj Kamal, McGraw Hill
4. 'Programming And Customizing The AVR Microcontroller', Dhananjay Gadre, Tata McGraw Hill Publishing Company Limited

**Reference Books:**

1. Datasheet of AVR ATMega8535
2. Microchip AVR Microcontroller Primer Programming and Interfacing', Steven Barett, Daniel Pack, Third Edition, Morgan & Claypool Publishers
3. AVR Programming: Learning to Write Software for Hardware, Elliot Williams, Maker Media Inc.

**Tutorials:**

**Minimum 8 assignments based on the course contents**

**20IN404 Power Electronics and Drives**

**Teaching Scheme:**
Lectures: 3 Hrs/week
Tutorial: 1 Hr/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 4

**Prerequisites:** Linear Integrated Circuits and Digital Electronics

**Course Objectives:**
1. To understand and analyze different power electronic devices.
2. To study different special purpose integrated circuits.
3. To use different control methodologies based on different applications.
4. To use the knowledge to understand and solve practical problems.

**Course Outcomes:** the students will be able to
1. List and Define characteristics of different power devices.
2. Compare and select various power circuits and motors for suitable applications.
3. Develop controlling circuits for various design stages.
4. Design and construct the suitable controlling circuit for given applications.

**Unit 1: Introduction to Power Devices (08)**
SCR, TRIAC, DIAC, Power MOSFET, UJT, SCR gate triggering and commutation circuits

**Unit 2: Phase Controlled rectifiers (07)**
Single Phase and Three Phase controlled rectifiers, (Half wave, full wave and bridge Configuration) with resistive and inductive load with freewheeling diode.

**Unit 3: Choppers and Inverters (08)**
Choppers: Principle, Working, Classification, Thyristor choppers- Jones Chopper, Morgan Chopper, Chopper controlling strategies.
Inverters: Classification, Single Phase half bridge and full bridge Inverters, PWM Inverters
Uninterruptible Power Supply (UPS): Principle, Construction, Working, Types, Application

**Unit 4: Electric Machines (07)**
DC Motors - Principle, Construction, Working, Types, Characteristics, efficiency and Applications
Stepper Motors - Principle, Construction, Working, Types, Characteristics and Applications
Induction Motor - One phase and three phase

**Unit 5: Protection Devices (07)**
Starters for motors, circuit breakers, fuses, over voltage and over current protection circuits for power devices, cooling mechanism for power devices

**Unit 6: Controllers for AC Loads (05)**
Solid state relays, Firing angle control, AC Synchronous motor drive, Variable frequency drive (VFD)

**Text Books:**

1. M.D. Singh, K. B. Khanchandani, 'Power Electronics', 2nd edition, McGraw Hill Company

2. B. L. Theraja and A. K. Theraja, S. Chand &Sons, "A textbook of Electrical Technology", Volume-II, AC & DC Machines

**Reference Books:**

1. P. C. Sen,' Power Electronics', TMH, 2007
2. Mohamad Rashid,' Power Electronics', PHI, 2ndedition, 2004
3. G.K.Dubey, Power semiconductor controlled drives, Prentice Hall- 1989
4. Bhag S. Guru, Huseyin P. Hiziroglu,"Electric Machinery and Transformers", Third Edition, Oxford University Press
5. Krishnan, Electrical Motor Drives, PHI-2003

**Tutorials:**
**Minimum 8 assignments based on the course contents**

**20IN405 Unit Operations**

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lecture: 3 Hr/week | In Semester: 50 Marks |
| Tutorial: 1 Hr/week | End Semester: 50 Marks |
| | Credit: 4 |

**Prerequisites:** Sensors and transducers

**Course Objectives:**
1. To learn various Unit Operations used in Industry.
2. To describe various equipment involved in various unit operations.
3. To understand different renewable and non-renewable energy sources

**Course Outcomes:** the student will be able to
1. Delineate the working of various process equipment used for mass transfer, heat transfer, fluid transfer.
2. Compare various process equipment used in specific unit operations.
3. Select unit operation and related instruments for a given application.
4. Analyze various industries like dairy, pharmaceutical, sugar, etc by identifying various process units and unit operations

**Unit 1: Unit Operations and Fluid Transportation** **(08)**

A. Introduction, Flow of incompressible fluids through pipes, transportation and metering of fluids, Pipes, Fittings, Valves, Pumps, Fans, Blowers, Compressors, Feeders, Dampers
B. Fluids filtration, solids fluidization

**Unit 2: Unit Operations in Chemical Engineering** **(08)**

A. Gas absorption and liquefaction, refrigeration
B. Mechanical processes: including solids transportation, crushing and pulverization, screening and sieving
C. Separation and mixing of fluids

**Unit 3: Heat Transfer Operations** **(08)**

A. Principles of heat flow in fluids, Heat transfer to fluids without phase change, Heat Transfer to fluids with phase change
B. Heat Exchange Equipment: Heat Exchangers, Condensers, Boilers and Calandria, Evaporators, Cooling towers

**Unit 4: Mass Transfer Operations and Introduction to Energy Sources** **(06)**

A. Distillation: Flash and Continuous, Multi component Distillation, Leaching and Extraction
B. Drying of Solids and liquids, Crystallization
C. Energy Sources and their classification
D. Introduction to Power generation

**Unit 5: Boiler Ancillaries** **(06)**

A. Types of boilers like FBC, CFBC, DIPC, Fluidized Bed, boiler safety parameters

B. Instrumentation for Boiler, water treatment, electro-static precipitator, soot blower, economizer, deaerator, super heater, chemical dosing systems, air preheater, coal and ash handling systems, fuel storage and distribution, Bag House Filters.

**Unit 6: Unit Operations in Process Industry (06)**

Study of Processes and Unit Operations applied to process industry, viz. sugar, paper and pulp, Dairy, Pharmaceutical, and Fertilizer

**Text Books:**

1. Unit Operations in Chemical Engineering by McCabe, W.L., Smith, J.C., and Harriot P., McGraw-Hill VII Edn. 2004.
2. Perry, "Chemical Engineer's Handbook", McGraw Hill, 1984.
3. Non-conventional energy resources by B. H. Khan, McGraw Hill, New Delhi.
4. Renewable energy Technology. Chetan Singh Solanki, Prentice Hall Publication.

**Reference Books:**

1. Process Control, B.G. Liptak
2. Solar Energy, by S. P. Sukhatme, Tata McGraw Hill, New Delhi.
3. Nonconventional Energy Sources. G. D. Rai, Khanna Publication.
4. M. G. Rao and Misting, "Outline of Chemical Technology", Second Edition, East West, 1973.
5. Leverspel O., "Chemical Reaction Engineering", Second Edition Willey Eastern Pvt Ltd

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20IN402L Control Systems Lab

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** Students would be able to
1. Test the System Response for the various Standard Test Signals
2. Analyse Transient Response of the System
3. Analyse Frequency Response of the System
4. Design compensator using Root Locus Method

**List of Practical Assignments:**

1. Formation and Study of Standard Test Signals.
2. Response of First/Second Order System to Standard Test Signals.
3. Transient Response of a System.
4. Analysis of Time Domain Specifications of a Control System.
5. Analysis of Stability in Frequency Domain using Bode Plot.
6. Analysis of Stability in Frequency Domain using Nyquist Plot.
7. Analysis of Stability using Root Locus.
8. Design and Performance Analysis of Lead/Lag Compensator using Root Locus.

**Or similar type of practical assignments based on the course contents**

**20IN403L Microcontroller Techniques Lab**

**Teaching Scheme:**
Practical: 2 Hrs/week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** The students will be able
1. Program microcontroller using C programming
2. Select appropriate peripheral for given application
3. Configure the peripherals in different modes
4. Debug the developed program / given problem statement

**List of Practical Assignments (any 8):**

1. Introduction and familiarization with programming environment of AVR
2. Arithmetic and Logical Operations in AVR
3. Bit wise operations and Port pin manipulations
4. Data Conversion Programs in C
5. Square wave generation using software delay
6. Square wave generation using hardware delays with polling and interrupts
7. Event counter using timer
8. Frequency measurement using time period method
9. Analog input measurement using ADC
10. Interfacing of LCD display
11. Introduction to Arduino system Programming

**Or similar type of practical assignments based on the course contents**

**Autonomous Program Structure**
**Third Year B. Tech. Fifth Semester**
**(Instrumentation and Control)**
**Academic Year: 2022-2023 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Oral | Practical | | |
| 20IN501 | Process Loop Components | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN502 | Digital Signal Processing | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN503 | Internet of Things (IoT) | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20PEIN501 | Programme Elective-I | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIN502 | Programme Elective-II* | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OEHS501 | Open HS Elective –I | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN501L | Process Loop Components Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IN502L | Digital Signal Processing Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20PEIN501L | Programme Elective Lab-I | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20AC501 | Audit Course | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | No Credit |
| | **Total** | **18** | **2** | **8** | **375** | **300** | **25** | **50** | **750** | **23** |
| | **Grand Total** | **28** | | | **750** | | | | **750** | **23** |

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**For Women, Pune-411052**

**Programme Elective-I**
20PEIN501A Modern Control Theory
20PEIN501B Biomedical and Analytical Instrumentation
20PEIN501C Advanced Micro controller Techniques

Open Elective I (Humanities)

| Sr. No. | Course Code | Course Title |
|---|---|---|
| 1 | 20OEHS501A | Entrepreneurship Development |
| 2 | 20OEHS501B | Intellectual Property Rights |
| 3 | 20OEHS501C | Introduction to Digital Marketing |
| 4 | 20OEHS501D | Law for Engineers |
| 5 | 20OEHS501E | Organizational Behaviour |
| 6 | 20OEHS501F | Project Management |

APPROVED BY
Secretary Governing Body
MKSSS's Cummins College of Engineering
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APPROVED BY
Chairman Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

## 20IN501 Process Loop Components

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 3 Hrs /week | In semester: 50 Marks |
| | End semester: 50 Marks |
| | Credit: 3 |

**Prerequisites**: Sensors and transducers, pneumatic flapper nozzle system**,** op amp circuits

**Course Objectives:**
1. To understand the different types of systems and basics of process control.
2. To explain the need, construction, working, types of process control components
3. Develop process control circuits/loops for various applications using standard symbols and notations
4. To demonstrate PLC programming skill for industrial applications

**Course Outcomes**:
1. Delineate the working of different process control components.
2. Compare to select different process control components for various applications.
3. Analyse the performance of the process control components with respect to calibration, configuration, tuning.
4. Develop process control circuits/loops and PLC programs for various industrial applications using standard symbols and notations.

**Unit 1: Types of systems and process control components (08)**
Introduction to different types of systems, process control components related to different types of systems like switches, contactors, miniature circuit breaker, relays, actuators, FRL, Relief/safety valve, DCV, NRV etc, and applications.

**Unit 2: Process Control Fundamentals (07)**
Elements of process control loop, Types of process variables, Representation of process loop components using standard symbols (basics with reference to control loop), P & ID for temperature, flow, level, pressure process loops, Process Characteristics like process load, plant lags, dead time, capacity and regulation. Auxiliary components like alarm annunciator.

**Unit 3: Transmitters and Converters (06)**
Need of transmitter (concept of field area & control room area) ,Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero, Types of transmitters (Two and four wire transmitters), Types, mounting (Installation), manifold, calibration setup, of electronic Differential Pressure Transmitter (DPT). DPT for Level measurement, zero elevation, zero suppression, Square root extractor, Block schematic and

calibration of Smart transmitter, Comparison of SMART with conventional transmitter, Difference between converter and transmitter, Converters like Current to pressure converter and Pressure to current converter

**Unit 4: Controllers** **(08)**

Discontinuous (Two position, time-proportional), Continuous controllers (Proportional, Integral, Derivative, Proportional-Integral, Proportional- Derivative, Proportional-Integral-Derivative (PID), Reset windup, Anti reset windup, Rate before reset, Bump less transfer, Effect of process characteristics on PID combination, Tuning of controllers, Block schematic and face plate of digital controllers, Position and Velocity algorithms

**Unit 5: Programmable Logic Controller** **(07)**

Continuous versus Discrete Process Control, Limitations of relay based system, PLC architecture, Types of Input & Output modules, Fixed & Modular PLC, Interfacing pneumatic systems to PLC, PLC specifications, PLC manufacturers, PLC Basic instructions, Timers & Counters, PLC programming languages, Ladder programming for process applications

**Unit 6: Control valve** **(06)**

Parts of pneumatic control valve, Control valve terminologies, Inherent and Installed control valve characteristics, types of control valves, Control valve selection criteria, Control valve accessories, types of actuators, Introduction to Control valve sizing and cavitation and flashing

**Text Books:**

1. Petruzella, "Industrial Electronics", McGraw-Hill
2. Andrew Parr, "Hydraulics and pneumatics: A Technician's and Engineer's guide",
4. Butterworth Heinemann Ltd
5. C. D. Johnson, "Process control and Instrument technology", Tata McGraw Hill Publications
6. B. G. Liptak, "Process Control", Instrument Engineering Handbook CRC Press.
7. N.A. Anderson, Boca Ratan, "Instrumentation for Process measurement and control" CRC Press, Third ed., 1980.
9. Frank Petruzella, "Programmable Logic Controllers" McGraw-Hill, 2011
10. Gary Dunning, "Introduction to Programmable Logic Controller", Cengage Learning India Pvt. Ltd., Third ed., 2006.

**Reference Books:**

1. Armando B. Corripio,"Tuning of industrial control systems", ISA.

2. James W. Hutchinson, "Control valve Handbook", ISA
3. E. B. Jones, "Instrument Technology", Butterworth's, Forth ed., 1985
4. William Andrews, "Applied Instrumentation in Process Industries", Gulf, Second ed., 19

## 20IN502 Digital Signal Processing

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 3 Hrs/Week | In Semester: 50 Marks |
| Tutorial: 1 Hr/Week | End Semester: 50 Marks |
| | Credit: 4 |

**Prerequisites:** Linear Algebra, Complex numbers, basics of ZT and FT

**Course Objectives:**
1. To understand the concept of digital different types of signals and systems.
2. To learn the use of various transforms for different applications.
3. To understand designing steps of various types of digital filters for given applications.

**Course Outcomes:** After the successful completion of the course the students will be able to:
1. Analyse the signals in time and frequency domain.
2. Apply the transformation tools on signals and systems and analyse their significance and applications.
3. Design the structures of different types of digital filters.
4. Design various digital filters and analyse their frequency response

**Unit 1: Introduction to Signals and Systems (08)**
Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable. Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response

**Unit 2: Analysis of Discrete-LTI Systems (07)**
Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, autocorrelation, cross correlation, decimation and interpolation

**Unit 3: Z-Transform, Discrete Fourier Transform and its Properties (08)**
Z-transform and its properties, solving difference equations and analysis of discrete-time systems in z-domain, Transfer function, pole-zero plot.
Discrete Fourier Transform (DFT) and its properties, Fast Fourier Transform (FFT), Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

**Unit 4: Design of Digital Filters: FIR (07)**
FIR Filters: Concept of analog filter design, Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. Magnitude and Phase response of Digital filters, Frequency response of Linear phase FIR filters

**Unit 5 : Design of Digital Filters: IIR** **(06)**
**IIR Filters:** IIR filter design by approximation of derivatives, IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Butterworth filter design, Characteristics of Butterworth filters

**Unit 6: DSP Practical Application: 1-D Signal Processing** **(06)**
Applications of Convolutions, Auto-correlation, Cross-correlations, DFT, Digital filters.
Biomedical Signal Processing:
Baseline Wander removal techniques, Power line Interference removal techniques, EMG noise removal techniques, Motion Artifacts removal techniques, Feature extraction like RR interval, Heart rate, Time vs Frequency domain filtering
Audio Signal Processing: Basics of LPC, MFCC, Introduction to SVD, PCA, ICA, NMF, Spectrogram, Time vs Frequency domain filtering Applications of Audio Signal Processing: Audio Equalizer, Noise Filtering, Audio Compression
Vibration Analysis: Vibration signature analysis for defective gear teeth

**Text Books:**
1. Nagoor Kani, Digital Signal Processing, Tata McGraw-Hill Education
2. Salivahanan, A Vallaraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill Publishing Company Limited.
3. P. Ramesh Babu, "Digital Signal Processing", Sci-Tech Publications
4. S. K. Mitra, "Digital Signal Processing-A Computer Based Approach", MGH

**Reference Books:**
1. J. G. Proakis and D. J. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", PHI, 2000.
2. V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Pearson Education.
3. Rabiner, Gold, "Theory and Applications of Digital Signal Processing", TMH.
4. E. C. Ifeachor and B. W. Jervis, "Digital Signal Processing-A practical Approach", Addison-Wesley publication

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20IN503 Internet of Things

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| Lectures: 3 Hrs/week | In Semester: 50 Marks |
| Tutorial: 1 Hr/week | End Semester: 50 Marks |
| | Credit: 4 |

**Prerequisites:** Basics of sensors and actuators, networks, logic building ability

**Course Objectives:**
1. To understand building blocks and components of IOT
2. To understand technologies used in IOT
3. To understand the role of platforms and big data in IOT

**Course Outcomes:** the students will be able to
1. Compare connectivity technologies for IoT
2. Compare protocols used for IoT applications
3. Select appropriate IoT technology for given application
4. Design small system solution for given problem statement

**Unit 1: Introduction to IoT (08)**

IoT Basics, Components, architecture, Interdependencies, categories, gateways, associated technologies, Challenges, Considerations, Scalability
Role of sensors, actuators and networks in IoT
Study of Raspberry Pi/ Arduino/ equivalent for integration of sensors/ actuators/ devices in IoT based systems. Small system examples of interfacing sensors and devices to embedded systems for IoT applications

**Unit 2: Connectivity Technologies -I (08)**

Connectivity technologies: Introduction, Features, working principle, addressing, Routing and applications of Zigbee, IEEE 802.15.4, ZWave, LoRa WAN, Bluetooth and BLE. System examples and case studies using these technologies.

**Unit 3: Connectivity Technologies -II (07)**

Connectivity technologies: Introduction, Features, working principle, addressing, Routing and applications of GSM, Low Power WiFi, Power Line Communication, RFID, NFC, Sigfox. System examples and case studies using these technologies.

**Unit 4: Networking Protocols and Security (07)**
Introduction, features, components, methods, variants, communication, Response models, message types, addressing, Routing and applications of 6LoWPAN, MQTT, CoAP, XMPP, AMQP. System examples and case studies using these technologies.
Privacy and Security issue in IoT. Overview of Governance in IoT.

**Unit 5: Communication Protocols in Industrial IoT (06)**
Introduction, features, components, methods, variants, communication, Response models, message types, addressing, Routing and applications of Wireless HART, ISA100.11A, IEEE1451, OPC UA. Case Studies from Home, Infrastructures, Buildings, Industries, Health Care, Inventory Management and Equivalent.

**Unit 6: Wireless Sensor Networks and Big Data (06)**
Introduction, Features, Components, Multi-hop Paths, Challenges of WSN, Detection and Connectivity, Event Aware Topology Management, Information Theoretic Self-Management of WSN, Applications
Platforms in IoT, Functions, Types, Privacy and Trust in IoT-Data-Platforms for applications
Introduction to Big Data, Cloud Computing, Edge computing and Fog computing
Case Studies from Home, Infrastructures, Buildings, Industries, Health Care, Inventory Management and Equivalent.

**Books:**

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving".
4. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
5. "The Internet of Things: Key Applications and Protocols", by, Wiley
6. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

**Tutorials:**
**Minimum 8 assignments based on the course contents**

## 20PEIN501A Modern Control Theory

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Control Systems

**Course Objectives:** To
1. Learn basics of Compensator, its types, and Electrical Network.
2. Learn how to Choose and Design a Compensator.
3. Learn PID Control Actions, Requirements, Constraints and Tuning Procedures.
4. Learn and Analyse Controller Design Methods using Modern Control Theory.

**Course Outcomes:** Students will be able to
1. Investigate and Interpret System Requirements in Time and Frequency Domain.
2. Classify, Choose, Compare suitable Compensator.
3. Determine, Compare and Choose Controller Tuning Parameters.
4. Apply Modern Control Techniques in Continuous and or Discrete Domain.

**Unit 1: Introduction to Modern Control (08)**
Introduction to Modern Control Techniques, Classical Control Vs Modern Control, Need to Modern Control Techniques, Advantages and Limitations of Modern Control Techniques, Basic Representation of Modern Control.

**Unit 2: Basics of Control Actions and Controller Tuning (06)**
Control Actions: ON/OFF, Proportional, Proportional plus Integral, Proportional plus Integral plus Derivative, Controller Tuning Methods.

**Unit 3: Controller Design (07)**
Design of PI/PD/PID using Root Locus and Bode Plot Approach, Direct Synthesis of Controller, Controller Design for System with and without Dead Time through Controller Synthesis Formula.

**Unit 4: State Space Analysis (07)**
State Transition Matrix, Concept of Controllability and Observability, Controllability and Observability Matrix, Necessary and Sufficient condition for State Controllability and State Observability.

**Unit 5: Design Concepts in State Space (08)**

State Variable Feedback, Control System Design using Pole Placement, State Observer, Quadratic Optimal Control System, Design of Optimal State Regulator using Riccati Equation, Concept of Performance Indices.

**Unit 6: Fundamentals of Digital Control (06)**
Introduction to Digital Control, Analog Control Vs Digital Control, Need of Digital Control, Advantages of and Limitations of Digital Control, Sample and Hold, Nyquist Theorem, Interpolation and Extrapolation.

**Text Books:**

1. B. C. Kuo, "Digital Control Systems", John Wiley and Sons, 2003.
2. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education.
3. D. Roy Choudhury, "Control System Engineering", PHI.

**Reference Books:**

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd Edition, 1998.
2. Norman Nise, "Control System Engineering", 3rd Edition, John Wiely and Sons.
3. R.C. Dorf & R.H. Bishop, "Modern Control System", 11th Edition, Pearson Education.
4. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, "Control System Design", PHI.
5. Christopher T. Kilian, "Modern Control Technology Components & Systems", 3rd Edition, Cengage Learning.
6. R. T. Stefani, B. Shahian, C. J. Savant and G. H. Hostetter, "Design of Feedback Control Systems", Oxford University Press.
7. Samarjit Ghosh, "Control Systems Theory and Applications", Pearson Education.

**20PEIN501B Biomedical and Analytical Instrumentation**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Human Anatomy and Physiology and Basics of optical Instrumentation.

**Course Objectives:**
1. To learn functioning of various body organs
2. To study the characteristics of signals generated during the functioning of the organ.
3. To learn bio signal acquisition and measurement techniques
4. To understand laws of photometry
5. To interpret instrumentation required for all types of spectroscopy

**Course Outcomes:**
1. Identify the characteristics of bio-signal generated during the functioning of an organ.
2. Analyse the various bio-signals recovered using different biomedical instruments
3. To interpret instrumentation required for all types of spectroscopy
4. To apply various principles for analysing different samples using suitable analytical technique

**Unit 1: Cell Anatomy (08)**
Structure and function of Cell. Generation and Conduction of Bio potential, Homeostasis, Sensors: Study of Bio transducers, Biochemical Sensors (Glucose, pH, Po2,Pco2), Electrode as sensor, Types of electrodes, Electrode circuit model.

**Unit 2: Cardiovascular System and measurement (08)**
Function of heart as Pump, electro conduction system, Basics of ECG, Einthoven triangle, 12 lead Configuration & Electrocardiograph, Types of ECG monitors, Analysis of ECG signal. Correlation of Blood Pressure, Heart Sounds, Blood Flow with ECG, Phonocardiography, Plethysmography Pulse transit time, Pulse wave Velocity, Blood pressure measurement-Manual and Automatic, Blood Flow meters- Electromagnetic, Ultrasound and Dye dilution.

**Unit 3: Physiological Systems (08)**
Respiratory system: lungs anatomy, Regulation of Respiration. Pulmonary function test: lungs volume and capacities, Artificial respiration, Spirometers, ventilators.
Structure and function of Neurons, brain anatomy, 10-20 electrode system, EEG basics.
Structure and function of Neurons, brain anatomy, 10-20 electrode system, EEG basics, Electroencephalograph.
Structure and function of kidneys and Nephron, regulation of water and electrolyte balance, dialysis.

**Unit 4: Overview and Introduction of Spectroscopy** **(06)**
Introduction to Analytical methods and its classification, Laws of Photometry, components of optical systems (source, wavelength selector, detectors, signal processor, readout device), UV- Visible Spectroscopy, IR Spectroscopy.

**Unit 5: Absorption & Emission Spectroscopy** **(06)**
Fluorescence & Phosphorescence Spectroscopy, Atomic absorption spectroscopy: Principle, Hollow cathode source, Types, working, Background correction methods.
Atomic emission spectroscopy: Principle, Sources (AC & DC Arc Excitation, Plasma Excitation), Types, working and Flame photometer.

**Unit 6: Separative Methods & Gas Chromatography** **(06)**
Components of mass spectrometry, Mass analyser types, Quantitative analysis of mixtures Chromatography: Fundamental of chromatographic separation, Gas chromatography, High Performance Liquid Chromatography.

**Text Books:**

1. Human Physiology- The Mechanism of Body Function By Vander, Sherman, TMH Ed.1981
2. Introduction to Biomedical Equipment Technology By Carr& Brown
3. Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, Pearson Education.
4. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH
5. Text book of clinical Ophthalmology- Ronald Pitts Crick, Pang Khaw, 2nd Edition, World Scientific publication. ISBN 981-238-128-7.
6. Medical Instrumentation, John G Webster
7. Khandpur R. S., Handbook of Analytical Instruments, Tata McGraw–Hill Publications, 3rd ed.
8. Ewing Galen W., Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company, 5th ed.
9. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, CBS Publishers. & Distributors, New Delhi, 7th ed.

## 20PEIN501C Advanced Microcontroller Techniques

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:**
1. Concepts of Microprocessors and Microcontrollers
2. Logic building concepts and programming microcontrollers in C

**Course Objectives**:
1. To introduce the architecture and features of high-capacity microcontrollers
2. To provide an understanding of integrated peripherals and its configuration
3. To design system for specified application

**Course Outcomes:** The students will be able to
1. Select appropriate features of microcontroller for given application.
2. Identify detailed hardware structure and software model of the microcontroller for the given application.
3. Develop configuration of integrated peripherals.
4. Design system for given application using microcontrollers

**Unit 1: Introduction to ARM Cortex (07)**
Architecture, Block Diagram, Programmer's Model, Registers and Memory Management, CPU operating modes, Pipeline, Thumb instructions set, Reset circuit and Sequence. Development Tools, Tool chains, Libraries and Software for programming

**Unit 2: The ARM Cortex Processor (08)**
Buses, System Timing, Interrupt handling and NVIC, Power management, Clock, comparison with ARM7 and ARM10

**Unit 3: Introduction to STM32 microcontrollers (08)**
Overview and Features of STM32 Microcontrollers, Advantages, Drawbacks and Subfamilies, Low Power operation and reset sources

**Unit 4: Integrated Peripherals of STM32 microcontrollers-I (07)**
General Purpose I/O, External Interrupts, ADC and Timers, DMA

**Unit 5: Integrated Peripherals of STM32 microcontrollers-II (06)**

SPI, I2C, USART, CAN and USB

**Unit 6: Small System Design with STM32 microcontrollers (06)**

System design for specified applications using integrated peripherals and external components necessary for the same.

**Books:**

1. Discovering the STM32 Microcontroller, Geoffrey Brown
2. The Insider's Guide To The STM32 ARM Based Microcontroller, Trevor Martin, Published by Hitex (UK) Ltd.
3. Mastering STM32, Carmine Noviello, Lean Publishing, 2016
4. The Definitive Guide to ARM Cortex®-M0 and Cortex-M0+ Processors, Joseph Yiu, Second Edition, Elsevier

**20PEIN502A Industry 4.0 and IIOT**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basic knowledge of Computer and Internet

**Course Objectives:**

1. To understand building blocks, components of IoT and concepts of Industry 4.0
2. To understand technologies used in IoT and Industry 4.0
3. To understand the role of platforms and big data in IoT

**Course Outcomes:** The students will be able to

1. Identify the different stages of industrial revolution & features of Industry 4.0.
2. Compare connectivity technologies & protocols used for IoT.
3. Comprehend IoT, cyber-physical systems, cloud computing and big data, smart factories and their role in Industry 4.0.
4. Select appropriate IoT technology for an application.

**Description:**

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

**Suggested Swayam link:**

https://onlinecourses.nptel.ac.in/noc22_cs95/preview

**Reference Books:**

1. S. Misra, A. Mukherjee, and A. Roy, 2020. *Introduction to IoT*. Cambridge University Press.
*Availability:*
https://www.amazon.in/Introduction-IoT-Sudip-Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1

2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0.* CRC Press.
*Availability:*
https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.

4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

## 20PEIN502B Biomedical

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of signals and systems and linear algebra.

**Course Objectives:**

1. Deduce which imaging technique is appropriate for a given application.
2. Describe their fundamental promises and limitations
3. Differentiate the imaging modalities covered in the course.

**Course Outcomes:** The students will be able to

1. Delineate various biomedical imaging modalities
2. Differentiate the imaging modalities covered in the course.
3. Select the appropriate imaging technique for given application
4. Identify various medical image processing algorithms

**Description:**

This course attempts to provide an introduction to the different commonly-used medical imaging systems. Overview of biomedical imaging systems and analysis. Examination of various imaging modalities. Although there are several courses and textbooks available from medical physics background, there are only a few materials that treat the subject from a system's perspective, which is the view point taken here.

Topics: Introduction, 2D- Signals Systems review, Image Quality metrics, Projection Radiography,:X-ray CT, Nuclear Medicine- PET/SPECT, Ultrasound Imaging, MRI

**Suggested Swayam link:**

https://onlinecourses.nptel.ac.in/noc22_bt56/preview

**Reference Books:**

1. Medical Imaging Signals and Systems by J. L. Prince and J. M. Links, Pearson Prentice Hall, 2006, ISBN 0130653535.
2. Webb's Physics of Medical Imaging, 2nd Edition, CRC press
3. Foundations of Medical Imaging , Z. H. Cho, J. P. Jones, and M. Singh , Wiley , 1993
4. Stewart C. Bushong, Radiologic Science for Technologists: Physics, Biology, and Protection, 10th ed., Mosby, 2012. (ISBN-13: 978-0323081351)

**20IN501L Process Loop Components Lab**

**Teaching Scheme:**
Practical: 2Hrs/weeks

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:**

1. Calibrate various process control components like transmitter, converter etc by selecting proper test and measuring instruments
2. Find the characteristics of various process control components like transmitter, converter, control valve etc.
3. Configure, tune and test various process control components like pressure switch, transmitter, controller, control valve etc by proper analysis of given application
4. Develop and implement control circuits and PLC programs for the given application

**List of Practical Assignments: (**Minimum 8)

1. Plot the characteristics of the pressure switch and observe the switch output.
2. Testing of various pneumatic and hydraulic components.
3. Identify the sequence of the given Alarm Annunciator and testing of Alarm annunciator using pressure switch
4. Calibration of Temperature Transmitter
5. Calibration of Current to pneumatic Converter
6. Plot the characteristics of square root extractor
7. Calibration of Differential pressure transmitter
8. Calibration of SMART differential pressure transmitter and Flow measurement using SMART differential pressure transmitter
9. Plot the step response of electronic controllers
10. PLC programming
11. Interfacing of PLC to pneumatic circuit
12. Plotting control valve characteristics
13. Open ended assignment on PLC programming

**Or similar type of practical assignments based on the course contents**

## 20IN502L Digital Signal Processing Lab

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** After the successful completion of the course the students will be able to:
1. Implement various DSP operations like convolution, auto correlation using Matlab.
2. Implement different transforms applied to signals using Matlab.
3. Design and implement IIR and FIR filters for bandpass, band stop, lowpass and high pass filters in Matlab.
4. Develop digital signal processing blocks for given application.

**List of Practical Assignments:**
Students are expected to perform at least eight experiments using MATLAB or equivalent software:
1. Write a program to generate the basic signals and implement the basic DSP operations on the given signals.
2. Write a Program to implement Linear Convolution of the two given sequences.
3. Write a Program to obtain the auto-correlation and Cross-correlations of the given sequences.
4. Write a Program to obtain the transfer function and plot is pole-zero plot
5. Write a Program to find the DFT of the given sequences. Plot its magnitude and phase plot. Also find its IDFT to obtain the original sequence.
6. Write a Program to design and implement FIR filters using difference windowing methods.
7. Write a Program to design and implement IIR filters (Using Butterworth or Chebyshev approximations).
8. Generation of signal. Generate a noise signal. Mix both the signals. Design a Filter. Recovery of original signal using filter.
9. DSP Application: design solution to any application using emerging technologies which is beyond syllabus.

**Or similar type of practical assignments based on the course contents**

**20PEIN501LA Modern Control Theory Lab**

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** Students will be able to
1. Investigate Time and Frequency Domain Specifications.
2. Choose, Compare suitable Compensator.
3. Determine, Compare and Choose Controller Tuning Parameters.
4. Apply Modern Control Techniques in Continuous and or Continuous/Discrete Domain.

**List of Practical Assignments:**
1. Effect of Addition of Pole and Zero on Transient and Steady State Performance of System.
2. Design of Lag, Lead-Lag and Lead Compensator.
3. Analysis of Effect of Proportional, Integral and Derivative Control Action.
4. Design of P, PI, PID Controller using Frequency Response Approach.
5. Design of Controller using Direct synthesis Approach for System with and without Dead Time.
6. Computation of State Controllability and State Observability for a System.
7. Computation of State Feedback Controller using Pole Placement Technique.
8. Computation of Full Order State Observer.
9. Design of Optimal State Regulator for Minimising Performance Index.
10. Formation of a Control System in Discrete Domain.

**Or similar type of practical assignments based on the course contents**

**20PEIN501LB Biomedical and Analytical Instrumentation Lab**

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:**
1. Analyse the bio signals acquired by biomedical instruments.
2. Operate biomedical instruments to record bio-signals.
3. Select appropriate analytical instruments for sample analysis based on application.
4. Test samples using various analytical instruments.

**List of Practical Assignments:**
1. To Study principles and design concept of biosensors and their applications in biomedical field.
2. To Measure systolic and diastolic Blood Pressure Using Sphygmomanometer and automatic BP apparatus for different subjects.
3. To study 12 lead configuration and details of ECG waveform using ECG recorder and calculation of heart rate.
4. To study standard amplitude and frequency of EEG signal and to learn frequencies of alpha, beta, delta, theta waves of EEG signal.
5. To learn and record various lung capacities of Respiratory system using Power lab.
6. To Study and Check Specifications of an ECG Recorder. To record various leads of ECG using ECG machine and analysis of recorded ECG signal.
7. To record/monitor first and second heart sound using Electronic Stethoscope and Power lab and analysis of recorded heart sound.
8. To design and implement the photo-plethysmography Sensor for Pulse Rate Measurement.
9. Analysis by using photoelectric colorimeter.
10. Analysis by using Densitometer.
11. Analysis by using Double beam spectrometer.
12. Analysis by using Flame photometer.
13. Analysis by using Spectrofluorometer.

**Or similar type of practical assignments based on the course contents**

**20PEIN501LC Advanced Microcontroller Techniques Lab**

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** The students will be able to
1. Program microcontroller for given application
2. Select integrated peripheral for given application
3. Configure the peripherals in different modes
4. Debug the developed program / given problem statement

**List of Practical Assignments:**
Part A: (any 5)
1. Introduction and familiarization with programming environment of ARM
2. Display interfacing and Programming using ARM
3. Wave generation using ARM
4. Introduction and familiarization with programming environment of STM32
5. Port configuration and programming for input/ output devices
6. Analog input measurement using ADC
7. Communication interface configuration and programming

Part B:
System development using STM32 microcontroller for given problem statement

**Or similar type of practical assignments based on the course contents**

MKSSS's Cummins College of Engineering for Women, Pune

(An Autonomous Institute Affiliated to SavitribaiPhule Pune University)

# Autonomous Program Structure
# Third Year B. Tech. Sixth Semester
# (Instrumentation and Control)
# Academic Year: 2022-2023 Onwards

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Oral | Practical | | |
| 20IN601 | Process Instrumentation and Control | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20IN602 | Industrial Automation | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN603 | System Engineering and Management | 3 | 1 | 0 | 50 | 50 | 0 | 0 | 100 | 4 |
| 20HS601 | Management Information System (MIS) | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIN601 | Programme Elective-III | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE601 | Open Elective-II | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN602L | Industrial Automation Lab | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| 20IN603L | System Engineering and Management Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20PEIN601L | Programme Elective Lab-III | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20IN604 | Mini Project | 0 | 0 | 2 | 25 | 0 | 0 | 25 | 50 | 1 |
| | **Total** | **18** | **2** | **8** | **400** | **300** | **50** | **50** | **800** | **24** |
| | **Grand Total** | **28** | | | **800** | | | | **800** | **24** |

| Programme Elective-III | Programme Elective-III Lab |
|---|---|
| 20PEIN601A Building Automation | 20PEIN601LA Building Automation |
| 20PEIN601B Embedded Product Design | 20PEIN601LB Embedded Product Design |

Department of Instrumentation & Control Engineering

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Secretary Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

CUMMINS COLLEGE OF ENGINEERING FOR WOMEN
KARVE NAGAR
PUNE-411 052

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Chairman Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

| | |
|---|---|
| 20PEIN601C MEMS | 20PEIN601LC MEMS |

| 20OE601 Open Elective-II | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE601A | Automation and Control Engineering | Y | Y | Y | Y | Y |
| 2 | 20OE601B | Automotive Electronics | Y | Y | Y | Y | Y |
| 3 | 20OE601C | Avionics | Y | Y | Y | Y | Y |
| 4 | 20OE601D | Bioinformatics | Y | Y | Y | N | Y |
| 5 | 20OE601E | Computer Vision | Y | Y | Y | Y | Y |
| 6 | 20OE601F | Design Thinking | Y | Y | Y | Y | Y |
| 7 | 20OE601G | e-Business | Y | Y | Y | Y | Y |
| 8 | 20OE601H | Electric Vehicles | Y | Y | Y | Y | Y |
| 9 | 20OE601I | Gamification | Y | Y | Y | Y | Y |
| 10 | 20OE601J | Geographical Information Systems | Y | Y | Y | Y | Y |
| 11 | 20OE601K | Multimedia Systems | Y | Y | Y | N | Y |

| 20OE601L Open Elective-II Lab | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE601LA | Automation and Control Engineering | Y | Y | Y | Y | Y |
| 2 | 20OE601LB | Automotive Electronics | Y | Y | Y | Y | Y |
| 3 | 20OE601LC | Avionics | Y | Y | Y | Y | Y |
| 4 | 20OE601LD | Bioinformatics | Y | Y | Y | N | Y |
| 5 | 20OE601LE | Computer Vision | Y | Y | Y | Y | Y |
| 6 | 20OE601LF | Design Thinking | Y | Y | Y | Y | Y |
| 7 | 20OE601LG | e-Business | Y | Y | Y | Y | Y |
| 8 | 20OE601LH | Electric Vehicles | Y | Y | Y | Y | Y |
| 9 | 20OE601LI | Gamification | Y | Y | Y | Y | Y |
| 10 | 20OE601LJ | Geographical Information Systems | Y | Y | Y | Y | Y |
| 11 | 20OE601LK | Multimedia Systems | Y | Y | Y | N | Y |



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**20IN601 Process Instrumentation and Control**

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs/week | In Semester: 50 Marks |
| Tutorial: 1 Hr/week | End Semester: 50 Marks |
| | Credit: 4 |

**Prerequisites:** Principle and applications of various Sensors and Transducers, Basics of control systems, Principle of actuators and final control element and their applications.

**Course Objectives:**
1. To understand the principles of multi-loop controllers and nonlinear systems.
2. To equip students with knowledge of multi variable control, interaction, the pairing, decoupling and design of controllers for interacting multi variable systems.
3. Explain the control loops related to heat exchanger, Boiler, distillation column, reactor, pumps and compressors

**Course outcomes:** The students will be able to
1. Identify the characteristics of given process
2. Compare the features of different control strategies
3. Select appropriate control strategy for given application
4. Develop the instrumentation and control loops for various processes

**Unit 1: Multi-Loop Control & Nonlinear Systems (09)**
SLPC and MLPC features, Feedback, feed forward control, cascade control, ratio control, selective control, split-range control
Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance, Improvement in nonlinear process performance through Deterministic Control Loop Calculations, Calculations of the measured variable, final control element selection, cascade control design, Real time implementation issues.

**Unit 2: Multivariable Control (09)**
Concept of Multivariable Control: Interactions and its effects, Modelling and transfer functions, Influence of Interaction on the possibility of feedback control, important effects on Multivariable system behaviour Relative Gain Array, effect of Interaction on stability and multiloop Control system. Multiloop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.

**Unit 3: Heat exchanger and Boiler controls (08)**

Types, gain and time constants, degrees of freedom. Basic controls in Heat exchangers, Steam Heaters, Condensers, fired heaters and vaporizers. Advanced Control Override, Feed forward Control.
Types, Components, Boiler controls like Drum level control (1,2,3,5 element), Air to fuel ratio control, Combustion controls, Steam temperature and pressure control, Safety interlocks, Burner management system, startup and shutdown procedures, boiler safety standards

**Unit 4: Distillation Column control (08)**
Mass and Energy balance, column feed control, column pressure control, control of overhead and bottom composition, distillate reflux flow control. Frequency response, lag in liquid and vapour flow, concentration lag, predicting the behaviour of control system

**Unit 5: Reactor and pumps and compressor control (08)**
Types of reactions and reactors, factors governing the conduct of reaction, stability of reactors, time constant, effects of lag, flow control, temperature control, pH control, end point detection of continuous and batch reactors. Sequential & logic control in batch process, batch production management.
Pumps: Types, Basic Controls, Multi pump system controls. Compressors: Types, Basic Controls.

**Text Books:**
1. Process Control Systems -F.G. Shinskey, TMH.
2. Instrument Engineers' Handbook: Process Control: B.G. Liptak, Chilton.
3. Optimization of Industrial Unit Processes - Bela G. Liptak

**Reference Books:**
1. Boiler Control Systems: David Lindsey, Mc GRAW-HILL

**Tutorials:**
**Minimum 8 assignments based on the theory syllabus**

## 20IN602 Industrial Automation

**Teaching Scheme:**
Lectures: 3Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of Process Loop Components

**Course Objectives:**

1. Understand the basic concepts of automation and its requirements.
2. To develop an automation project and its documentation.
3. To learn and apply standards and recommended practices to automation.
4. To understand the activities followed in automation projects.

**Course Outcomes:** The student will be able to,

1. Classify and compare the different automation tools used in industry.
2. Select suitable communication protocol for the required automation system.
3. Develop the logic and communication for any PLC/DCS system.
4. Discuss various safety methods used in automation industries.

**Unit 1: Introduction to Industrial Automation (08)**

Introduction to industrial automation (Automation Pyramid according to industry 4), Introduction to automation tools (PLC, HMI, SCADA, DCS, Robotics and Drives), Introduction to automation tools performance criteria, Development of URS (User Requirement Specification) for automation and FDS (Functional Design Specification) for automation tools.

**Unit 2: Components and Hardware (07)**

Controllers: PLC, DCS, Embedded controllers; Operator Interfaces: Text based interfaces, graphical interfaces, Touch screens; Sensors: Discrete devices (sourcing and sinking concept, limit switches, proximity switches), Analog (pressure, flow, temperature sensing), Special purpose components: Encoders(high speed counter), vision sensors, bar code, RFID; Contactors, Starters, Circuit breakers, fuses, terminal blocks; Actuators and motion control : Pneumatic and hydraulic actuators, motors. Wiring of discrete, analog input and output devices.

**Unit 3: Industrial Protocols (08)**

Definition of protocols, Introduction to OSI model, Communication standards (RS232, RS485), Modbus (ASCII/RTU), Foundation fieldbus (H1/HSE), Profibus, Profinet, Industrial Ethernet, CAN, DeviceNet, ControlNet and HART protocols, Introduction to third party interface. Comparison between the protocols.

**Unit 4: PLC Based Automation (07)**

IEC 61131-3 standard, Logic development(Timer, Counter, Compare, Math, Conversion and Move instructions) Analog control loop (PID) configuration in PLC, PLC to PLC communication, PLC to HMI communication, PLC to other devices communication programs(servo motor and stepper motor logic in PLC)

**Unit 5: Distributed Control System (06)**

DCS introduction, Architecture of different makes: comparison and specification, Configuration of discrete and analog IO's and programming, Development and configuration of user interface, alarm management, diagnosis, security and user access management.

**Unit 6: Process Safety and Safety Management System (06)**

Introduction to process safety, hazardous area classification, process hazard analysis, safety integrity levels (SIL), Introduction to IEC61511 standard, SIS application for safety system.

**Text Books:**

1. S.K.Singh, "Computer Aided Process Control", PHI.
2. Garry Dunning, "Introduction to Programmable Logic Controllers", Thomson Learning.
3. Krishna Kant, "Computer Based Process Control", PHI.
4. Frank Lamb, "Industrial Automation Hands On", Mc Graw Hill.

**Reference Books:**

1. Samuel Herb, "Understanding Distributed Process Systems for Control", ISA.
2. Webb & Reis, "Programmable Logic Controllers: Principles and Applications", PHI.

## 20IN603 System Engineering and Management

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| Lectures: 3hrs/week | In Semester: 50 Marks |
| Tutorial: 1 Hr/week | End Semester: 50 Mark |
| | Credit: 4 |

**Prerequisites**: -

**Course Objectives:**
1. To Know the basic concepts of Project Engineering and Management.
2. To Understand various engineering documents.
3. To interpret and apply national and international standards, and recommended practices.
4. To Know the activities followed in instrumentation projects.

**Course Outcomes:** By the end of the course, students should be able to
1. Develop documentation for, work distribution, team, planning and scheduling for any project.
2. Apply national and international standards, and recommended practices
3. Develop instrumentation detailed engineering documents as per required standards
4. Develop testing and commissioning documentation

**Unit 1: Basic Concept of Project Management (08)**
Definition, Types and Life cycle phases of project, Basics of Project management, Project Planning, Scheduling, Tools and techniques of project management.

**Unit 2: Instrumentation Documentation and its Related Standards (07)**
Detailed discussion of ISA standards, FEED documents (PFD, Material balance, P&ID etc.) and DED documents (Process data sheets, instrument index, instrument specification sheet, calculation sheets like valve sizing, thermowell design, orifice design etc.).

**Unit 3: Panels and Wiring Documentation (08)**
Electrical Panels: Specification, GA drawings, Instrumentation Panels (Instrument panels, Marshalling panels) Terminal Strip reports, Power requirement calculation etc. Instrument Cable: Types, specification, Cable trays, Control room engineering.

**Unit 4: EPC Contracting and Procurement Activities (07)**
Introduction to EPC contracting, Vendor registration, requirements for qualification documents. Tendering and bidding process, requirement and qualification documents, Bid

evaluation (Role and knowledge required as an instrumentation engineer), Purchase orders etc..

**Unit 5: Installation (06)**

Understand, design and develop instrument Installation sketches for various instruments (Hook up drawings like Thermowell, Flow transmitter, Differential pressure transmitter, orifice, pitot tube, rotameter, DPT type level transmitter installation specification etc.

**Unit 6: Commissioning and testing (06)**

Inspection and Testing: Factory Acceptance Test (FAT) Team, Planning, documentation, Customer or Site Acceptance Test (CAT or SAT), Team, Planning, documentation. Test and inspection reports. Pre-commissioning planning activities, documents required for Cold Commissioning and hot commissioning, Performance trials and final hand over, Calibration records

**Text Books:**

1. Applied instrumentation in process industries by Andrew & Williams (Gulf Publishing)
2. Management systems by John Bacon (ISA)
3. Process control Instrument Engineers Handbook by Liptak.

**Reference Books:**

1. Instrument Installation Project Management (ISA).
2. Successful Instrumentation & Control Systems Design, by Michael D. Whitt (ISA)

**Tutorials:**

**Minimum 8 assignments based on the course contents**

**20HS601 HS – Management Information System**

**Teaching Scheme:**
Lectures: 3 Hr/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To introduce the students to the Management Information Systems
2. Its application in organizations and related technology
3. The course would expose the students to the managerial issues relating to information systems.
4. Help them identify and evaluate various options in Management Information Systems.

**Course Outcomes:**
1. Identify the functionalities and use of Management information system in industry.
2. Analyse various factors of Management Information System in organization e.g. sales, profit, digital marketing.
3. Develop various information system like ERP,CRM, data warehouse, etc
4. Analyse various parameters of technology solutions in any organization

**Unit 1: Introduction to Management Information Systems (07)**
Need, Purpose and Objectives - Contemporary Approaches to MIS, architecture of MIS, MIS as an instrument for the organizational change. Organizational levels, functional area. Automation pyramid, MIS in level 5 of industry 4.0.

**Unit 2: Information System in Business (08)**
Data and Information: Introduction, data and information- measuring data, information as a resource, information in organisational functions, types of information technology, types of information systems- transaction processing systems-management information systems

**Unit 3: Management Information Systems, Technology, and Strategy (08)**
Role of Information Technology in Organization, Plant Operation management and digitization. Information System and Strategy; Strategic Analysis and management. The Information Centre, Plant Operation management and digitization.

**Unit 4: Systems Analysis and Design (07)**
Systems Development Life Cycle (SDLC), Alternative System Building Approaches Prototyping, Rapid Development Tools, Agile, CASE Tools, Object Oriented Systems. MIS in renewable energy.

**Unit 5: Decision Support Systems (06)**
Understanding DSS- MIS and DSS-Decision making-types of decisions, Analytics and Business Intelligence- BI techniques. Group Decision Support Systems, Executive Information Systems, Executive Support Systems, Expert Systems and Knowledge Based Expert Systems, Artificial Intelligence in DSS.

**Unit 6: SCM, CRM, EIS and International Systems (06)**
Introduction, Supply Chain Management Systems, Customer Relationships Management Systems, Challenges of Enterprise Systems Implementations- Managing the implementation, International Information Systems-Outsourcing and off-shoring.

**Text Books:**

1. Management Information Systems, Laudon and Laudon, 7th Edition, Pearson Education Asia
2. Management Information Systems, Jawadekar, Tata McGraw Hill
3. Management Information Systems - Sadagopan, Prentice Hall
4. Analysis and Design of Information Systems, Rajaraman, Prentice Hall

**Reference Books:**

1. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia
2. Management Information Systems, Schultheiss, Tata McGraw Hill
3. Management Information Systems, Davis and Olson, Tata McGraw Hill 4. Management Information Systems - Jayant Oke

## 20PEIN601A Building Automation

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of Electronics and Instrumentation

**Course Objectives:**
1. Enable students to understand basic concept of building automation
2. Learn to create safe, secure, comfortable, healthy, and sustainable environment in buildings
3. Learn to bring energy efficiency in building systems

**Course Outcomes:** The student will be able to
1. Delineate various HVAC system, fire and security system components and systems.
2. Investigate the system requirements to select HVAC system, fire and security system components.
3. Develop the HVAC air systems and water system operations and control philosophies
4. Develop the Fire Safety, Security and Access Control Systems.

**Unit 1: Introduction to Building Automation Systems (08)**
Intelligent buildings, its's architecture and structure - Evolution of intelligent buildings. Facilities management vs. intelligent buildings, Lifecycle of building. BAS System Hierarchy – Field level components, Direct Digital Control (DDC), Supervisory Controller, Server, Operator Workstation (OWS). Different systems in BAS which includes HVAC, security, fire, lighting systems. Importance of each system in BAS. Process of BAS design, Role of different stakeholders (Architect, contractor, consultant, application engineer and engineer) in BAS system design. BAS communication protocols and addressing concepts – BACnet and LON

**Unit 2: Comfort parameters and measurement in BAS system (08)**
Comfort parameters for human being - temperature, humidity, flow, pressure, clean air: Working Principle, Characteristics of different types of temperature sensors - RTD, Thermistor, Thermocouple, Bimetallic strip; Humidity, Specific Humidity, Relative Humidity, Dew point, Saturation point; Dry bulb & Wet bulb temperature, Working principle of Psychrometer; Pressure and Flow measurements in HVAC for air-side and water-side applications; Measurement of $CO_2$ level in air, Air filtration techniques, ozonisation and UV; Other Parameters affecting building operation - Building load for Chilled water and hot water system, Working principal of BTU meter, BTU meter mounting.

**Unit 3: HVAC Water Systems (07)**

Chilled Water Systems: Concept of refrigeration cycle. Working, mechanical configuration of different types of components used in refrigeration cycle - evaporator, condenser, compressor, expansion valve. Difference between air-cooled chiller and water-cooled chiller. Working and mechanical configuration of different types of cooling towers. Concept and working of heat pump. Design, working of different types of chilled water system - single chiller system, series chiller system, parallel chiller system. Working of different components of chilled water system - decoupler line, bypass line, primary circuit, secondary circuit, and condenser pumps.

Hot Water Systems: Working and design of different types of boilers- fire tube, water tube, packaged boiler. Working and design of different types of heat exchanger. Design of different types of hot water system- with boilers, heat exchanger with steam input, heat exchanger with hot water input. Concept of geothermal system - Variable frequency drives: Use of VFD's for Pumps and Fans. Purpose and application of VFD.

**Unit 4: HVAC Air Systems (07)**

Air Handling Units and Terminal units - Concept of Air handling unit. Design, working of different components in AHU - damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. Design and working of different types of AHU with combination of - 100% outdoor air, mixed air, constant volume, variable volume, dual duct, single duct. Operation of different modes in AHU - cooling, heating, humidification, dehumidification, static pressure control, volume matching, economizer mode. Heat recovery techniques - plate heat exchanger, heat recovery wheel and glycol heat recovery loop. Concept of Variable Air Volume (VAV) system - Design, working, use of different types of VAV- CAV, cooling only, with reheat, supply-exhaust VAV for critical areas (hospital and labs)

**Unit 5: Introduction to Fire Alarm System & Fire Detection (06)**

What is Fire? Fire alarm System-The History, FAS architecture & operation, Classification of Fire Alarm System, Conventional and Addressable Fire Alarm System, Important Codes-NFPA72, IS 2189, BS 5839, Critical fire & safety parameters in Facility Environment FAS Loops-Classification of Loops and Examples, Power Supply Requirement and its designing parameters. Battery Calculations. Network terminology for Fire Systems, Classification of Cables, Class of Cables, Types, and distance Supported specific to fire alarm system, Working Principles of Fire Alarm devices and its working Application in building safety, Components of fire detection system, SLC wiring and its classification, Concepts of Water leak detection system & Concepts of VESDA (Very early smoke detection system)

**Unit 6: Introduction to Building Security – Access Control & CCTV (06)**

Basic Concept of Access Control System it's benefits & architecture, Access Control System Devices –Its features and Working principles. Antipassback, Forgiveness, Two-man Rule, Time and Attendance, Guard Tour, Elevator Control, Secure and Non-Secure Concept, Card Technology Overview –Smartcard, Proximity Card, MI fare Cards, System Architecture of Access Control System, Basic of CCTV system, System Architecture of CCTV System, Types of Camera –Fixed, PTZ, Analog, Digital, Video Analytics, Camera Connectivity, Video Management System: DVR, DVM, NVR

**Text Books:**

1. Robert Gagnon, Design of Special Hazards and Fire Alarm Systems.
2. Damjanovski, Vlado, CCTV, Butterworth-Heinemann , 3rd ed.
3. Benantar M., Access Control System
4. Montgomery R, Fundamentals of HVAC Control Systems , Elsevier Publications
5. Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6. James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7. "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

**Reference Books:**

1. "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

**20PEIN601B Embedded Product Design**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Embedded system design, Knowledge of Assembly and C programming, Electronic instrumentation and system design

**Course Objectives:**
1. To give knowledge of interfacing analog and digital input devices to microcontrollers.
2. To give knowledge of interfacing analog and digital output devices to microcontrollers.
3. To implement different power optimization techniques for low power systems.
4. To give an overview of product design with case study.

**Course Outcomes:** Students will be able
1. Apply different methodologies to interface different sensors and devices to microcontrollers.
2. To apply different methodologies to interface different actuators to microcontrollers.
3. To explore and select proper power optimization techniques.
4. To design and test performance of a system.

**Unit 1: Programming and interfacing analogue input devices (07)**
Load cell, Temperature sensor, 2-wire transmitters, potentiometric sensors, LVDT, Linear opto IL300

**Unit 2: Programming and interfacing analogue output devices (08)**
Linear opto IL300, PWM based DAC, serial DAC, Voltage to current converter, Lamp/indicator, miniature DC motor,

**Unit 3: Programming and interfacing digital input devices (08)**
Key board, Proximity switch, incremental Encoders, Ultrasonic sensors, serial ADC, RTC-1307, Optocoupler MCT2E

**Unit 4: Programming and interfacing digital output devices (08)**
Alpha-numeric LCD, 7-Segment LED display, serial memories, Optocoupler MCT2E, printer, Stepper motor, relays (SSR and Electro-mechanical)

**Unit 5: Power efficient system and communication design (06)**
Design considerations for battery powered systems, communication based on RS-232, RS-485, Bluetooth, USB drives

**Unit 6: Small system design with case study (05)**
Embedded system design for Temperature data logger, Burglar alarm, Fire alarm, WSN based system, RFID based access control

**Text Books:**

1. Microcontrollers: Theory & Applications by Dr. A. V. Deshmukh, Tata McGraw Hill, Publications
2. Programming and Customizing the AVR Microcontroller by Dhananjay V. Gadre, Tata McGraw Hill Publishing Company Limited, 2003.
3. AVR microcontroller & Embedded System by A. Mazidi , Prentice Hall

**Reference Books:**

1. Internet resources for AVR:
2. Atmel AVR Page:. http://www.atmel.com/images/doc2502.pdf
3. http://www.atmel.in/Images/doc0856.pdf
4. Datasheets of ATmega 8535, ATtiny2313
5. Datasheets of IL300, RTC1307, MCT2E, serial ADCs, DACs

# 20PEIN601C MEMS

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Conventional sensors and materials, application of sensors

**Course Objectives:**
1. To introduce emerging MEMS field and importance of micro scaling to students
2. To provide knowledge of advanced materials, sensors and actuators
3. To learn advance micro fabrication techniques
4. To know advancement in instrumentation field of bio, automotive, aerospace field

**Course Outcomes:** The student will be able to,
1. Compare smart material based on their characteristics.
2. Select the appropriate micro sensor, micro actuator and type of microfluidic flow for given application.
3. Identify and define various phases of micro scaling and micro fabrication process.
4. Develop applications using MEMS devices.

**Unit 1: Introduction to MEMS (06)**
Introduction to MEMS, Introduction to micro sensors, Evaluation of MEMS, Application of MEMS

**Unit 2: Smart Material (08)**
Shape memory Materials, Electrostrictive Materials, Magnetostrictive Materials, Rheological Materials, Electro chromic Materials, Self-healing Material, Conducting polymer

**Unit 3: Micro Fabrication (09)**
Study of Silicon as a Material for Micromachining, Thin-film Deposition –Evaporation, Sputtering, Chemical Vapor Deposition, Epitaxial Growth of Silicon Thermal Oxidation, Lithography, Doping the Silicon Wafer: Diffusion and Ion, Implantation of Dopants, Etching. Dry Etching, Silicon Micromachining Bulk Micromachining, Surface Micromachining

**Unit 4: Micro Sensor and Micro Actuator (07)**
Micro sensor - Silicon Capacitive Accelerometer, Conductometric Gas Sensor, Fibre-Optic Sensors, Electrostatic Comb-Drive
Micro Actuator - Magnetic Micro relay, Microsystems at Radio Frequencies, Piezoelectric Inkjet Print Head, Portable Blood Analyzer, Micro mirror Array for Video Projection

**Unit 5: Microfluidics** **(06)**
Droplet Microfluidics, Active Flow control, Microvalves, Electrically actuated microvalves, Micromixers, Combinational Mixers, Elastomeric Micromixers. Microfluidic for Flow cytometry, cell sorting, cell trapping, Cell culture in microenvironment.

**Unit 6: MEMS –Electronics, Packaging and Applications** **(05)**
Wafer Bonding & Packaging of MEMS Interface Electronics for MEMS

**Text Books:**

1. Micro And Smart Systems by G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Atre : Wiley, India (2010).
2. Microfluidics and Microfabrication by Suman Chakraborty
3. Foundation of MEMS by Chang Liu
4. An Introduction to MEMS by Nadim Maluf and Kirt Williams

**Reference Books:**

1. Smart Material Systems and MEMS: Design and Development Methodologies, Vijay, K., Varadan K., Vinoy J. Gopalakrisham S. Willey 2006
2. Smart materials and new technologies, Addington, M. ,Schodek, Daniel L. Architectural Press, 2005.
3. Smart Structure and Materials, Brain Culshaw Artech House – Borton. London 1996
4. Smart Structure analysis and design, Srinivasan A.V., Michael McFarland D., Cambridge University Press, 2001
5. Fundamentals of Micro fabrication, Marc Madou

## 20OE601C Avionics

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of Control Systems, Basics of Communication System

**Course Objectives:**
1. To integrate the digital electronics with cockpit equipment
2. To understand the various principles in flight desk and cockpit panels.
3. To understand the communication techniques used in aircraft.
4. To explain the modern era of flight control system

**Course Outcomes:** The student will be able to
1. Identify the mechanical and electronic hardware required for aircraft.
2. Compare the communication and navigation techniques used in aircrafts.
3. Disseminate the autopilot and cockpit display related concepts.
4. Compare and identify different actuators in avionics.

**Unit 1: Introduction to Avionics (08)**
Basics of Avionics-Basics of aircraft- glider – control surfaces- Cockpits instrumentation -Need for Avionics - Integrated Avionics Architecture.

**Unit 2: Digital Avionics Bus Architecture (07)**
Avionics Bus architecture–Data buses MIL–RS 232- RS422-RS 485-STD 1553- ARINC 429–ARINC 629- Aircraft system Interface- Network topologies

**Unit 3: Flight Deck and Cockpit (07)**
Control and display technologies CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil cockpit and military cockpit: MFDS, PFDS-HUD, HMD, HMI

**Unit 4: Avionics Systems (06)**
Communication Systems – Navigation systems – Flight control systems – Radar electronic Warfare – Utility systems Reliability and maintainability Fundamentals-Certification-Military and civil aircrafts.

**Unit 5: On Board Navigation Systems** **(07)**

Overview of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture , performance aspects, approach and landing challenges, regulatory and safety aspects, black box instrumentation INS, GPS and GNSS characteristics.

**Unit 6: Basics of Final Control Element** **(06)**

Basics of pneumatic, hydraulic and electric actuators, Function of DC Servo motor, AC Servo motor function of pneumatic, hydraulic actuators.

**Text Books:**

1. R.P.G. Collinson, "Introduction to Avionics", Chapman & Hall Publications, 1996.
2. N. S. Nagaraja(1996),Elements of electronic navigation, 2 edition, Tata McGraw Hill, New Delhi.

**Reference Books:**

1. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Brain Kendal, "Manual of Avionics", The English Book House, 3rd Edition, New Delhi, 1993

**20OE601D Bioinformatics**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To understand the basics of bioinformatics and explore various databases used in bioinformatics.
2. To be familiar with a set of well-known supervised, unsupervised learning algorithms used for bioinformatics applications.
3. To understand the concepts and types of Phylogeny.

**Course Outcomes:** Students will be able
1. Apply basic concepts of bioinformatics to biological data analysis.
2. Classify different types of biological databases.
3. Apply various techniques, algorithms and tools to nucleic acid and protein sequence analysis.
4. Apply various techniques, algorithms and tools to be used for phylogenetic analysis.

**Unit 1: Introduction to Bioinformatics (06)**
Definition, applications, Protein and DNA structure, Biological Data Acquisition: The form of biological information. Retrieval methods for DNA sequence, protein sequence

**Unit 2: Bioinformatics Databases (08)**
Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence, Information on various databases and bioinformatics tools available. For eg; nucleic acid sequence database (GenBank, EMBL, DDBJ), protein sequence databases (SWISSPROT, TrEMBL, PIR, PPB)

**Unit 3: Algorithms for bioinformatics (08)**
Introduction to various machine learning techniques and their applications in bioinformatics. Genetic algorithm, Support Vector Machine, Neural Network and their practical applications towards the development of new models, methods and tools for bioinformatics

**Unit 4: Sequence Analysis (08)**

Various file formats for biomolecular sequences - genbank, fasta, gcg, msf, nbrf-pir, etc Basic concepts of sequence similarity, identity and homology, paralogues. Sequence based database searches - BLAST and FASTA algorithms

**Unit 5: Sequence Alignment** **(06)**

Pairwise and Multiple Sequence Alignments (MSA). Basic concept of sequence alignment, Pairwise alignment (Needleman and Wunsch, Smith and Waterman algorithms), MSA (Progressive and Hierarchical algorithms). Their use for analysis of Nucleic acid and protein sequences and interpretation of results

**Unit 6: Phylogeny** **(06)**

Phylogeny analysis, definition and description of phylogenetic trees and its types. Various computational methods in phylogenetic and molecular evolutionary analysis

**Text Books/Reference Books:**

1. Hooman Rashidi, Lukas K. Buehler, 'Bioinformatics Basics: Applications in Biological Science and Medicine' (2nd Edition) (May 2005)
2. Des Higgins (Ed),Willie Taylor (Ed), 'Bioinformatics: Sequence, Structure and Databanks - A practical approach' (1st Edition) (October 2000)
3. N.J. Chikhale and Virendra Gomase, 'Bioinformatics- Theory and Practice' (1st Edition)(July 2007)
4. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
5. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC
6. Mathematical Biology & Medicine), by SorinDraghici
7. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
8. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

**20IN602L Industrial Automation Lab**

**Teaching Scheme:**
Practical: 2Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** Students will be able to,
1. Develop URS and FDS documents for any automation project.
2. Develop PLC/ DCS logic for any given industrial application.
3. Simulate and test the developed logic for the given application.
4. Interface different devices with PLC/ DCS

**List of Practical Assignments:(any 8)**
1. Compare the applicability of different automation tools for the given application.
2. Preparing URS and FDS for any automation project.
3. Logic implementation of any automation project in PLC using ladder language.
4. Logic implementation of any automation project in PLC using FBD language.
5. Simulate digital and analog function blocks in DCS.
6. Tune PID controller for any loop using PLC/DCS.
7. Interface PLC and HMI for any automation project through OPC or suitable protocol.
8. Study the interfacing of PLC to PLC and PLC to other devices(Servo motor, stepper motor, printer, etc)
9. Develop Graphical User Interface in DCS for any control loop.
10. Study the application of different safety systems (Case study).

**Or similar type of practical assignments based on the course contents**

**20IN603L System Engineering and Management Lab**

| | |
|---|---|
| **Teaching Scheme:** | **Examination Scheme:** |
| Practical: 2Hrs/Week | In Semester: 25 Marks |
| | Oral: 25 Marks |
| | Credit: 1 |

**Course Outcomes:** By the end of the course, students should be able to
1. Develop Project Management documents
2. Apply national and international standards and recommended practices.
3. Create instrumentation detailed engineering documents as per specified standards
4. Create testing and commissioning documentation.

**List of Practical Assignments:**
1. Develop documents for SOW/WBS/Organization structure for any I&C Project
2. Interpret the Process flow diagram and Material Balance sheet.
3. Introduction Auto CAD like (smart sketch etc.) software.
4. Develop P&ID for given process
5. Develop Instrument Index sheet, I/O list for given P&ID
6. Develop Specification sheets for given instruments and P&ID
7. Develop GA drawings for a given panel (JB/Electrical/ PLC/DCS) .
8. Develop Hook up drawings (Control valve, Thermowell, orifice plate, rotameter etc..)
9. Create Loop Wiring Diagram/Logic diagram
10. Create documents for tests like FAT/SAT or CAT
11. Develop commissioning documents.

**Or similar type of practical assignments based on the course contents**

**20PEIN601LA Building Automation Lab**

**Teaching Scheme:**
Practical: 2Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes**: Student will be able to,
1. Describe the various components of a Building Automation System.
2. Investigate the system requirements of a Building Automation System.
3. Design the various Building Automation System components.
4. Develop the various Building Automation System components.

**List of Practical Assignments:** (minimum eight)
1. To study Architecture of BMS & IBMS
2. To study Psychrometric chart and various parameters
3. To study different types of Air Handling Units
4. To study various terminal unit systems (CAV, VAV)
5. To study Chilled Water System and loops
6. To study Hot Water System and loops
7. To study FAS loops and classifications
8. To study SLC wiring, loops, classifications
9. To study cause and effect matrix-Fire alarm system
10. To study CCTV System Architecture and types of cameras

**Or similar type of practical assignments based on the course contents**

## 20PEIN601LB Embedded Product Design Lab

**Teaching Scheme:**
Practical: 2Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** The student will be able to
1. Verify and compare the performance of different displays
2. Design and interface various sensors to embedded controller
3. Select appropriate output devices for given application
4. Design and test embedded controller-based systems for industrial application.

**List of Practical Assignments: (minimum 5)**
1. Interfacing of Keyboard and LCD
2. Interfacing of 2-wire transmitter
3. Design of up-down counter and Interfacing of 7-segment LED display
4. Design and testing of an application based on power down mode of microcontroller

**(Any 1 from)**
5. Temperature indicator using LM35
6. Interfacing of proximity switch and relay using MCT2E optocoupler
7. Distance measurement using ultrasonic sensor HC-SR04

**(Any 1 from)**
8. Speed control of miniature DC motor
9. Intensity control of Lamp/Power LED
10. Programmable voltage to current converter

**Or similar type of practical assignments based on the course contents**

**20PEIN601LC MEMS Lab**

**Teaching Scheme:**
Practical: 2Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:**
1. Simulate a sensor design through software like COMSOL
2. Selection of appropriate sensor and actuator for the specified application
3. Characterization of simulated sensor design
4. Design a MEMS system based on the specified application

**List of Practical Assignments:**
1. Finite element simulation of MEMS sensor – COMSOL/ANSYS
2. Design of MEMS sensor – system on a chip approach
3. Fabrication of MEMS sensor – resistive/capacitive type
4. Characterization of MEMS sensor – resistive/capacitive type
5. Microfluidics – Design, simulation, fabrication and characterisation
6. Micromixers – Design, simulation, fabrication and characterisation
7. Paper microfluidics – Simulation, fabrication and characterisation

**Or similar type of practical assignments based on the course contents**

# 20IN604 Mini Project

**Teaching Scheme:**
Practical: 2 Hrs/week

**Examination Scheme:**
In Semester: 25 Marks
Practical: 25 Marks
Credit: 1

**Course Outcomes:** Students will be able to
1. Identify and define with proper study, problem statement related to industry, healthcare, society, laboratory.
2. Design various stages to solve the identified problem.
3. Implement and test the developed design or system or prototype
4. Prepare and present technical documentation of the developed system.

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**Autonomous Program Structure of**

**Final Year B. Tech. Seventh Semester**
**(Instrumentation & Control Engineering)**
**Academic Year: 2023-2024 Onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Total Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Sem | End Sem | Practical | Oral | | |
| 20IN701 | Internship/Project | 0 | 0 | 0 | 200 | 0 | 0 | 100 | 300 | 15 |
| 20HS702 | Economics and Personal Finance (EPF) (Online) | 2 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 2 |
| | **Grand Total** | **32** | | | | | | | **400** | **17** |

| | Credits | Marks | ıching Hrs / week | ıluation Mode |
|---|---|---|---|---|
| Internship / Project = | 15 | 300 | 30 | Presentations + Oral |
| HS- EPF (Online) = | 2 | 100 | 2 | ISE + ESE |

**Duration of Internship / Project :**

1. Full Internship 6 Months
2. Full Project 6 Months
3. Combination: Internship of 2 to 6 Months duration + Project from 1 to 6 Months Duration.

**For Internship / Project:**
**In-Sem-Reviews =Two** ; **ESE = One Review with external (Final)**

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**20IN701: Internship/Project**

**Teaching Scheme:**
Practical: 30 Hrs/week

**Examination Scheme:**
In Semester: 200 Marks
Oral: 100 Marks
Credit: 15

**Course Outcomes:** The student will be able to

1. Identify and define technical problem related to various fields.
2. Implement and test the designed stages involved in solving the defined problem statements.
3. Work in a team and abide by the norms of professional ethics.
4. Gain effective communication and documentation skills along with self-learning ability.

Cummins

**Autonomous Program Structure of**
**Final Year B. Tech. Eighth Semester**
**(Instrumentation & Control Engineering)**
**Academic Year: 2023-2024**
**onwards**

| Course Code | Course Title | Teaching Scheme Hours /Week | | | Examination Scheme | | | | Marks | Credit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Lecture | Tutorial | Practical | In Semester | End Semester | Oral | Practical | | |
| 20IN801 | Process Data Analytics | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIN801 | Program Elective-IV | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20PEIN802 | Program Elective-V | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE801 | Open Elective-III | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20OE802 | Open Elective-IV* | 3 | 0 | 0 | 50 | 50 | 0 | 0 | 100 | 3 |
| 20IN801L | Process Data Analytics lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| 20PEIN801L | Program Elective–IV Lab | 0 | 0 | 2 | 25 | 0 | 25 | 0 | 50 | 1 |
| | **Total** | **15** | **0** | **4** | **300** | **250** | **50** | **0** | **600** | **17** |
| | **Grand Total** | **19** | | | **600** | | | | **600** | **17** |

| **Programme Elective-IV** | **Programme Elective-IV Lab** |
|---|---|
| 20PEIN801A Process Modelling and Optimization<br>20PEIN801B Artificial Intelligence and Machine Learning<br>20PEIN801C Medical Device Technology | 20PEIN801LA Process Modelling and Optimization<br>20PEIN801LB Artificial Intelligence and Machine Learning<br>20PEIN801LC Medical Device Technology |

| **Programme Elective-V** |
|---|
| 20PEIN802A Safety Instrumentation Systems<br>20PEIN802B Computer Techniques and Operating Systems<br>20PEIN802C Environmental Instrumentation |

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| 20OE801 Open Elective-III | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE801A | Big Data and Analytics | Y | Y | Y | Y | Y |
| 2 | 20OE801B | Cyber Physical Systems | Y | Y | Y | N | Y |
| 3 | 20OE801C | Digital Control | Y | N | N | Y | Y |
| 4 | 20OE801D | Industrial Engineering and Management | Y | Y | Y | Y | Y |
| 5 | 20OE801E | Introduction to Cyber-crime and Forensics | Y | Y | Y | Y | Y |
| 6 | 20OE801F | Instrumentation in Food and Agriculture | Y | Y | Y | Y | Y |
| 7 | 20OE801G | Medical IoT | Y | Y | Y | N | Y |
| 8 | 20OE801H | Quantum Computing | Y | Y | Y | N | Y |
| 9 | 20OE801I | Renewable Energy Sources | Y | Y | Y | Y | Y |
| 10 | 20OE801J | Soft Computing | Y | Y | Y | Y | Y |
| 11 | 20OE801K | Software Testing and Quality Assurance | Y | Y | Y | Y | Y |

| 20OE802 Open Elective-IV | | | Eligible Departments | | | | |
|---|---|---|---|---|---|---|---|
| Sr. No. | Course Code | Course Title | EnTC | Comp | IT | Mech | Instru |
| 1 | 20OE802A | Applied statistics with R Programming | Y | N | N | Y | Y |
| 2 | 20OE802B | Automobile Engineering | Y | Y | Y | N | Y |
| 3 | 20OE802C | Autonomous Robots | N | Y | Y | Y | N |
| 4 | 20OE802D | Building Automation and Energy Audit | Y | Y | Y | Y | N |
| 5 | 20OE802E | Data Analysis and Visualization | Y | N | Y | Y | Y |
| 6 | 20OE802F | Data Science using Python | Y | N | Y | Y | Y |
| 7 | 20OE802G | Industrial Drives and Control | Y | Y | Y | Y | N |
| 8 | 20OE802H | Smart Sensors and Systems | Y | Y | Y | Y | N |
| 9 | 20OE802I | Wireless Networks | N | Y | Y | N | Y |

**20IN801 Process Data Analytics**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To explore the statistical analysis techniques for various kinds of data.
2. To understand the concepts and types of Artificial Intelligence and Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

**Course Outcomes:** The student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. List and define the basic concepts of artificial intelligence and machine learning.
3. Compare and select various machine learning algorithms for solving practical problems.
4. Implement various machine learning algorithms to different domains.

**Unit 1: Introduction to data analytics (07)**

Need of data analytics in process industries, types of data analytics (Descriptive analytics, Diagnostic analytics, Preventative analytics and Prescriptive analytics), Application of each type of analytics in various process and manufacturing industries. Data types: Structured, unstructured data and challenges with unstructured data, numerical and categorical data.

**Unit 2: Data Acquisition and Preprocessing (07)**

Sources of data: internal and external. Data acquisition: data access, Data handling at different levels of data access modes, ownership of data, data security, data reliability
Data Preparation: Data restoration, Identification of tables/fields of interest, Importing into the analytical tool, Merging and splitting data files, Data cleaning, Missing values and other data preparation steps, Data integration: linking multiple databases.

**Unit 3: Descriptive Statistics (07)**

Compute measures of central tendency (mean, mode, median), measures of variability (Range, variance, standard deviation, degrees of freedom), normal distribution (Characteristics of normal distribution, skewness, kurtosis), confidence interval.

**Unit 4: Inferential Statistics (07)**

Hypothesis and hypothesis testing, Chi square test, t test, correlation, Linear regression, multi regression, Logistic regression, Goodness of fit, Analysis via linear models, Non-linear model: ANOVA, Test decision rules

**Unit 5: Supervised and Unsupervised Learning Methods (07)**

Compare supervised and unsupervised learning, Supervised learning algorithms: Neural networks, Naive Bayes, Linear regression, Logistic regression and random forest
Unsupervised learning methods: Clustering, Associative Rule Mining, Introduction to Big Data and Challenges for big data analytics. Case studies and applications of algorithms in process applications.

**Unit 6:Clustering and Classification (07)**

Basics of clustering and classification, classification metrics, classification via Bayes rule, Identifying clusters in your data, Clustering and classifying using nearest neighbors algorithm: Average nearest neighbor, k nearest neighbor , Decision trees. Case studies and applications of algorithms in process applications.

**Text Books:**

1. Montgomery, Douglas C. and Runger, George C. (2014) Applied Statistics
2. Probability for Engineers, 6 th edition, John Wiley & Sons, Inc (ISBN-978-1118539712).
3. An Introduction to R, by Venables and Smith and the R Development Core Team.
4. Data Analysis and Graphics Using R; An Example-based Approach, by John Maindonald and John Braun. Cambridge Series in Statistical and Probabilistic Mathematics, 2003.
5. Sheldon M. Ross,"Introduction to Probability and Statistics for Engineers and Scientists", 4th edition, Academic Press; 2009.

**Reference Books:**

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2.Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", VPT, 2016
3. E. Alpaydin, "Machine Learning", MIT Press, 2010.
4. K. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
5. C. Bishop, "Pattern Recognition and Machine Learning, Springer", 2006.
6. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
7. John Mueller and Luca Massaron, "Machine Learning For Dummies", John Wiley & Sons, 2016.

8. Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015
9. Hastie, Trevor, et al. "The elements of statistical learning". Vol. 2. No. 1. New York: springer, 2009.
10. Montgomery, Douglas C., and George C. Runger. "Applied statistics and probability for engineers" John Wiley & Sons, 2

## 20PEIN801A Process Modelling and Optimization

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Process Instrumentation, Automatic Control System, Control system Design

**Course Objectives:**
1. Understand and develop system's mathematical models.
2. Learn the use of Numerical methods in solving the model equations.
3. To learn to various optimization techniques.

**Course Outcomes:** The student will be able to
1. Define and list types of mathematical models.
2. Develop mathematical model of process.
3. Simulate and analyse the system performance.
4. Apply the optimization techniques and analyse the results.

**Unit 1: Modelling Aspects & Mathematical Models (07)**

Definition of process model, physical and mathematical modelling, deterministic and stochastic process. Introduction, uses of mathematical models, classification of mathematical methods, scope of coverage, principles of formulation, fundamental laws, continuity equations, energy equations, equation of motion, transport equation, equation of state, equilibrium, kinetics

**Unit 2: Mathematical Modelling of Mechanical & Chemical Engineering Systems (08)**

Process models of some typical systems in differential equations form, , dead time, first and second order models, higher order models, Behaviour of first order and second order system

**Unit 3: Mathematical Models (08)**

Mathematical Models of Tanks in series, Tanks in parallel Reaction dynamics, Modelling the chemical reactions, CSTR models, Plug flow reactor model, modelling of flash drum, distillation columns, evaporators, dryers, heat exchangers.

**Unit 4: Basic concept of Optimization (07)**

Optimization: Concept, need, Essential features of optimization Problem, Concepts of objective functions, Equality and Inequality Constraints, Payback period, Return of Investment, Net present Value, Internal Rate of Return. Classification of optimization problem, Continuity of functions, convex and concave functions, Convex Region, Extremum of the objective functions, quadratic approximation, Feasible region.

**Unit 5: Optimization of Unconstrained Functions & Linear Programming (06)**

One-Dimensional search numerical methods for optimizing a function of one variable , scanning and bracketing procedures, Newton, Quasi Newton and Secant methods, Runge Kutta method.

**Unit 6: Unconstrained Multivariable Optimization (06)**

Simplex method, Direct Methods, Indirect Methods, Steepest Descent method. Linear Programming: Basics of Linear Programming, Simplex Algorithm

**Text Books:**

1. W. L. Luyben, Process, Modelling, Simulation and Control for Chemical Engineers• by McGraw Hill, 1973.
2. Thomas Edgar, David Himmelblau, Optimization of Chemical Processes• Second edition, McGraw Hill, 2001.

**Reference Books:**

1. W. F. Stoecker, Design of Thermal Systems International Education, McGraw hill 1989.
2. J. Malley, Practical Process Instrumentation and Control • McGraw Hill.
3. Deo Narsingh ,System Simulation with digital Computer • Prentice Hall India, New Delhi.
4. Singiresu S.Rao,Engineering Optimization (Therory & Practice),third Edition,New Age International(p) Ltd,Publishers.

## 20PEIN801B Artificial Intelligence and Machine Learning

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs/Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credit: 3 |

**Prerequisites:** Basics of Mathematics, Computational Techniques.

**Course Objectives:**
1. To explore the statistical analysis techniques for various kinds of data.
2. To understand the concepts and types of Artificial Intelligence and Machine Learning Algorithms.
3. To be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms.

**Course Outcomes:** The students will be able to
1. Explore Machine Learning Methodology
2. Analyse research-based problems using Machine Learning Techniques.
3. Formalize a given problem in the different AI methods.
4. Implement basic AI algorithms.

**Unit 1: Machine Learning** **(08)**
Machine learning -examples of machine learning applications
Types of Learning: Supervised, Unsupervised, Issues in machine learning. Hypothesis, Target Function, Cost Function, Gradient, Training, Testing, Cross-validation, Evaluating hypothesis accuracy.

**Unit 2: ML Algorithms** **(09)**
Classification Algorithms , Regression Algorithms, Clustering Algorithms,
Deep Learning,

**Unit 3: Fundamentals of Artificial Intelligence** **(08)**
Introduction, What is AI, Applications of AI, Types of AI, A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, Production Systems, Problem Characteristics, Types of production systems.

**Unit 4: State Space Search** **(09)**
Search Algorithms: Depth Bounded DFS, Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Optimal Search: A* algorithm, Iterative Deepening A*, AO* search.

**Unit 5: Applications of AIML** **(08)**
Case Study: Uber Alternative routing, Credit card fraud analysis, Sentiment Analysis,
Camera Age Analysis, etc

**Text Books:**

1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hil
2. Stuart Russell & Peter Norvig : "Artificial Intelligence : A Modern Approach", Pearson Education, 2nd Edition.
3. T. Mitchell, Machine Learning,”, McGraw-Hill, 1997.
4. Anup Kumar Srivastava, Soft Computing, Alpha Science International limited. 2009.

## 20PEIN801C Medical Device Technology

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Physiology of human body organs

**Course Objectives:**
1. To study diagnostic and operating instruments
2. To study life saving devices
3. Get the knowledge of laser technology
4. To learn various instruments used for checking performance of sensory organs

**Course Outcomes:**
1. Suggest the use of life saving devices for cardiovascular diseases
2. Justify the need and working of continuous monitoring devices
3. Describe use of lasers for various medical applications
4. Summarise use of diagnostic instruments

**Unit 1: Cardiac Assistive and Coronary Care Devices: (06)**
Pacemaker, Types of pacemakers: External and Internal, Programmable Pacemaker, Defibrillators: AC and DC Defibrillator, Implantable defibrillator, Heart Lung Machine.

**Unit 2: Clinical Lab Instrumentation (06)**
Blood and its composition and function, Blood Cell Counters, Electrophoresis, Pulse Oximetry- principle, Invitro and In vivo Oximeter, Telemetry- Time division and Frequency division multiplexing, Telemedicine.

**Unit 3: Respiratory and Kidney Therapy Equipment (06)**
Spiro meters, Ventilators, Dialysis System- Haemodialysis and Peritoneal dialysis Artificial Kidney-types (Coil type, parallel plate type), Lithotripsy

**Unit 4: Laser Applications and Rehabilitation Engineering (06)**
Types of lasers, Properties of laser, Basic Endoscopes system and its characteristics ,Laser applications in ophthalmology- Diabetic Retinopathy, glaucoma and Retinal hole and detachment treatment , Dermatology- Tattoo, port wine treatment.
Orthotics & Prosthetic devices, overview of various orthotics and prosthetic devices along with its materials. Wheelchair types, material used in wheelchair.

Motor Rehabilitation: Functional Electrical Stimulation - Robotics in rehabilitation - Sports, stroke and geriatric Rehabilitation - Assistive technology for dyslexia - Computer & internet access for challenged people - Neural engineering in rehabilitation engineering -

**Unit 5: ICU Operating Room Instrumentation, Electrical & Fire Safety: (06)**

Drug Delivery System, ICU layout: organization, bedside monitor. Operating room instrumentation: Electro surgical Unit, Anaesthesia Machine. Sources of Shocks, Macro and Micro Shocks, monitoring and Interrupting the operation from leakage current-Elements of Fire, causes of fire and protection.

**Unit 6: Sensory Assist Devices (06)**

Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids, Visual acuity, Slit Lamp, Tonometer, Ophthalmoscope, Perimeter.

Assistive Devices for Visual and hearing Impairments, application of DSP in hearing aids - Cochlear implants - Voice synthesizer, speech trainer - Ultra sonic, Infrared and LASER canes - Intra ocular lens - Braille Reader - Tactile devices for visually challenged - Text voice converter - Screen readers.

**Text Books:**

1. Medicine and Clinical Engineering by Jacobsons& Webster, PHI
2. Introduction to Biomedical Equipment Technology ByCarr& Brown
3. Biomedical Instrumentation and Measurements by Cromwell, PHI
4. Handbook of Biomedical Instrumentation by R. S. Khandpur, TMH

**Reference Books:**

1. The Biomedical Engineering Handbook, Bronzino, IEEE Press
2. Applied Chemical Engineering Feenberg,
3. Principles of Medical Imaging.-By: K. Kirk Shung, Michael B. Smith, BenjaminTsui.-Pub: Academic Press.
4. Medical Laser Applications -By Carruth
5 .Biomedical Instrumentation and Measurement, R.Anandanatarajan

**20PEIN802A Safety Instrumentation Systems**

| **Teaching scheme:** | **Examination scheme:** |
|---|---|
| Lectures: 3Hrs /week | In semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credit: 3 |

**Prerequisites**: -

**Course Objectives:**
1. To make the students aware of basic concepts of safety instrumented system,
2. To make the students aware of standards
3. To make the students aware of risk analysis techniques.

**Course Outcomes:** The student will be able to
1. Differentiate between process control and safety control and identify the role of safety instrumented systems in the industry.
2. Identify and analyse the process hazards.
3. Select the Safety integrity level.
4. Analyse the performance of different logic system technologies and field devices with optimum risk levels.

**Unit 1: Introduction (07)**
Safety Instrumented System (SIS) - need, features, components, difference between basic process control system and SIS, Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions, review of Standards and Regulations related to Safety,

**Unit 2: Safety Life Cycle (08)**
Hazard and risk analysis, allocation of safety functions to protective layers, develop safety requirements specification, SIS design & engineering, installation commissioning and validation, operations and maintenance, modifications, decommissioning.

**Unit 3: Determining the Safety Integrity Level (SIL) (07)**
Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA)

**Unit 4: Technology Selection (08)**
Covers the safety requirements specification (SRS) and the pros and cons of pneumatic, relay and microprocessor logic systems, PLC systems for safety system development. Issues

Relating to Field Devices: importance of field devices: impact of field devices such as sensors, final elements on system performance.

**Unit 5: Reliability of SIS** **(06)**

Covers reliability issues and helps make sense of the minimum hardware fault tolerance requirement, Likelihood analysis: estimation and statistical analysis, fault propagation, event tree analysis and fault tree analysis, Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities

**Unit 6: Case Study** **(06)**

The safety life cycle and its importance, furnace/fired heater safety shutdown system, scope of analysis, define target SILs, develop safety requirement specification (SRS), SIS conceptual design, life cycle cost analysis, verification of SIL satisfaction, detailed design, installation, commissioning and pre-start-up tests, operation and maintenance procedures.

**Reference Books:**

1. Paul Gruhn and H Jarry L. Cheddie, "Safety Instrumented systems: Design, Analysis and Justification", ISA, 2 nd edition, 2006.
2. Dr. Eric W Scharpf, Heidi J Hartmann, Harlod W Thomas, "Practical SIL target selection: Risk Analysis per the IEC 61511 Safety Lifecycle", exida, 2012.
3. Ed Marszal, Eric W Scharpf, "Safety Integrity Level Selection", ISA.

**20PEIN802B Computer Techniques and Operating Systems**

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To understand the functions of operating systems
2. To understand the software development cycle and its blocks
3. To learn the current trends in software engineering

**Course Outcomes:** The students will be able to
1. Illustrate functionalities of operating system
2. Compare parallel computer architecture and functions
3. Identify methods in software engineering
4. Compare trends and techniques used in software engineering

**Unit 1: Operating System Overview** **(07)**
Concepts of Operating System and its services, Types of operating systems
Process Management: Concept, scheduling, operations on process
CPU scheduling: Basic concepts, CPU scheduling algorithms
Deadlocks: Characterization, Handling, Recovery Disk scheduling algorithms

**Unit 2: Memory and File Management** **(08)**
Memory Management: Address Binding, Overlays, Swapping, Contiguous memory allocation, Paging, Segmentation
Virtual memory: Concept, Demand paging, Preparing, Page size considerations, Page replacement algorithms, Thrashing
File system management: Concept, file access methods, directory structures, file allocation methods

**Unit 3: RTOS, Parallel Computers** **(07)**
Real Time & embedded System OS: Concepts, Types, their differences, Handheld Operating Systems. Interrupt Routines in RTOS environment, RTOS Tasks and their Scheduling models, Strategy for synchronization between the processes,
Parallel Computers: Basic concepts, Types of parallelism, Intertask dependencies, classification of parallel computers, vector computers, Array processors, Systolic Arrays
Introduction to Tensor Processing Units

Data Compression, Encryption and decryption

**Unit 4: Introduction to Software Engineering (08)**

Nature of Software, software process model, Application domains, web applications, mobile applications Preliminaries: Discipline, layers, process, practice and myths

Process models: Generic, Process assessment and improvement, prescriptive models, specialized models

Software Development Life Cycle and its models:

a. Linear Sequential

b. Rapid development

c. Incremental

Component based Software Analysis, Software Design, Software Implementation

**Unit 5: Software Testing (06)**

Software Testing: fundamentals, white box, black box testing, control structure testing, specific environment testing, comparison testing, orthogonal testing, strategic approach to testing, unit testing, integrated testing, validation testing, system testing

Software debugging: Standard guidelines, debugging techniques use of break points, test macros, output files for sampled inputs, instruction set simulation, laboratory tools

Software maintenance: Preventive, Corrective, Adaptive, Enhancement, System Re engineering

**Unit 6: Trends in Software Engineering (06)**

CASE, Risk Management, Software Configuration Management Tools like GitHub

Agile Development Process, SCRUM, Cleanroom methodology

Project Management trends such as ERP, SAP, Global Software Development, Test-driven development

**Text books:**

1. Operating System Concepts by Silberschatz, Galvin, Gagne
2. Parallel Computer architecture and programming by V. Rajaraman, C. SivaRam Murthy, PHI
3. Introduction to Data Compression by Khalid Sayood, Morgan Kaufmann Publishers, Inc.
4. Software Engineering by Ian Somerville, 4th edition, Addison Wesley publication

**Reference Books:**

1. Computer Architecture and Parallel processing by Kai Hwang, Faye Briggs, McGraw Hill International Editions.

2. Operating Systems: Internals and Design Principles by William Stallings
3. Modern Operating Systems by Andrew S. Tanenbaum
4. Software Engineering: A practitioner's approach by Ian Somerville
5. A Gentle Introduction to Agile and Lean Software Development by Stephen Haunts

## 20PEIN802C Environmental Instrumentation

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Sensor & Transducer, Analytical Instrumentation

**Course Objectives:**
1. To learn necessity of Instrumentation in Environmental Engineering.
2. To describe various components in Environmental Instrumentation.
3. To understand different types of Pollutions and various control strategies.

**Course Outcomes:** The student will be able to
1. Identify the Instrumentation related to Environment.
2. Analyse various aspects of disaster management and ecosystem
3. Select various sensors and instruments for measurement of weather parameters.
4. Select various sensors and instruments for measurement of air and water quality parameters

**Unit 1: Sensors, Detectors, Analysers for Environmental Instrumentation (08)**
Necessity of instrumentation & control for environment, sensor requirement for environment, Instrumentation methodologies: Detectors & Analyzer

**Unit 2: ICT- Automatic Weather Station (08)**
Instruments in Weather stations like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring Station (REMS).

**Unit 3: Water Quality Parameters and Water Treatment (09)**
Standards of raw & treated water, sources of water & their natural quality, effects of water quality, Water quality parameters & their application, conductivity analysers & their application, Water treatment

**Unit 4: Air Pollution and Sound Monitoring Systems (09)**
Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipment, analytical methods for air pollution studies. Control of air pollution, Instruments used for air pollution control. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring, control methods

**Unit 5: Geoinformatics** **(08)**

Introduction to Geo-informatics, Role of Geo-informatics in Environmental Monitoring and Control

**Text Books:**

1. Water treatment technology by Walter J. Weber.
2. Air pollution engineering by M. N. Rao & H. V. N. Rao.
3. Air pollution control technology by Wark & Warner.
4. 'Environmental Engineering' by Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy

**Reference Books:**

1. Environmental Instrumentation & Analysis Handbook by Randy D. Down.
2. Environmental Instrumentation & Analysis Handbook, by Randy D. Down & Jay H. Lehr, Wiley.
3. Environmental noise pollution by Patrick F. Cunniff, Wiley, May 1977
4. Environmental Engineering and Science by Gilber M Masters, Pearson Education (1997)

## 20OE801C Digital Control

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of Control Systems

**Course Objectives:** To
1. Understand the basic components of a digital control system.
2. Design various Digital Controllers and Study response of those controllers.
3. Learn and understand the stability of the system in the Z plane.
4. Introduce Optimal Control Design and Its need.

**Course Outcomes:** Students will be able to
1. Analyse system design in various planes S-W-Z and its mapping.
2. Analyse system stability in the S and Z plane.
3. Design and analyse systems using classical methods and State Space.
4. Design Optimal Control for a Discrete System.

**Unit 1: Introduction to Discrete Time Control System (08)**
Basic building blocks of Discrete Time Control System, Sampling Theorem, Choice of Sampling Rate, Z Transform and Inverse Z Transform for applications of solving Differential Equations, Impulse Sampling, Reconstruction – Zero Order Hold

**Unit 2: Pulse Transfer Function and Digital Controllers (08)**
Pulse Transfer Function, Pulse Transfer Function of Open Loop and Closed Loop System, Pulse Transfer Function of Digital PID Controller, Design of Deadbeat Controller

**Unit 3: Stability Analysis of Discrete Control System (08)**
Stability regions in S plane W plane and Z plane, Mapping between three planes, Stability Tests for Discrete Systems

**Unit 4: Design of Discrete Control System by State Space Approach (07)**
Different Canonical Forms, Relation between Pulse Transfer Function and State Equation, Solution of Discrete Time State Space Equations, Eigen Values, Eigen Vectors

**Unit 5: Pole Placement and Observer Design (07)**
Concept of Controllability and Observability, Pole Placement Design by State Feedback, Design of Feedback Gain Matrix by Ackerman's Formula, State Observer Types.

**Unit 6: Introduction to Optimal Control** **(05)**

Basics of Optimal Control, Quadratic Optimal Control, Performance Index.

**Text Books:**

1. K. Ogata, "Discrete Time Control Systems", Prentice Hall, Second Edition.
2. M. Gopal, "Discrete Control and State Variable Methods", Tata McGraw Hill.
3. Kannan Moudgalya, "Digital Control", John Wiley and Sons.

**Reference Books:**

1. G. F. Franklin, J. David Powell, Michael Workman, "Digital Control of Dynamic Systems", Addison Wesley, Third Edition.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern LTD.
3. Forsytheand W, Goodall R, "Digital Control".
4. Contantine H. Houpis, Gary B. Lamount, "Digital Control Systems", McGraw Hill International, Second Edition.

**20OE801F Instrumentation in Food and Agriculture**

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites:** Basics of sensors and transducers, knowledge of Unit operations and basics of process control, PLC and pneumatic and hydraulic instrumentation

**Course Objectives:**
1. To know the scope of Instrumentation in agriculture field
2. To know greenhouse, food packaging automation schemes
3. Understand sensors used in agriculture field and weather monitoring stations
4. To get acquainted with food quality standards

**Course Outcomes:** The student will be able to
1. Identify the different unit operations, process control equipments involved in different types of process industries
2. Select appropriate measurement techniques for measurement of various process parameters related to soil, green house, Dam and agro-metrology
3. Analyse and develop various control loops for processes involved in various food processing plants
4. Assess various automation tools to develop automation strategy to Dam, Green house, food processing and packaging in accordance to various food standards

**Unit 1: Process Control in Agriculture and Food Industries (08)**
Sensors in Agriculture (Hygrometers, Anemometers, fine wire thermocouple, etc), Sensors in Food (ph, temperature sensor for pasteurization, brix sensor, etc), Flow diagram of some continuous processes like sugar plant, dairy, juice extraction, etc & batch process (Fermentation)

**Unit 2: Instrumentation in Irrigation and Green House (09)**
SCADA for DAM parameters & control, irrigation canal management systems, Auto drip & sprinkler irrigation systems
Green House Automation: Construction of green houses, Sensors for greenhouse, Control of ventilation, cooling & heating, wind speed, temperature & humidity

**Unit 3: Instrumentation in Farm equipments, Food Safety and Sanitation (09)**

Instrumentation for farm equipment: Implementation of hydraulic, pneumatic and electronic control circuits in harvesters cotton pickers, tractors, etc; Classification of pumps, pump characteristics, selection and installation.

Food safety standards (Food safety and standards bill 2005, Agmark, Bureau of Indian Standards, Codex Standards, recommended international code of hygiene for various products)

Sanitation regulatory requirements: Sanitation standards operating procedure (SSOP's), Sanitation performance standards (SPS), 11 principles of sanitary facility design, Sanitation best practices.

**Unit 4: Automation in Food Packaging (08)**

Ware house management, Cold Storage Units, PLC and SCADA in food packaging

**Unit 5: Smart Instrumentation in Agriculture and Food Industries (08)**

Wireless sensors, Application of IOT in agriculture and food industries, application of Image processing in agriculture and food industries, application of robots in agriculture and food industries, Case studies.

**Text Books:**

1. D. Patranabis, "Principles of Industrial instrumentation", TMH (2010), ISBN-13: 978-0070699717

2. Michael. A.M, " Irrigation : Theory and Practice" , Vikas Publishing House Pvt Ltd, Second edition (2008), ISBN-13: 978-8125918677

3. Curtis D. Johnson, " Process control and instrumentation technology", , 8th Edition, 2015,Person, ISBN: 9789332549456, 9332549451

4. Akalank Kumar Jain , Vidhi Jain "Food Safety and Standards Act, Rules & Regulations", Akalank Publications; 13th Edition edition (2015), ISBN-13: 978-8176393584

**Reference books:**

1. Rosana G. Moreira, "Automatic Control for Food Processing Systems (Food Engineering Series)", Springer; 2001 edition (28 February 2001), ISBN-13: 978-0834217812

2. Bela G. Liptak , "Instrument Engineers' Handbook, Process Control and Optimization", CRC Press; 4 edition (29 September 2005), ISBN-13: 978-0849310812.

3. Robert H. Brown, " CRC Handbook of Engineering in Agriculture, Volume II: Volume 1 (C R C SERIES IN AGRICULTURE)", CRC Press; 1 edition (30 June 1988), ISBN-13: 978-084933862

## 20OE801G Medical IoT

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To understand smart Objects and IoT Architecture
2. To learn sensor Interfacing
3. To learn IoT Protocols
4. To build simple IoT based Health care system

**Course Outcomes:**
1. Ascent the basic concepts of IOT in healthcare
2. Relate the existing hardware platforms and sensor interfaces for various healthcare-based Applications
3. Comprehend the ways of communication between the client and the server in IOT
4. Build various applications in healthcare using IOT based approach with appropriate case studies.

**Unit 1: Medical Measurements (06)**
Cardiovascular system, respiratory system, nervous system etc. Measurement of Heart, Brain and Muscle activity using wearable sensors. Monitor health parameters like Blood Pressure, ECG, EMG, EEG, HR, RR, SPO2 etc.

**Unit 2: Sensors & Smart Patient Devices (08)**
Role of Wearables, Challenges and Opportunities, Future of Wearables, Social Aspects, Wearable Haptics, Intelligent Clothing, Industry Sectors' Overview – Sports, Healthcare, Military, Environment Monitoring, Mining Industry, Public Sector and Safety.

**Unit 3: Wearable mechatronics device (08)**
Accelerometers, Gyroscopic Sensors; In – Shoe Force and Pressure Measurement its applications. Physical Activity Monitoring: Human Kinetics, Cardiac Activity.
Cuffless Blood Pressure Monitor, Study of Flexible and Wearable Piezo resistive Sensors for Cuffless Blood Pressure Measurement, Wearable Pulse Oximeter, Wearable Sweat Analysis, Wearable Heart Rate Measurement.

**Unit 4: Device Connectivity and Security / Biomedical Sensors with Internet connectivity (08)**
Gateway, Embedded Systems for devices like RPi, Arduino, etc, Protocols as applied to medical devices.

Sensor interface: Temperature sensor, pressure sensor, optical sensor etc. Wireless body area network. IoT Privacy and Security.

**Unit 5: Data Analytics for Medical Applications (06)**
Real Time Data Analytics, Continuous IoT Monitoring, Approach to Predict and Diagnosis of Heart and Chest diseases, Alzheimer, Diabetic Retinopathy etc. through data analytics.

**Unit 6: IoT in Biomedical Applications - Case Studies (06)**
Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application development in mobile and cloud Environments.
Case Study1: Wireless Patient Monitor system; Design an IoT System for Vital Sign Monitors, Weight measuring device, Blood pressure measuring device, ECG, Blood glucose measuring, Heart rates measuring devices and Pulse Oximeters etc.
Case Study2: Wearable Fitness & Activity Monitor; Walking time measuring device ii. Step counting device iii. Speed measuring device iv. Calorie spent measuring device v. Time spent in rest or sleeping measuring device.

**Text Books:**

1. Joseph D. Bronzino, "Handbook of Biomedical Engineering", 2nd edition –Volume II, CRC press, 2010.
2. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by CRC Press.
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press.

**Reference Books:**

1. Subhas Chandra Mukhopadhyay and Tarikul Islam, "Wearable Sensors - Applications, design and implementation" IOP Publishing Ltd 2017.
2. Shantanu Bhattacharya, A K Agarwal, Nripen Chanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018.
3. Dieter Uckelmann, Mark Harrison, Florian, "Architecting the Internet of Things", Springer.
4. "The Internet of Things: Key Applications and Protocols", by, Wiley
5. Olivier Hersent, David Boswarthick, Elloumi, Daniel Kellmereit, Daniel Obodovski, "The
6. Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

## 20OE802D Building Automation and Energy Audit

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| Lectures: 3 Hrs/Week | In Semester: 50 Marks |
| | End Semester: 50 Marks |
| | Credit: 3 |

**Prerequisites:** Basics of Electronics and Instrumentation

**Course Objectives:**
1. To understand Need and Applications Building automation systems.
2. To understand the working of various Building automation components.
3. To Select and Implement Building automation with various applications.

**Course Outcomes:** The student will be able to
1. Investigate the system requirements for developing building automation systems.
2. Compare and choose the suitable building automation systems for the applications
3. Design building automation system for required application.
4. Evaluate the performance of the designed building automation system.

**Unit 1: Fire Alarm Systems I (08)**
Introduction: to BAS, Need and Applications of BAS, Block diagram of BAS.FAS: Need and Applications of FAS, Types of FAS, Block diagram of FAS, Fire, Fire Development Stages, Fire Signatures, Initiation Devices, Notification Appliances, IDC Placements, NAC Placements, Fire Suppression: Fire Extinguishers & Its Classification, Fire Suppression Systems.

**Unit 2: Fire Alarm Systems II (08)**
IDC, NAC, SLC, FAS Wiring Standards, FAS Communication Protocols, Voltage Drop Analysis, Battery Capacity Analysis, Cause & Effect Matrix.

**Unit 3: Access Control Systems (06)**
Introduction to Security Systems, Types of Security systems, Access Control Systems: Introduction, Applications, Concept, Generic Model, Components, Card Technologies, Communication Protocols for ACS, Biometrics for ACS, CCTV System Types: CCTV Components, Digital Video Management System

**Unit 4: HVAC- Air Systems (06)**
Human Comfort Parameters and Air Properties Need of HVAC System, HVAC Block Diagram. AHU: Concept, Working, AHU Functions, AHU Components: Dampers, Filters, Cooling coil, Heating coil, etc., AHU Configurations, AHU Locations, AHU Terminal Units: CAV, VAV, Measurement and Control Loops for Air Systems.

**Unit 5: HVAC- Water Systems (07)**

Cold Water System: Refrigeration Cycles, Chillers, Cooling Towers, Types of chilled water system, Concept of Free Cooling : Direct Waterside, Series Waterside, Parallel Waterside. Hot Water Systems: Heating Circuits, Boilers, Types of Boilers, Heat Exchangers: Steam Input and Hot Water Input, Solar Hot Water System, Measurement and Control Loops for Water Systems.

**Unit 6: Building Energy Management System (07)**

Overview of Building Energy Management Systems, BEMS Control systems overview, Benefits of BEMS, Energy System Monitoring, Application of Energy Efficient Strategies, Effective Energy management, Computerized Energy Management Systems.

**Text Books:**

1. Robert Gagnon, Design of Special Hazards and Fire Alarm Systems.
2. Damjanovski, Vlado, CCTV, Butterworth-Heinemann, 3rd ed.
3. Benantar M., Access Control System
4. Montgomery R, Fundamentals of HVAC Control Systems, Elsevier Publications
5. Roger W. Haines "HVAC Systems Design Handbook", Fifth Edition
6. James E. Brumbaugh "HVAC Fundamentals", volume 1 to 3
7. "Basics of Air Conditioning" ISHRAE, Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)

**Reference Books:**

1. "All About AHU's", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. "Chillers Basics", ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. "HVAC Handbook Part-1", Indian Society of Heating, Refrigerating & Air Conditioning Engineers
4. "Handbook – Industrial Ventilation Application", 2004, Indian Society of Heating, Refrigerating & Air Conditioning Engineers

## 20OE802G Industrial Drives and Control

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**
1. To evaluate and select a suitable drive for a particular application.
2. To analyse the basic drive system dynamics
3. To develop the basic design of an electric drive system.

**Course Outcomes:**
1. Selection of appropriate drive for the given application
2. Selection of suitable control system scheme along with the interlocking for given application
3. Analysis of the control drive dynamics for the desired drive system
4. Design of the total electric drive system based on desired application

**Unit 1: Introduction to Industrial Drives (07)**
Concept of electric drive, Power modulators, Motors used in drives, types of loads choice of drives, classification of drives Multi quadrant operation of Drives.

**Unit 2: Introduction to Control Systems (07)**
Open and closed loop systems with examples, automatic control, speed control of motors

**Unit 3: Electrical Control of Machines (08)**
Manual control – Magnetic control – Semi-automatic and Automatic control of Modern machinery – Development of Control circuits–Two wire and Three wire control – Remote control –

**Unit 4: Interlocking of drives (08)**
Control circuit components –Symbols for control components–Fuses, Switches and Fuse Switch units.

**Unit 5: Dynamics and Control of Electric Drives (06)**
D.C. motor drives, Induction motor drives, Synchronous and Brushless D.C. motor drives.

**Unit 6: Industrial process and drives** **(06)**

Process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes, centrifugal pumps and compressors, solar powered pump drives, selection of drives for the above processes

**Text Books:**

1. Electrical Motor Drives, R. Krishnan [PHI-2003]
2. Electric Drives, Vedam Subrahmaniam [TMH-1994]
3. Industrial Drives and Control, Sandeep M. Chaudhari, Nilesh R. Ahire [Nirali Prakashan]

**Reference Books:**

1. Control of Electric Drives,W. Leonard, [Springer- 2001]
2. Electrical Drives, Second Edition, S.A. Nasar, Boldea [CRC Press - 2006]

## 20OE802I Smart Sensors and Systems

**Teaching Scheme:**
Lectures: 3 Hrs/Week

**Examination Scheme:**
In Semester: 50 Marks
End Semester: 50 Marks
Credit: 3

**Prerequisites**: -

**Course Objectives:**

1. Theoretical understanding of various physical phenomena behind the operation of different types of sensors and microsystems
2. Overview of micro/nano fabrication process
3. Develop a complete sensor or sensor system, MEMS device or microsystem

**Course Outcomes:**

1. Selection of suitable sensor along with the associated electronics and fabrication process for given application
2. Selection of appropriate smart sensors for the desired application in the field of Automobile, Biomedical, Military, Space and Défense.
3. Design of application-based sensors in the field of Military, Défense, Spacecraft and environment
4. Analysis of the system designed for applications in the field of Biomedical and Automobile

**Unit 1: Introduction to Smart Sensors and Systems (07)**

Principles of Sensing, Classification and Terminology of Sensors. Introduction to micromachining - Fabrication and miniaturization techniques
Digital Signal Controllers (Microcontrollers and Digital Signal Processors) for Smart sensors
Key features, Certain case studies - for eg: temperature, fingerprint recognition

**Unit 2: Microfabrication process (08)**

Fabrication and miniaturization techniques, Steps involved in fabrication

**Unit 3: Smart sensors in Biomedical field (08)**

Bio-analytical [sample preparation and detection of compound] sensors & systems, Transduction modes & classifications,
Hall Effect sensors and associated signal conditioning circuits, Sensors for displacement (linear and angular), velocity, acceleration, force, torque, vibration and shock measurements. Sensor measurements for conductivity and viscosity. Electrochemical transducer in Biology

and medicine Biochemical Transducer, Enzyme-based electrochemical biosensors, electronic tongue, few related Case studies

**Unit 4: Smart sensors in Automobile industry (07)**
Introduction to Modern Automotive Systems and need for electronics in Automobiles, Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems, Sensors for chassis management, Powertrain sensors, Air Bag and Seat Belt Pre tensioner Systems, Case studies explaining the Modern Trends and Technical Solutions, Related communication systems

**Unit 5: Smart sensors related to Environment and in Spacecraft (06)**
Human Toxicology Ecotoxicology, Water and air pollution sources
E nose for Sensitive and Selective Chemical Sensing, Chemical sensors, Ocean environment
Smart sensors in spacecraft - in monitoring applications, Smart Instrumentation Point Bus (SIP), Solid state micro-gyroscopes, related Case studies

**Unit 6: Smart sensors in Military and Defence (06)**
Types of sensors (Accelerometers, Inertial Sensors, Pressure Sensors, Force Sensors, Motion Sensors, Gyroscopes, Temperature Sensor and Others), Device-based Sensor, Clothing-based Sensor, Application based sensors - Wrist Wear, Foot Wear, Eye Wear, Body Wear and Neck Wear, intelligent sensor technology for surveillance and electronic intelligence, Case studies, related communication systems

**Text Books:**
1. Understanding Smart Sensors, Randy Frank [Artech House, Boston London]
2. Smart Sensors for Environmental and Medical Applications, Hamida Halilil, Hadi Heidari [Wiley]
3. Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, S Nihtianov, Antonio Luque [Science Direct]

**Reference Books:**
1. Smart Sensors and Systems, Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y. [Springer]
2. Smart Sensor Systems, Gerard Miejer [Wiley]

**20IN801L Process Data Analytics Lab**

**Teaching Scheme:**
Practical: 2 Hrs/week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 marks
Credit: 1

**Course Outcomes:** The student will be able to
1. Apply standard statistical inference procedures to draw conclusions from data analysis.
2. Analysis of data using various statistical methods.
3. Develop programming logic for various machine learning algorithms.
4. Implement various machine learning algorithms to process industries.

**List of Practical Assignments:**
1. Introduction to linear and multiple regression function in MATLAB
2. Applying linear & multiple regression to process data from a typical process plant
3. Implement ANOVA for a database
4. Data Analysis using K nearest neighbour Regression
5. Introduction to programming in R
6. Linear regression in R
7. Implementation of Neural Networks for standard data set
8. Implementation of Fuzzy logic for classification of standard data set

**Or similar type of practical assignments based on the course contents**

## 20PEIN801LA Process Modelling and Optimization Lab

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** The student will be able to
1. Analyze the system model.
2. Identify mathematical models of processes.
3. Analyze the system performance.
4. Apply the optimization techniques and analyze the results.

**List of Practical Assignments:**
Students are expected to perform Minimum 8 Experiments
1. Analysis of first/second order systems by using step and ramp input.
2. Simulation of mathematical modeling of electrical/ mechanical systems by first principle.
3. Simulation of mathematical modeling of liquid level systems.
4. Study of distillation columns.
5. Study of Heat Exchanger.
6. Identification of second order process by prediction error method and compare it with modeling by first principle.
7. Obtaining unknown parameters of second order process by least square technique.
8. Obtaining Relative gain array of any MIMO physical system.
9. Obtaining inverse Nyquist array of any Physical system.
10. Design of optimal control system by using quadratic approximation.
11. Analysis and comparisons of Quasi Newton and secant methods.
12. Finding optimal solution using Simplex Method system

**Or similar type of practical assignments based on the course contents**

## 20PEIN801LB Artificial Intelligence and Machine Learning Lab

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** The students will be able to
1. Formalize a given problem in the different AI methods.
2. Implement basic AI algorithms.
3. Evaluate decision tree learning algorithms.
4. Analyse research-based problems using Machine Learning Techniques.

**List of Practical Assignments:**
Any Software/Programming Language: PROLOG/Matlab/Python etc
1. Write a program to implement simple Chat-bot.
2. Implement Tic-Tac-Toe using A* algorithm.
3. Implement alpha-beta pruning graphically with proper example and justify the pruning.
4. Write a python program to implement Water Jug Problem.
5. Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).
6. Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.
7. Write a program to implement Hangman game.
8. Write a program to solve the Monkey Banana problem.
9. Write a program to implement Simple Calculator program.
10. Write a program to POS (Parts of Speech) tagging for the given sentence using NLTK
11. Solve 8-puzzle problem using best first search.
12. Solve Robot (traversal) problem using means End Analysis.
13. Implementation of Image features Processing
14. Write a program to implement Naïve Bayes Algorithm
15. Implement Support Vector Machine algorithms on a dataset.
16. Implement Genetic algorithm algorithms on a dataset.
17. Implement K-means algorithms on a dataset.
18. Implement PCA algorithms on a dataset.

**Or similar type of practical assignments based on the course contents**

## 20PEIN801LC Medical Device Technology Lab

**Teaching Scheme:**
Practical: 2 Hrs/Week

**Examination Scheme:**
In Semester: 25 Marks
Oral: 25 Marks
Credit: 1

**Course Outcomes:** The students will be able to
1. Identify various biomedical Instruments Involved in diagnosis, treatment and surgery.
2. Identify various controls of Instruments.
3. Record the response of the sensory organ.
4. Analyze and interpret the recorded data.

**List of Practical Assignments:**
1. Record and Monitor parameters using BSM.
2. Implementation of various modes using electrosurgical machine.
3. Design ECG telemetry system.
4. Recording and analysis of audiogram for different subjects using audiometer.
5. Design a signal conditioning to monitor and to remove the leakage current.
6. Develop an algorithm for Text to Voice Conversion in MATLAB/Suitable Language.
7. Develop an algorithm for Voice to Text Conversion in MATLAB/Suitable Language.
8. Design/Develop Ultrasonic Cane for Navigational Aid.
9. Pressure Measurement using In Shoe Pressure Sensor.
10. Fall Detection using Accelerometer and Flex Sensor
11. Hospital visit Report