Autonomous Programme Structure (Revision-1)
F. Y. B. Tech. Sem-I
Computer Engg and Information Technology Programmes
A. Y.: 2020-21 Onwards

F. Y. B. Tech. First Semester									
Course Code	**Course Title**	**Teaching Scheme Hours / Week**			**Examination Scheme**			**Marks**	**Credit**
20BS01	Linear Algebra and Univariate Calculus	3	1	0	50	50	0	100	4
20BS02	Chemistry	3	0	0	50	50	0	100	3
20ES01	Basic Electrical and Electronics Engg.	3	0	0	50	50	0	100	3
20ES02	Fundamentals of Programming Language- I	1	0	0	0	25	0	25	1
20ES03	Sustainable Engineering	3	1	0	50	50	0	100	4
20BS02L	Chemistry Lab	0	0	2	25	0	0	25	1
20ES01L	Basic Electrical and Electronics Engg. Lab	0	0	2	25	0	0	25	1
20ES02L	Fundamentals of Programming Language- I Lab	0	0	2	25	0	0	25	1
20ES07L	Technical Skill Development Lab	0	0	2	25	0	0	25	1
Total		**14**	**2**	**8**	**300**	**225**	**0**	**525**	**19**
Grand Total		**24**			**525**			**525**	**19**

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20BS01 Linear Algebra And Univariate Calculus

Teaching scheme	**Examination**
scheme	
Lectures: 3hrs/week	In-Sem Exam: **50** Marks
Tutorial: 1hr/week	End-Sem Exam: **50** Marks
Number of Credits: 4	

Course Objectives:

1. To familiarize the prospective engineers with techniques in linear algebra and calculus of one variable.
2. To equip the students with standard concepts and tools in Linear algebra and calculus of one variable which will find them useful in their disciplines.

Course Outcomes:

CO1: Use matrix method to solve linear system of equations, Linear Transformations.

CO2: Calculate eigenvalues, eigenvectors and apply it to diagonalize a matrix.

CO3: Apply knowledge of linear algebra to solve simple real life problems.

CO4: Compute differentiation, series expansion, integration of function of one variable.

Unit-I: Matrices **(08)**

Rank of a matrix, Echelon form, System of linear equations, Euclidean vector spaces and Linear Transformations

Unit-II: Diagonalization of a Matrix **(08)**

Eigenvalues, Eigenvectors, Properties of Eigenvalues, Diagonalization of a matrix

Unit-III: Applications of Linear Algebra **(09)**

Introduction to Modular Arithmetic, Euclid's algorithm, Encrypt and decrypt the statement using matrix, Applications to simple real life problems

Unit-IV: Differential Calculus **(08)**

Successive differentiation, nth order derivatives of some standard functions, Taylor's and Maclaurin's theorem, Standard series expansions

Unit-V: Integral Calculus **(09)**

Reduction formulae, Beta Function, Gamma function, Differentiation under integral sign, Error function

Text-Books:

1. David Poole,**' Linear Algebra: A Modern Introduction'** , 2nd Edition, Brooks/Cole (2005).
2. B. V. Ramana ,**'Higher Engineering Mathematics'**, *Tata McGraw-Hill Publications*, (2007).
3. B.S. Grewal, '**Higher Engineering Mathematics**', *Khanna publishers*, Delhi (40thedition), (2008).

Reference Books:

1. C.R. Wylie, L. C. Barrette, *'***Advanced Engineering Mathematics***'*, *McGraw-Hill Publications*, *New Delhi* (6 th edition),(2006)
2. Maurice Weir, Joel Hass, Thomas **'Calculus'** , 12th edition, *Pearson India*(2016)
3. George Thomas, Jr., Ross Finney, Late, **Calculus,** 9th edition, *Pearsons India*
4. Sudhir Ghorpade, Balmohan Limaye, '**A Course in Calculus and Real Analysis** *'*, (Undergraduate Text in Mathematics), *Springer*(2006).

5. Erwin Kreyszig, '**Advanced Engineering Mathematics'**, *Wiley Eastern Ltd*(10th Edition), (2017)

20BS02 Chemistry

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

Course Objectives

The Chemistry course is designed such that the learners imbibe chemical principles relevant in the engineering context. The course facilitates undergraduates to understand chemical processes, methods of analysis, structure-property relationship and evaluate role of chemical substances for engineering applications. Further the course inculcates basic problem-solving skills involving chemistry principles.

Course Outcomes

The students will be able to –

1. Interpret properties and applications of molecules based on their atomic structure.
2. Analyze quality parameters for water, coal, petrol using analytical methods.
3. Apply chemical principles for problems related to water, batteries, fuel or polymers.
4. Outline the process of synthesis for inorganic substances and nanomaterials.
5. Elucidate the construction and functioning of a device/chemical reagent.

Module 1: Physical Chemistry (13)

Unit 1. Chemical Bonding: Types of bonds, intermolecular forces, bonding in molecules: valence bond theory, molecular orbital theory for diatomic molecules.

Unit 2. Electrochemistry: Electrochemical cell, Nernst equation, EMF of cell, reference and indicator electrodes, battery characteristics, Lead-acid, Lithium-ion battery, Fuel cell technology.

Module 2: Inorganic and Materials Chemistry (13)

Unit 3. General overview of the Periodic table and properties; chemistry of some elements like H, Si and their compounds, Si for chipmaking, H_2 gas as fuel.

Unit 4. (A) Engineering materials: Structural features, properties and applications of OLEDs - PPV (- solar cell), liquid crystal polymers, conducting polymers – as a chemical sensor, polymer composites.

(B) Nanomaterials:

Introduction to nanomaterials, synthesis by top down and bottom-up methods. Structure, synthesis and some typical applications of nanomaterials.

Module 3: Analytical Chemistry **(16)**

Unit 5. Analysis of -

(A) Water: Hardness determination in water, TDS, effect of hard water in boilers, Internal and external treatment of hardness, water softening techniques -zeolite and ion exchange method. Desalination methods-Reverse osmosis. Electrodialysis. Waste water recycling.

(B) Carbon based fuels: Analysis of coal/petrol.

Unit 6. Analytical techniques such as spectroscopy, pH-metry, conductometry and their applications.

Text Books:

1. S.S. Dara 'Engineering Chemistry' S. Chand Publications (2010)
2. B.S. Chauhan 'Engineering Chemistry': Univ Sc Press. (Third edition)2009
3. Shashi Chawla 'A Text Book of Engineering Chemistry': Dhanpat Rai & Co. (2015)
4. Jain and Jain 'A Text Book of Engineering Chemistry' Dhanpat Rai & Co.
5. G. Chatwal 'Instrumental methods of Chemical Analysis' Himalaya publication house

Reference Books:

1. Steven S. Zumdahl, 'Chemistry concepts and applications', Cengage learning publication (2009)
2. Ram D. Gupta, 'Hydrogen fuel 'C.R.C. Publications (2009)
3. Puri, Sharma, Pathania 'Principles of Physical Chemistry': Vishal Publ. Co.
4. Robert Braun' Instrumental methods of analysis' Pharma med press (2010)
5. J.D. Lee, 'Concise Inorganic Chemistry', 4th edition, Wiley Publication (2019)

20ES01 Basic Electrical and Electronics Engineering

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

Course Objectives:

1. To educate the students about the realization of basic theoretical concepts & laws in electrical engineering in real physical world.
2. To make students familiar with three phase supply.
3. To make students familiar with single phase transformers.
4. To understand the construction and applications of diode and BJT
5. To understand basics of combinational logic, Boolean algebra and flip -flops.

Course Outcomes:

After completion of course, students will be able to
CO1: Analyze and calculate parameters of DC circuits
CO2: Analyze and calculate parameters of AC circuits
CO3: Calculate performance parameters of single-phase transformer.
CO4: Analyze I-V characteristics of semiconductor diodes and transistors and design simple analog circuits using these devices
CO5: Build simple combinational and sequential logic circuits.

Unit – I: DC Networks
(08)

Kirchhoff's laws, Mesh and Nodal Analysis, Thevenin and Superposition Theorems, maximum power transfer theorem, Network Simplifications using star-delta / delta-star transformations.

Unit – II: AC Circuits
(07)

Series and parallel RL, RC and RLC circuits , concept of Impedance and admittance, power triangle and power factor. Resonance in series and parallel RLC circuit, Three phase voltage generation and waveform, star and delta balanced systems. Relationship between phase and line quantities, phasor diagram, power in a three phase circuit.

Unit – III: Electromagnetism and Single Phase Transformers (06)

Magnetic materials and B-H curve, self and mutual inductance,1 Φ transformer: concept, types, working, ideal transformer, practical transformer, equivalent circuit, phasor diagram, efficiency and regulation calculations.

Unit – IV: Diodes and rectifiers (07)

Construction and characteristic of p-n junction diode, LED, photodiode, Half wave, full wave and bridge rectifiers, need of capacitor filter, rectifier operation with capacitor filter, Zener diode as a voltage regulator, block diagram of Regulated power supply

Unit – V: Junction Transistor Amplifiers (07)

Bipolar junction transistor, Construction of BJT, Types of biasing:-fixed bias and self bias circuit, BJT characteristics for-CE,CB,CC configurations, relationship between α and β, load line for a transistor, application of transistor as a switch and amplifier.

Unit – VI: Digital Electronics (07)

Basic gates, implementation of basic gates using universal gates, Boolean algebra, standard representation of logic functions (SOP and POS forms), Introduction of Combinational logic circuits like multiplexer ,demultiplexer, half adder and full adder, Introduction of Sequential logic circuits like flip- flops (SR, D), counters and shift registers.

Text Books:

1. Hughes, 'Electrical and Electronic Technology', Pearson education, (10th edition), (2008)

Reference Books:

1. D.P. Kothari and I.J. Nagrath, 'Basic Electrical Engineering', McGraw-Hill, (3rd edition), (2010)
2. A.E.Fitzgerald, A.Grabiel,'Basic Electrical engineering',McGraw-Hill, (5th edition), (2009)
3. Floyd, 'Electronic Devices and Circuits', pearson education, (7th edition),(2008)
4. AP Malvino & Donald Leach,'Digital Principles and Applications', McGraw Hill Education,(6 th edition), (2009)

20ES02 Fundamentals of Programming Language-1

Teaching Scheme:
Lecture: 1 Hr/week

Examination Scheme:
End-Sem: 25 Marks

Credits: 1

Course Objectives:
To facilitate the learners:
1. To learn the fundamentals of building blocks of computer system.
2. To develop problem solving ability by developing an algorithm, flowchart for given problem.
3. To implement the logic / solution for given problem using C programming language.
4. To understand the decision and iteration interpretation in a programming language.

Course Outcomes:
By taking this course, the learner will be able to:
1. Illustrate the use of algorithms, flow charts and components of computer systems.
2. Demonstrate the use of appropriate control structure for program development.
3. Make use of variables, data types, operators, expressions, strings and arrays for program development.
4. Solve the given problem using functions.

Unit 1: Introduction **(2)**
Introduction to components of a Computer System, types of programming languages.
Introduction to Algorithm: As flow chart, pseudo code, as a program.

Unit 2: Fundamentals of Procedural Programming Language **(1)**
Keywords, Identifiers, Constants and Variables, concept of memory, Structuring procedural program using exemplary language such as C.

Unit 3: Data Types and operators **(2)**
Data types, Typecasting, variable scope, Operators, Basic Input and Output Operations, Expressions and Precedence of Operators.
Illustration using real life examples and use cases.

Unit 4: Control Structures **(2)**

Selection (if-else ladder), Iteration (for loop, while loop).
Illustration using real life examples and use cases.

Unit 5: Arrays and String **(2)**
Introduction to linear structure (Arrays) and Strings,String functions
Illustration using real life examples and use cases.

Unit 6: Functions **(2)**

Use of function for modularization, Parameter passing.
Illustration using real life examples and use cases.

Text Books:-

1) Kernighan and Ritchie, " The C programming language" (2nd edition)., Prentice Hall of India, 1988.
2) G. Dromey, "How to Solve it by Computer", Prentice-Hall Inc., Upper Saddle River, NJ, 1982.
3) Yashwant Kanetkar, "Let's C", Allied Publishers, 1998.

Reference books:-

1) Reema Thareja, "Introduction to C programming", Oxford University Press (2nd edition), 2015.
2) Alan R. Feuer, "The C Puzzle book", Pearson, 1999

20ES03 SUSTAINABLE ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week
Credits: 4

Examination Scheme:
In-Semester : 50 Marks
End-Semester : 50 Marks

Course Objectives:

1. To understand interdisciplinary approach towards sustainable development
2. To acquire knowledge, skills, values & attitudes that empowers to contribute to sustainable development
3. Understand the relevance and importance of natural resources & protection of environment for sustainability
4. To understand the role of engineering & technology within sustainable development

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

CO1: Identify the need of sustainable development

CO2: Analyze the challenges posed at the interface of natural & man-made environment

CO3: Distinguish between conventional & green building with respect to environmental efficiency

CO4: Apply the knowledge of sustainability in the area of water & energy conservation

CO5: Distinguish between smart cities with other cities with respect to quality criteria

CO6: Specify the role of different stakeholders in sustainable development

Unit – I: Introduction to sustainable engineering **(05)**

Need and concept of sustainability, Principles of sustainability, Pillars of sustainable development, Multidisciplinary approach for sustainable development, Case study on Innovative technologies

Unit – II: Environmental sustainability **(06)**

Concept of natural and built environment , Concept of integrated built environment, Environmental global issue - Urban sprawl , Role of individual to protect environment

Unit – III: Green materials and green building (06)

Basic concept of Green buildings & its co-relation with sustainability, Material selection for sustainable design of green building, Concept of circular economy, Concept of IGBC, Green building certification, Methods for increasing energy efficiency of buildings

Unit – IV: Sustainable use of water and energy resources (08)

Water resources – use and conservation of water ,sustainable use of drinking water – waste water management- case study

Energy resources – Renewable and non-renewable sources of energy – conservation of non-renewable energy sources – case study, Definition & case study on LCA.

Unit – V: Smart City (05)

Concept and features of smart city, Strategies, Concept of smart village, Two case studies.

Unit – VI: Role of community and society in sustainable development (06)

Role of government,Global environmental agreements and protocols (Montreal& Kyoto protocol), Copenhagen summit, Role of citizen, Contribution of NGOs - social networking , Case study

Text Books:

1. *R.L.Rag, Lekshmi dinachandran Ramesh* - ***Introduction to Sustainable engineering***

Reference Books:

1. Bhavik R. Bakshi - **Sustainable engineering (principles and practise)** -*Ohio state university*
2. Allen D.T and shonnard D. R- **Sustainability engineering concept design and case studies**
3. *Mokia schoiz-* ***Sustainable Water treatment engineering solution for variable climate***
4. *DT Alle*DR Shonnard*n,-* Green engineering: environmentally conscious design of chemical processes
5. R.Rajagopalan **– Environmental Studies from Crisis to Cure –** ***Oxford Publication, Third edition,2016.***
6. A`Sankar R.N.- **Environmental Management** - *Oxford Publication, First edition,2015.*
7. *Shah, Kale, Patki –* ***Building planning and Built environment*** *-Tata McGraw Hill*

Websites:

Down to Earth - Magazine (hard copy and softcopies available)-

www.unsdsn.org/ For the World
-www.cseindia.org - For India
- indiaenvironmentalportal.org.in
- TERI - www.teriin.org
-cwmi.css.cornell.edu
-rodaleinstitute.org

20BS02L Chemistry Laboratory

Teaching Scheme:
2 hours per week
Marks
Number of Credits: 1

Continuous assessment
Term Work: 25

Course outcomes

CO	On completion of this course, student will be able to:
CO1	Apply chemistry principles for quantitative analysis.
CO2	Make use of an instrument for chemical analysis.
CO3	Calculate chemical parameter based on recorded observations .
CO4	Evaluate quality of coal and polymer based on their chemical properties.
CO5	Prepare a chemical substance such as soap,zeolite,biopolymer etc. based on experimental procedure.

LIST OF EXPERIMENTS:

1. Determination of total hardness of sample water by EDTA Method (complexometric titration)
2. Determination of total alkalinity of sample water .
3. Measuring EMF of electrochemical cell to predict spontaneity as well as to calculate Gibb's free energy and equilibrium constant.
4. Viscometric method to determine Molecular weight of a Polymer.
5. Estimation of sodium from given solution using flame photometry.
6. Colorimetric estimation of $KMnO_4$ from solution.
7. Proximate analysis of coal samples and Comment on it's quality.

Laboratory preparation of soap.

20ES01L Basic Electrical and Electronics Engineering Lab

Teaching Scheme:
Practical: 2 Hrs./Week
Credits: 1

Examination Scheme:
Term Work: 25 marks

Course Outcomes:

After completion of course, students will be able to

- Perform basic domestic wiring
- Apply circuit laws to find the parameters of given electrical network
- Build a basic regulated DC power supply
- Obtain frequency response of CE amplifier
- Build basic digital circuits

List of experiments:

- Introduction of different electrical and electronics components and instruments.
- To perform electrical wiring to control lamps using one way and two-way switches.
- To verify Thevenin's theorem & superposition theorem.
- To determine phase angle of L-C-R series circuit.
- To perform load test on single phase transformer to determine regulation and efficiency.
- To determine output voltage and ripple voltage of half wave, full wave rectifier with center tap transformer and bridge rectifier with and without filter.
- Assemble and build simple DC regulated power supply.
- To determine frequency response of CE amplifier.
- Assemble and build half adder & full adder circuits.

20ES02L Fundamentals of Programming Language -I Lab

Teaching Scheme:
Practical: 2 Hr/week
Credits: 1

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:

To facilitate the learners:
1. To learn the fundamentals of C programming for logic building.
2. To implement solution of given problem using appropriate data type, operators of C language.
3. To understand the decision and iteration interpretation in a programming language.
4. To implement the logic using arrays, strings, functions and structures of C programming language.

Course Outcomes:

By taking this course, the learner will be able to:
1. Apply logic development skills to solve simple real life problems.
2. Implement, test and execute developed logic or algorithm to C program using appropriate data type, operators.
3. Implement the given problem using appropriate control structures available in C language.
4. Identify different functions for a problem to construct a modular solution.

Following example list of problems are grouped into A, B and C, with increasing level of difficulty and understanding. Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions. Group B problem statements addresses the concept of control structures and Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.
Assignments can be framed and expanded in such a way that it explores concepts, language constructs, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Course tutor will set up assignments to challenge students through code debugging, code improvisation and code transformation. Course tutor will appropriately adopt assignments on similar lines as the examples shown here.

Instructors can conduct a total 10 assignments . Four assignments from Group A, four assignments from Group C and two assignments from Group C.

Example List of Assignments

(Minimum 10 assignments to be implemented, covering maximum Four from each Group. Assignment number 9, 10, 11 from Group C can be considered as extra assignments. Students can explore more on C constructs to implement these assignments.) :-

Group A

Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions.

1) Write C programs for basic problems Engineering Mathematics and Physics like area calculation, sin wave calculation, speed calculation, determine type of trainagle, verify pythogarous theorem etc.
2) Write C program to convert feet to inches, convert inches to centimeters, and convert centimeters to meters. Write a program that prompts a user for a measurement in feet and converts and outputs this value in meters. Facts to use: 1 ft = 12 inches, 1 inch = 2.54 cm, 100 cm = 1 meter.
3) Write a C program to swap 2 numbers.
4) Write C program to convert Kilograms to grams, convert grams to milligrams and vice a versa.
5) Write C program to convert Dollar to Rupees, convert Euro to Rupees, and vice a versa.
6) Write C program for temperature conversion Degree to Fahrenheit and vice a versa.
7) Write a C program to convert specified days into years, weeks and days.
8) Write a C program that accepts three integers and find the maximum of three.

Group B

Group B problem statements addresses the concept of control structures such as for loop, while loop.

1) Write C program to calculate Least common multiple (LCM) and Greatest Common Divisor (GCD) of given number.
2) Write C program to check whether the given number is prime or not.
3) Write C program to print a given pattern.
4) Write a C program to obtain the first 25 numbers of a Fibonacci sequence. In a Fibonacci sequence the sum of two successive terms gives the third term. Following are the first few terms of the Fibonacci sequence: 1 1 2 3 5 8 13 21 34 55 89...
5) Write C program for simple interest and compound interest calculation.

Group C

Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.

1) Write a C program to swap 2 integers using user defined functions (call by value, call by reference).
2) Write a program in C to compute the factorial of the given positive integer using function.
3) Write a menu driven program to perform following operations using Array of integers like (accept, display, sum of all numbers, search a number, maximum and minimum of number).
4) Write a menu driven program to perform string operations.
5) Write a program in C to compute addition / subtraction / multiplication of two matrices.
6) Write a C program to perform employee operations such as accept, display, search by name, search by number, update a record. Explore the possibility of modularity for implementation.
7) Write a C program to perform bank account related operations such as accept, display, withdraw and deposit money, check balance.

8) A string is provided from the user. Calculate the total number of characters in the string and the total number of vowels in the string with the number of occurrence in the string.
9) For a class an examination is conducted and the results for the students of all the 5 subjects are recorded. Write C program to display the record of students. On the basis of the record compute:
   i. The average score of class
   ii. Highest score and lowest score of class
   iii. Marks scored by most of the students
   iv. List of students who were absent for the test
10) Write a menu-based modular program in C to perform following operations for complex numbers:
   i. reading a complex number
   ii. writing a complex number
   iii. addition of two complex numbers
   iv. subtraction of two complex numbers
   v. multiplication of two complex numbers
11) Two friends issued 5 books each from the library, Write a program in C to compute set operations
   i. List of all books with them
   ii. List common titles with them
   iii. List of books with friend1 but not with friend 2

20ES07 Technical Skill Development Laboratory

Teaching Scheme:

Practical: 2 Hrs/Week

Examination Scheme:

In-Semester:25 Marks

Course Objective: Student will able to learn

I. To identify tools, work material and measuring instruments useful for assembly dissemble of products and different machining operations
2. To handle tools and instruments and use them to prepare joints of specific shape and size.
3. To install software and Operating system on computers

Course Outcome: Student will able to

1. select appropriate tools/equipment for measurement and manufacturing.
2. troubleshoot hardware software in computer systems.
3. produce joints of specific shape, size and material
4. assemble and disassemble components of a product.
5. Implement safety measures required to be taken while using the tools and machines

Sr. No.	Content :	Hrs
1	Use of measuring devices and instruments : Vernier Calliper, Micrometer, Digital Multi-meter, Tachometer, Lux meter etc.	2
2	Assembly -disassembly of products: Electric Iron, Water Purifier, Fan, Mixer Grinder etc.	4
3	Use of joining methods: Soldering and Welding.	4
4	Study and Hands on different day to day machining operations: such as drilling, tapping PVC pipe fitting, hacksaw cutting and filing.	2
5	Use of Machine Tool (Lathe machine)	6
6	Basic troubleshooting computer System in Hardware and Software. Installing and Uninstalling software's (OS 4 APPS) Computer system security aspects (Physical and logical)	6

**NOTE: Practical No. 5 is For Mechanical Engineering Branch and Practical No. 6 is for COMP/IT/E&TC/INSTRU Branch

Text Books:

I. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010.
2. The Elements of Workshop Technology - Vol I & Il, SK. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, I Ith edition 2001 others, Media Promoters and Publishers, Mumbai.

Reference:
I. Workshop manual prepared by Department of Mechanical Engineering.

Basic Sciences and Humanities

Autonomous Programme Structure (Revision-1)
F. Y. B. Tech. Sem-II
Computer Engg and Information Technology Programmes
A. Y.: 2020-21 Onwards

F. Y. B. Tech. Second Semester									
Course Code	**Course Title**	**Teaching Scheme Hours / Week**			**Examination Scheme**			**Marks**	**Credit**
20BS03	Multivariate Calculus	3	1	0	50	50	0	100	4
20BS04	Physics	3	0	0	50	50	0	100	3
20ES04	Engineering Graphics	2	1	0	50	50	0	100	3
20ES05	Fundamentals of Programming Language- 2	3	0	0	50	50	0	100	3
20ES06	Geo Informatics	3	0	0	50	50	0	100	3
20BS04L	Physics Lab	0	0	2	25	0	0	25	1
20ES04L	Engineering Graphics Lab	0	0	2	25	0	0	25	1
20ES05L	Fundamentals of Programming Language- 2 Lab	0	0	2	25	0	0	25	1
20ES06L	Geo Informatics Lab	0	0	2	25	0	0	25	1
Total		**14**	**2**	**8**	**350**	**250**	**00**	**600**	**20**
Grand Total		**24**			**600**			**600**	**20**

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Chairman Governing Body
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20BS03 Multivariate Calculus

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week
Number of Credits: 4

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

Course Objectives:

1. To familiarize the students with techniques of differentiation and integration of multivariable function.
2. To equip the students to deal with advanced level of Mathematics, and applications that would be essential for their disciplines**.**

Course Outcomes:

After completion of this course, students will be able to

CO1: Calculate partial derivatives of multivariate functions.

CO2: Apply partial differentiation to applications like maxima minima, construction of linear model etc.

CO3: Solve double integral, triple integral over the region.

CO4: Determine physical parameters using double and triple integral.

Course Content:

Unit – I: Partial differentiation **(09)**

Function of several variables, partial derivatives, Geometrical interpretation of partial derivatives, chain rule, higher order partial derivatives, Euler's theorem.

Unit – II: Applications of partial differentiation. **(07)**

Maxima, minima and saddle points, second derivative test, constrained extrema and Lagrange's multipliers, applications in optimization of functions of several variables. Applications of first order partial derivatives in data fitting using the method of least squares.

Unit – III: Double integration **(10)**

Tracing of curves in Cartesian and Polar coordinate system, double integrals over a rectangle, double integrals over regions, change of order of integration, Introduction of Jacobian determinant for two variables, double integral in polar coordinates, The Gaussian integral.

Unit – IV: Triple integration **(09)**

Triple integral over a box, triple integrals by iterated integration, change of variables, Cylindrical and Spherical coordinates, The Jacobian determinant for three variables, evaluation of triple integral.

Unit – V: Applications of Double and Triple integration **(07)**

Applications of double integral and triple integral: Area of plane Lamina, mass of plane lamina, surface area, volume, mass of solid.

Text Books:

1. B. V. Ramana, **'Higher Engineering Mathematics',** *Tata McGraw Hill Publications,* (2007).

2. B.S. Grewal, **'Higher engineering Mathematics'**, *Khanna publishers, (*40th edition), (2008).

3. Hughes-Hallett et al., '**Calculus - Single and Multivariable',** *John-Wiley and Sons,* (3rd Edition), (2003).

4. Maurice Weir, Joel Hass, '**Thomas' Calculus'**, *Pearson India*, (13th edition), (2016).

Reference Books:

1. J. E. Marsden, A. J. Tromba and A. Weinstein, '**Basic Multivariable Calculus'**, *Springer,* (3rd edition), (1993).

2. G. B. Thomas and R. L. Finney, '**Calculus and Analytic geometry'**, *Pearson, Reprint* (9th Edition), (2002).

3. Sudhir Ghorpade, Balmohan Limaye, '**A Course in Multivariable Calculus and Analysis'**, (Undergraduate Text in Mathematics), *Springer* (2009).

4. Dennis G. Zill, Warren S. Wright**, 'Multivariable Calculus**, **Early Transcendental'**, *Jones & Bartlett Publisher* (4th edition), (2009).

20BS04 Physics

Teaching Scheme	**Examination Scheme**
Lecture 3 Hrs per week	In – SEM Exam: 50 Marks
Number of Credits: 3	End – SEM Exam: 50 Marks

Course Objective:

To introduce undergraduate students of technology to the principles, notions, basic physical ideas, mathematical relations and applications of physical optics, thermodynamics, quantum physics, solid state physics and the properties of nano as well as bulk materials.

Course Outcomes:

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

CO – 1: **Apply** the generalized Coulomb law and the law of Electromagnetic Radiation to determine the electric fields due to the stationary and the accelerated charges.

CO – 2: Apply the laws of Physical Optics to determine intensity distributions of interference – diffraction patterns, and to identify polarization-types.

CO – 3: Apply the principles of Statistical Physics to determine the thermal distribution of matter in different energy states and the thermal response of engineering materials.

CO – 4: Justify the selection of — quantum probability rules and single qubit logic gates.

CO – 5: Differentiate between the physical properties of 'nano' materials and of their 'bulk' counterparts.

Title of Module, Brief Description of Course Contents and No. of Lectures

Module – 1: Electromagnetic Radiation and Interference: 8 Lectures

Expression for the electric field beyond Coulomb's law; Two dipole radiators and Physics of interference; Mathematical treatment (propagating waves, rotating vectors, complex functions)

Module – 2: Diffraction and Polarization: 8 Lectures

The resultant amplitude due to *n* equal oscillators; Diffraction Grating; The electric vector of light; Types of Polarized Light; Birefringence; Polarizers

Module – 3: Statistical Mechanics and Thermodynamics: 8 Lectures

Principles of Statistical Mechanics (Distribution of particles in thermal equilibrium); Laws of Thermodynamics (Carnot Cycle, Entropy, Clausius-Clapeyron Equation); Information Entropy

Module – 4: Quantum Physics: 9 Lectures

Laws of combining probability amplitudes; The Hamiltonian matrix & Schrödinger equation; Two-state systems: Pauli spin matrices & Photon polarization states; Single Qubit Logic Gates

Module – 5: Properties of Solids: 9 Lectures

Band Theory; Electrical (conductivity, resistivity), Magnetic (dia-para-ferro), Optical (absorbance, reflectance, transmittance), Mechanical (hardness, elasticity) properties (of 'bulk' & 'nano' solids)

Text Book:

R. P. Feynman, R. B. Leighton and M. Sands, **'The Feynman Lectures on Physics'**, *Pearson Education* (2006)

Reference Books:

1. **J. Walker, D. Halliday, R, Resnick, 'Principles of Physics', Wiley *Student Edition* (10th Edition)**

2. **H. Young and Roger Freedman, 'University Physics', Pearson Addison Wesley (12th Edition)**

20ES04 Engineering Graphics

Teaching Scheme	**Examination Scheme:**
Theory: 2 Hrs/week	In semester: 50 Marks
Tutorial: 1 Hr/week	End semester: 50 Marks
Credits: 3	

Course Objectives:

1 To develop the visualization and interpretation skills for the physical objects.
2 To provide the basic knowledge and develop the skills for creating 2 D drawings.
3 To provide the basic knowledge and develop the skills for creating Isometric views.
4 To familiarize about the development of solids.
5 To familiarize the construction and applications of Engineering Curves.

Course Outcomes:

After completing the course students will be able to draw
CO1 Orthographic and sectional orthographic projections of an objectCO2 Isometric views of the given object
CO3 Development of surfaces of the given object
CO4 Engineering curves by applying the given method

Unit – 1

Introduction Layout and sizes of drawing sheets, drawing instruments, types of lines used in drawing practice, dimensioning systems, representation of tolerances, standard codes by B.I.S (SP-46). (Not for Examination**)** **(01)**

Unit – 2

Orthographic Projection Theory of projections, methods of obtaining orthographic views, sectionalorthographic projections, Missing views. **(08)**

Unit – 3

Isometric Views Isometric axes, Isometric scale, isometric projections and views, construction ofisometric view from given orthographic views**.** **(08)**

Unit – 4

Development of Solids Parallel line development, radial line development, methods to transferpoints for development of prisms, pyramids, cylinder and cone. **(05)**

Unit – 5

Engineering Curves Construction of ellipse, parabola, hyperbola, involute, cycloid, Archimedeanspiral, helix on cone and cylinder. **(06)**

Text Books:

1. N. D. Bhatt and V. M. Panchal,'Engineering drawing, plane and solid geometry',Charotor Publication House.
2. R. K. Dhawan,'A text book of Engineering Drawing', Pearson Education Inc.
3. P.S. Gill, 'Engineering Graphics', Kataria and sons Publications.
4. M. L. Dabhade, 'Engineering Graphics', Vision Publications.

Reference Books:

1. Warren J. Luzzader, 'Fundamentals of Engineering Drawing', Prentice Hall of India,New Delhi.
2. Fredderock E. Giesecke, Alva Mitchell, 'Principles of Engineering Graphics',Maxwell

Dhananjay A. Jolhe, 'Engineering Drawing', Tata McGrawHill Publishing Co. Ltd.

20ES05 Fundamentals of Programming Language-2

Teaching Scheme:
Lecture: 3 Hr/week

Examination Scheme:
In-Sem: 50 Marks
End-Sem: 50 Marks
Credits: 3

Course Objectives:

To facilitate the learners:

1)To understand and apply object-oriented principles for application development.
2)To develop programming applications using Java.
3)To make use of class, object, constructor.
4)Learn programming construct of Java.

Course Outcome:

By taking this course, the learner will be able to:

1) Develop basic object oriented program using class, object and constructor.

2) Differentiate between different types of polymorphism

3) Demonstrate object-oriented programming concepts of exceptions using inbuilt classes and user-defined exceptions

4) Make use of principles of object-oriented programming language Java to solve given problem

Unit-I : Introduction to Object Oriented Programming Paradigm (5)

Role and need of programming languages, characteristics of a good programming language, introduction to various programming paradigms. Need of object-oriented paradigm, basic concepts of object oriented programming (OOP), benefits of OOP. General characteristics for OOP, Object oriented concepts: Class, Object, abstraction, encapsulation, polymorphism, and inheritance.
Illustration through real life examples and use cases

Unit-II : Introduction to Java Programming Language (6)

History of Java, Features of Java, Java and Internet, Java virtual machine, First java Program, Command line arguments, Java Programming elements: Data types, Control Structures, Encapsulation, Abstraction and Polymorphism, Class, object, constructor
Illustration through real life examples and use cases

Unit-III : Polymorphism **(5)**

This keyword, static method, function overloading, argument passing, constructor overloading. String and Array's in Java, Java Collection Framework – Arraylist, HashSet
Illustration through real life examples and use cases

Unit-IV: Inheritance **(6)**

Types of inheritance, base class and derived class, access specifiers, method overriding.
Illustration through real life examples and use cases

Unit-V: Abstract Class, Interfaces and Packages **(6)**

Abstract class, interfaces, run time polymorphism. Creating and importing packages.
Illustration through real life examples and use cases

Unit-VI: Exception Handling in Java **(5)**

Errors and Exceptions, Types of exceptions, try, catch, throw, throws and finally keywords, Build-in exceptions, creating and using custom exceptions.
Illustration through real life examples and use cases

Text Books:

1) Herbert Schilt, "JAVA Complete Reference", Tata McGraw Hill, (9thEdition), (2014)
2) Eckel B., "Thinking in Java", Pearson Education, (3rd Edition)

Reference Books:

1. Kathy Sierra & Bert Bates, "Head First Java", Oreilly publication,(2nd Edition) (2009)
2. Barry Burd "Beginning Programming with Java for Dummies", Oreilly publication, (5th Edition) (2017)
3. Paul Deital and Harvey Deital,"Java How to program", Prentice Hall Publication,(9th Edition) (2011)

20ES06 GEO-INFORMATICS

Teaching Scheme:

Lectures: 3 Hrs/Week

Credits: 3

Examination Scheme:

In-Semester : 50Marks

End-Semester : 50Marks

Course Objectives:

1. To introduce the science and technologies involved in Remote sensing
2. To understand the application of GIS in various fields
3. To explain the earth and mapping principles
4. To learn basics about the Geodata & GIS software

Course Outcomes:

After completion of course, students will be able to

CO1: Analyse the parameters affecting visual interpretation of physical features of an image

CO2: Justify use of various types of maps applicable in different scenarios

CO3: Identify use of components of GIS for spatial and attribute data relationship

CO4: Apply GPS technologies to real world examples using an understanding of GPS theory

CO5: Relate GIS and remote sensing technologies with maps, images and apps

Unit – I: Principles of remote sensing **(05)**

Concept of Remote Sensing, Working Principle, Types of remote sensing , Platforms of remote sensing , Output of remote sensing – photography, satellite imaginary and visual interpretation data

Unit – II: Data interpretation method in remote sensing (05)

Types of data, Visual interpretation of images-Natural and false colour composites, Image resolution, Limitations, Applications

Unit – III: Photogrammetry & Cartography (06)

Fundamentals of aerial photography, satellite images, virtual images, Image processing, Digitalization of maps

Cartography: Conventional Maps, Definition, Map Basics Elements/components of map, Map Scale, Large & Small Scale maps, Thematic maps , Coordinate system , Polar & Cartesian (Latitude-Longitude & x, y coordinates)

Unit – IV: Geographical information system (GIS) & Database management for geoinformatics (08)

GIS : Concept & definition of GIS (based on components, based on functions), GIS vs. Conventional Mapping, Components of GIS, Working Principle of GIS, Strengths of GIS, Geoinformatics Vs. GIS

Database management for geoinformatics : GIS Data and Data Models, Concept of Query, Concept of Spatial Analysis

Unit – V: Global Positioning System (GPS) (05)

History of GPS, Types of GPS, Working principle, Applications of GPS, Case study

Unit – VI: Application of geoinformatics (07)

Case studies to be used for demonstration-

Navigational services : available on phones (travel direction from A to B), Vehicle tracking system / Fleet management : Cabs, City buses, Trains, Aircrafts, City Planning (urban sprawl, master planning) , Solid waste management (identifying location for waste disposal site, route optimization of waste collection, online/offline monitoring of waste collection); Identifying suitable location for business outlet (Pizza hut, Teco bell, General Motors), GIS for location based services (courier & other home delivery services) – Fedex, DHL, Telecom sector uses GIS (planning of OFC network, identifying suitable location for mobile towers, marketing, operations), Disaster Management using GIS (modelling & simulation tools – through videos)

Text Books:

1. **Information Systems**, *Prentice-Hall of India, New Delhi, 2006.*
2. Ian Heywood, Sarah Cornelius and Steve Carver -**An Introduction to Geographical Information Systems-** *(4th Edition) by 2012*
3. A.M. Chandra, S.K. Ghosh,- "**Remote Sensing and Geographical Information System**", *1 st Edition, Narosa Publishing house, 2007.*

Reference Books:

1. 1. Peter A. Burrough and Rachael A. Mc. Donnell- **Principles of Geographical Information** System, *Oxford University Press Inc., New York, 2004.*
2. 2. Ian Heywood, Sarah Cornelivs and Steve Carver, **An Introduction to Geographical Information System**, *Pearson Education Pvt .Ltd., New Delhi, 2007.*
3. Arthur H. Robinson et al. **Elements of Cartography**, *V Edition, John Wiley & Sons, New Delhi, 2002.*
4. Misra, R.P.and Ramesh, A**, Fundamentals of Cartography concept-***Publishing Company, New Delhi, 2002.*
5. Lillesand M. Thomas and Ralph W.Kiefer **- Remote Sensing and Image Interpretation**

20BS04L Physics Laboratory

Teaching Scheme	**Examination Scheme**
2 hours per week	In-SEM Exam : Term work (25 M)
Number of Credits : 1	End-SEM Exam : NA

Course Objectives :

The objective of the Physics Lab course is two-fold :

To inculcate experimental skills, and

To demonstrate the interplay between theoretical & experimental physics.

Course outcomes (CO) for Physics Lab - 20BS04L

By taking this course, the students will be able to —

CO - 1 : Record the observations as per the least counts of measuring instruments and Perform necessary calculations.

CO - 2 : Compare the experimental findings with the corresponding theoretical physics models.

CO - 3 : Determine errors in experimental findings and Analyze their sources and causes.

CO - 4 : Reach the conclusions pertaining to the observed behaviour of physical systems.

List of Experiments :

Physical Optics Experiments :

I. Polarization of light, II. Diffraction Grating : Emission Spectra, III. Michelson Interferometer, and IV. Newton's Rings.

Electromagnetism & Heat Experiments :

I. Dia-Para-Ferromagnetism : Magnetic Permeability, II. Faraday's Law, and III. Hysteresis (B-H) Curve of Iron core, IV : Specific Heat of solid materials.

Modern Physics Experiments :

I. Planck's Constant, II. I - V Characteristic of LED, III. Hall Effect, and IV. Zeeman Effect.

20ES04L Engineering Graphics Lab

Teaching Scheme

Practical: 2 Hrs/week

Credits: 1

Examination Scheme

In Semester: 25 marks

Course Objectives:

To familiarize student about1

1.Advantages of using software for Engineering drawing

2.2-D drafting using a software

3. 3-D modeling using a software

4. 3-D printing technology

Course Outcomes:

After completing the course using a software package students will be able to

CO1: Draw orthographic projections of a given component

CO2: Draw Isometric projections of a given component

CO3: Draw development of solids

CO4: Draw free hand sketches of the machine elements

Part I

Introduction to 2-D Drafting using a drafting software **(20 Hrs.)**

- Orthographic Projections
- Isometric Projections
- Development of surfaces of solids
- Free hand sketching of standard machine elements

Part II

Demonstration of 3-D Modeling and 3-D Printing **(08 Hrs.)**

Creating a 3-D model of a simple component using a solid modeling software and manufacture using arapid prototyping technique.

Text Books:

N. D. Bhatt and V. M. Panchal,**'***Engineering drawing, plane and solid geometry'*,Charotor Publication House.

M.L.Dabhade, **'Engineering Graphics'**, *Vision Publications.*

Bethune, J.D., "*Engineering Graphics with AutoCAD 2013*", PHI Learning Private Limited, Delhi, 2013

20ES05L Fundamentals of Programming Language Lab-2

Teaching Scheme:
Practical: 2 Hr/week
Credits: 1

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:
To facilitate the learners:

1) To explore the principles of object oriented programming
2) To apply object oriented programming concept for developing applications using Java
3) To make use of class, object and constructor for coding basic object oriented program
4) To handle built-in and user defined exceptions

Course Outcome:
By taking this course, the learner will be able to:

1) Develop basic object oriented program using class, object and constructor
2) Develop readable and reusable code using inheritance and polymorphism
3) Make use of exceptions using inbuilt classes and user defined exceptions
4) Develop application using object oriented programming language Java to solve given problem

A large part of ESFL205 lab would be for understanding the basic concepts of object-oriented programming and implementation of some real-world simple applications. Assignment statements are in brief and should be implemented in JAVA programming language. Faculty members are encouraged to expand problem statements with variations. Assignments can be framed and expanded in such a way that it explores concepts, language constructs, 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.

Example List of assignments:-

Group A: Assignment to write program in OO language to understand concept of data abstraction and encapsulation

1. Write a MyDate class which has attributes as day, month and year. Create five objects of MyDate and display them.
2. Design a user defined abstract data type 'Complex' in Java. Write a program to perform arithmetic operations of two complex numbers.
   A complex number has a real part and an imaginary part.

a) Given the values of real part and imaginary part of a complex number, the magnitude of the complex number can be calculated as square root of the sum of squares of real part and the imaginary part.
b) The argument of the complex number can be calculated as tan inverse of ratio of imaginary part(numerator) and real part(denominator)
c) The complex number can be added to another complex number and the answer of the addition is a complex number. When one adds two complex numbers, the real parts of each of the complex numbers is added which becomes a real part of the answer and imaginary part of each complex number is added together which becomes imaginary part of the answer. Both these results are real and imaginary parts for a complex number which is the answer of the addition complex conjugate of the complex number can be calculated by negating the imaginary part of the complex number
d) The complex number can be subtracted from another complex number and the answer of the subtraction is a complex number.
e) When one subtracts a complex number from the other, the real part one complex number is subtracted from the other and the result becomes a real part of the answer and imaginary part of one complex number is number is subtracted from the other and the result of subtraction becomes imaginary part of the answer. Both these results are real and imaginary parts for a complex number which is the answer of the subtraction.

3. Create a student result database in Java. Calculate the grades of students. Decide criteria for best student and short-list students who satisfy the criteria.
   a) A student has a roll No, name, marks in five courses and a grade. A student list has many students. If a student has grade equal or beyond 8, he is considered as a top band student.
   b) Create at least ten students. From these, find all such students which satisfy the criteria of top band student. Create a list of such students and display the students in the list.

4. A circle has a radius. Its area can be calculated. The area is a double number. Its perimeter can be calculated as $2\pi r$. The perimeter is a double number. Given two circles one can find out which is large and which is small.
   Create two circles c1 and c2 with radius as 10 and 7 respectively. Calculate the area and perimeter of each. Compare two circles with each other and display which is large and which is small.
5. Write a JAVA program to perform String operations using String/String Buffer class

a) Write a program that reads a word and then prints the first character, the last character, and the characters in the middle. For example, if the input is Cummins, the program prints Cummins.
b) Write a program that reads a name (such as Ranbeer Rishi Kapoor) and then prints a monogram consisting of the initial letters of the first, middle, and last name (such as RRK).

Group B: Assignment to write program in OO language to understand concept of class inheritance and polymorphism.

1. Implement Java program to calculate area and perimeter of various shapes-circle, triangle and rectangle.
2. Create an application like book shop and maintain the inventory of books that are being sold at the shop
3. Find appropriate class hierarchy, polymorphic behavior in applications like banking and implement it.
4. Model the HRD application using the concepts of inheritance, interface, polymorphism
5. A company has many employees. An employee has employee Id, basic salary, house rent allowance, dearness allowance, profession tax and total salary. An employee has an address. The address has apartment number, apartment name, road and PIN code.

   The total salary of an employee is the summation of basic salary, house rent allowance which is 20 percent of basic salary, dearness allowance which is 45 percent of basic salary. The take home salary is calculated after deducting profession tax from which is 7 percent of basic salary from the total salary. When an employee is appointed, he is assigned with an employee Id and basic salary. One can ask for total salary of the employee and take-home salary of the employee.
   Identify a class/classes from the above statement, identify the attributes, the data types, the behaviour. Test your program for ten employees
   Display all the details of the employees as per id and as per pin code.
   Display take home salary for all the employees, display the tax to be deducted across all employees.
6. Reading material has title and price. A book is a reading material. It has ISBN number. A magazine is a reading material, it has month of issue. A CD is a reading material, it has duration in minutes. Represent the above description as a generalization, specialization tree. Identify the parent class, its attributes, child class and their attributes. Write all of them clearly.

7. A vehicle has engine no and chassis number. It can be locked, unlocked. Every vehicle is movable (interface). It can be started, stopped, turned, accelerated, turned, and decelerated. A car is a vehicle. It has steering. An airplane is a vehicle. It has wings. A boat is a vehicle. It has propeller.

Group C: Assignment to write program in OO language to understand concept of exception handling

1) Write a program to catch various in-built exceptions (try, catch and finally block)

2) Create User defined exception to check the specific conditions for systems like recruitment etc and throw the exception if the criterion does not met in Java.

3) Consider student data consist of fields such as roll number, name, and marks of various subjects. Write a program using inbuilt and user defined exceptions to avoid invalid entry.

20ES06L GEO-INFORMATICS Lab

Teaching Scheme:

Practical : 2 Hr/Week

Credit1: 1

Examination Scheme:

Term Work: 25 Marks

Course Objectives:

1. To introduce students basics of spatial data and its creation.
2. To learn basics about the Geodata & GIS software.

Course Outcomes:

After completion of course, students will be able to

CO1: **Interpret** satellite images and their characteristics with the use of software features

CO2: **Apply** basic data visualization concepts for identification of physical features

CO3: **Use software to interpret** aspatial attribute data and relate it with spatial data

CO4: **Use software to interpret** vector layer and relate it with attribute data

List of Experiments

1) Exploring Digital Map
2) Study and observations of paper map and digital map
3) Measurement of area using Digital planimeter.
4) Study of Layers, Display Controls, Locating a place

5) Adding place marks - Saving KMZ/ KML files

6) Study of ground profile between given two points

7) Visual Interpretation of multispectral image

8) Creating csv file (attribute data) and importing in GIS platform

9) Understanding QGIS interface

10) Working with vector data – Point, Line, Polygon

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**			

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

APPROVED BY
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

20IT 301 Data Structures

Teaching Scheme:
Lectures: 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures: 3 hours/week
Tutorial : 1

Examination Scheme:
In-Semester : 50 Marks
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:
Practical: 4 hours/week

Examination Scheme:
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**					

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

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

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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:
Lectures: 3 hours/week
Tutorial: --

Examination Scheme:
In-Semester: 50 Marks
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	20PEIT 501L A Artificial Intelligence
20PEIT 501 B Business Intelligence	20PEIT 501L B Business Intelligence
20PEIT 501 C Computer Graphics and Animation	20PEIT 501L C Computer Graphics and Animation
Programme Elective – II	
20PEIT 502 A Blockchain Architecture Design and Use Cases	
20PEIT 502 B Internet of Things	

Department of Information Technology

APPROVED BY
Secretary Governing Body
MKSSS's Cummins College of Engineering
For Women, Pune-411052

MKSSS's Cummins College of Engineering for Women, 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:
Lectures: 3 hours/week

Examination Scheme:
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: Cohen sutherland method, midpoint subdivision method
Polygon Clipping: Sutherland 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. 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
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Cummins College of Engineering for Women, Kurvenagar, Pune-411052

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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:
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. 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:
Lectures: 3 hours/week
Tutorial: 1 hour/week

Examination Scheme:
In-Semester: 50 marks
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:
Lectures: 3 hours/week
Tutorial: -

Examination Scheme:
In-Semester: 50 marks
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

Autonomous Program Structure of
Final Year B. Tech. Seventh 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	Practical	Oral		
20IT-P 701	Internship/Project	0	0	30	200	0	0	100	300	15
20HS 701	Economics and Personal Finance (EPF) (Online)	2	0	0	100	0	0	0	100	2
	Grand Total	**32**			**400**				**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 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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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**		
	Grand Total	**19**			**600**				**600**	**17**

*** Inter-disciplinary Course**

Programme Elective – IV 20PEIT 801 A Advanced Machine Learning 20PEIT 801 B Introduction to DevOps 20PEIT 801 C Design Patterns	**Programme Elective – IV Lab** 20PEIT 801L A Advanced Machine Learning 20PEIT 801L B Introduction to DevOps 20PEIT 801L C Design Patterns
Programme Elective – V 20PEIT 802 A Advanced Databases 20PEIT 802 B Unified Communication 20PEIT 802 C Information Retrieval	

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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 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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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:
Practical: 2 hours/week

Examination Scheme:
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:
Practical: 2 hours/week

Examination Scheme:
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

Third and Final Year B. Tech.
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		
20OEHS 501	Open HS Elective –I	3	0	0	50	50	0	0	100	3
20OE 601	Open Elective-II	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

* **Inter-disciplinary Course**

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

20OE601 Open Elective-II

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

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

20OEHS501A ENTREPRENEURSHIP DEVELOPMENT

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: NA

Course Objectives:

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:

After completion of the course, students will be able to

CO1	Describe what it takes to be an entrepreneur
CO2	Analyze business opportunities and the basics to create, launch and manage new businesses
CO3	Develop Business Model for their Idea/Problem
CO4	Create MVP (Minimum Viable Product)

Module 1: Introduction (03)

Discover yourself, Principles of Effectuation, Identify your entrepreneurial style

Module 2: Problem Identification and Idea generation (04)

Identify Problems worth Solving, Introduction to Design Thinking, Generate ideas that are potential solutions to the problem identified

Module 3: Customer Segmentation (07)

Customer identification, Market, Creative solution, Unique Value proposition

Module 4: Business Model Canvas (04)

Types of business models, Business Plan documentation, Risk identification

Module 5: Validation (09)
Identification of MVP, Solution development, Building products/services, Build-measure-learn loop for development, Market fit of solution

Module 6: Money (05)
Revenue streams, Pricing and cost, Venture financing, Investor expectations

Module 7: Team building (03)
Shared leadership, role of good team, Collaboration tools and techniques

Module 8: Marketing and sales (03)
Positioning, Channels and strategies, Sales planning

Module 9: Support (04)
Project management, Planning and tracking, Business Regulation

Text Books:

1. Course contents available at: https://staging.learnwise.org/ - Through a Cloud Technology Platform – WF Learn Wise Platform
2. 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-ofentrepreneurship-you-actually-follow-whethe
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=46uP6vOj5G
7. Google : Think branding: https://www.youtube.com/watch?v=1l2CUjkg0ug

20OEHS501B Intellectual Property Rights

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: No pre-requisite

Course Objectives:
To facilitate learners
to,

1 Overview of Intellectual Properties (IP) regime in India and International arrangements
2 Introduce the types of IP as Patents, Copyrights, Trade Secrets etc.
3 Understand the process and steps involved in filing Intellectual Properties
4 Understand intricacies involved in drafting patent applications

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

CO 1 Demonstrate the concepts of Intellectual Property Rights, patents and other forms of IP
CO2 Apply appropriate type of IP for the Intellectual property
CO3 Analyze the patentability of inventive step by searching patents
CO4 Construct patent drafts for given Patent specification
CO5 Understand the advances in patent law, in national and international scenario

Unit 1: Introduction (06)

Intellectual Property (IP) Vs. Physical property, History of IP in India, Importance of IP, Patentable inventions / art, types of IPR-Patents, Copyright, Industrial Design, Trade Marks etc., Basic principles of IPR, Economic Importance of Intellectual Property Rights, IPR-ownership, morality, public order, traditional knowledge

Unit II: Patents (08)

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, Patent of Addition

Unit III: Drafting of patent applications (08)

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 (06)

Working of patents, compulsory licensing, Revocation of patents, Transfer of Patent Rights- Assignment, License; Concept of infringement, Infringement of Patents Rights, Infringement of Patents rights

Unit V: Introduction to other types of IPs (08)

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 (06)

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

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"

Online Resources:

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/intellectualproperty-ip-policy

20OEHS501C Introduction to Digital Marketing

Teaching Scheme
Lectures: 3

Examination scheme:
In Semester: 50 marks
End Semester: 50 marks
Credits: 3

Prerequisite:

Course Objectives:

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 Outcomes:
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)

Introduction 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

20HS501D - LAW FOR ENGINEERS

Teaching Scheme
Lectures: 3 Hours / Week

Examination scheme:
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1 To acquaint the students with legacies of constitutional development in India and help them to understand the most diversified legal document of India and philosophy behind it
2 To make students aware of the theoretical and functional aspects of the Indian Parliamentary System
3 To channelize students' thinking towards basic understanding of the legal concepts and its implications for engineers
4 To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework
5 To make students learn about role of engineering in business organizations and e- governance

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

CO 1 Identify and explore the basic features and modalities about Indian constitution
CO2 Differentiate and relate the functioning of Indian parliamentary system at the center and state level
CO3 Differentiate different aspects of Indian Legal System and its related bodies
CO4 Correlate and apply different laws and regulations related to engineering practices
CO5 Correlate role of engineers with different organizations and governance models

Unit 1: Legal Structure and Constitutional Law (06)

Legal Structure **:** Court System in India (District court, District Consumer court, Tribunals, High courts, Supreme Court), Arbitration, Constitutional Law: The Preamble, Fundamental Rights, Fundamental Duties, Emergency provisions: Kinds, Legal requirements and Legal effects.

Unit II: RTI and Contract Law (06)

Right to Information Act, 2005: Evolution and concept, Practice and procedures, Contract Law : General Principles of Contract under Indian Contract Act, Kinds of government contracts and dispute settlement, Standard form contracts : Nature, Advantages, Unilateral character, Principles of protection against possibility of exploitation, Clash between two standard forms contract.

Unit III: Sale of Goods Law and Consumer Protection Act (06)

Sale of Goods Law **:** Goods- movable property, Warranty, Guarantee, Consumer Protection Act **:** Consumer Rights and Legislative framework on Consumer protection.

Unit IV: Environment Law and Labour Laws (08)

Environment Law**:** Laws relating to industrial pollution, environmental protection, Labour Laws**:** Industrial Disputes Act, Collective bargaining; Industrial Employment, Health and safety at work, Accidents, PoSH Act 2013 **:** Laws relating to Equality and Empowerment of Women, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013

Unit V: Patent and Cyber Law (08)

Law relating to Patents : Patents Act, 1970, Law relating to Intellectual property, Law relating to Copyright, Law relating to Trademarks, Cyber law Act 2000 : The Information Technology Act, 2000 (also known as ITA-2000, or the IT Act) - dealing with cybercrime and electronic commerce.

Unit VI : Corporate Law and Land Law (08)

Corporate Law**:** Meaning of corporation; Law relating to companies, public and private (Companies Act, 1956) general provisions, Corporate liability, civil and criminal, Code of Business Conduct (COBC) provides the ethical guidelines and expectations for conducting business, Land Law: Transfer of Property Act, Land disputes.

Text Books:

1 D.D. Basu, "**Shorter Constitution of India"**, Prentice Hall of India, December 2017
2 S.K. Awasthi & R.P. Kataria, "**Law relating to Protection of Human Rights"**, Orient Publishing, 2000
3 Wadhera , "**Intellectual Property Rights"**, Universal Law Publishing Co, 5th edition
4 O.P. Malhotra, "**Law of Industrial Disputes"**, N.M. Tripathi Publishers, 1968

Reference Books:

1 M.P. Jain, "**Indian Constitutional Law"**, Wadhwa & Co., 2018
2 S.K. Kapur, "**Human Rights under International Law and Indian Law"**, Central Law Agency, 7th edition
3 Avtarsingh, "**Law of Contract"**, Eastern Book Co, 2020
4 T. Ramappa, "**Intellectual Property Rights Law in India"**, Asia Law House, 2016

Online Resources:

1 **Companies Act, 2013 Key highlights and analysis by PWC.**
https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlightsandanalysis.pdf

20OEHS501E ORGANIZATIONAL BEHAVIOR

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 Develop familiarity with the concepts related to organizational behavior.
2 Gain knowledge about personality traits and individual behavior.
3 Study group dynamics.
4 Get exposure to the recent trends in Organizational behavior.

Course Outcomes:
After completion of the course, students will be able to
1 Explain concepts of organizational behavior, its importance and culture.
2 Outline meaning of personality and how individual behavior impact organization.
3 Relate with ideas of group dynamics and influence of groups in work place.
4 Recall latest trends in Organizational behavior.

Unit 1: Introduction (07)
Management and Organizational Behavior (OB), Organizational behavior in historical perspective, Developing an OB model, Challenges and Opportunities for OB, Foundation of individual behavior.

Unit II: Individual (08)
Personality, personality frameworks, big five model, perception, individual decision making, attitudes, components of attitudes, attitudes and behavior, Job attitudes, values

Unit III: Diversity and Ethics (06)
Environmental context : diversity and ethics, Communication, Case studies

Unit IV: Trends (07)
International organizational behavior, emotional intelligence, strategic organizational behavior, Intra-preneurship, flat organization,Gig economy

Unit V: Group Dynamics (08)
Foundation of group behavior, stages of group development, group decision making, team building, organizational conflicts and negotiation, power and politics,employee engagement

Unit VI : Dynamic Environment and Culture (06)

Information technology and globalization, Human resource policies and practices, OKR (Objective and Key results)framework, Learning

Text Books:

1 Stephen P. Robbins, Timothi A.Judge, **'Organisational Behavior'**, 18th Global Edition, Pearson Education(2017),ISBN: 978-0-13-410398-3
2 Dr. S. S. Khanka, **'Organisational Behaviour (Text and Cases)',** S.Chand & Company Pvt.Ltd. (2018), ISBN 978-81-219-2014-8
3 Fred Luthans, **'Organizational Behavior '**, 12th Edition, McGraw Hill Publication (2017), ISBN-978-1-25-909743-0

Reference Books:

1 Moorhead, Griffin, 'Introduction to Organizational Behavior', India Edition (2010), Cengage Learning, ISBN: 978-81-315-1242-5
2 P. Subba Rao, 'Organisational Behaviour (Text , Cases and Games)' Himalaya Publishing House (2017), ISBN 978-93-5024-673-3
3 K. Aswathappa, 'Organisational Behavior : Text, Cases & Games', 12th Revised Edition,Himalaya Publishing House(2017), ISBN 978-93-5051-588-4

Online Resources:

1 NPTEL on "Organizational Behavior": https://nptel.ac.in/downloads/110105034/#

20OEHS501F PROJECT MANAGEMENT

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

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:

1 To introduce concepts of Project management
2 To discuss life cycle of real life projects and activities involved in projects
3 To understand risks involved in a project

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

CO 1	Identify scope of a project and lifecycle of a project
CO2	Develop a plan for a project
CO3	Determine schedule of a project
CO4	Assess risks involved in a project
CO5	Estimate budget of a project
CO6	Adapt project management tools and techniques

Unit 1: Introduction (07)
Definition of project, Objectives of Project Management, Classification of projects, Life cycle phases of the project. Project management and Project manager, Role and responsibilities of the project manager, Stakeholder Identification, team building

Unit II: Project Planning (07)
Project Planning: Introduction and basic requirements, establishing project objectives, Statement of work (SOW), project specifications, Work Breakdown structure (WBS).

Unit III: Project Scheduling (07)
Project scheduling: Introduction and basic requirements, milestone scheduling, Network Scheduling techniques: PERT(Program Evaluation Review Technique), CPM(Critical Path Method), GANNT chart, Schedule control

Unit IV: Risk Assessment and Management: (07)
Risk Management Planning, Risk identification, Qualitative Risk analysis, Quantitative Risk analysis, Risk response planning, Risk monitoring and controlling

Unit V: Project Cost Estimation (07)

Resource Planning, Cost Estimating, Cost Budgeting, Budget control, Earned Value Analysis, Project Audits, Project closure

Unit VI : Tools and Techniques for Project Management (07)

Project Management tools, International Project Management, Collaborative development, Planning Quality Management, Quality metrics, Techniques for Quality Control (statistical control, six sigma, ISO)

Text Books:

1 1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), PMI.
2 PROJECT MANAGEMENT A Managerial Approach, Jack R. Meredith, John Wiley & Sons

Reference Books:

1 Morris, P. W. G., Pinto, J. K., The Wiley Guide to Managing Projects, 2004, John Wiley & Sons
2 Phillips, J.PMP Project Management Professional Study Guide, McGraw-Hill, 2003.

Online Resources:

1 http://www.pmi.org
2 https://www.ipma.world

20OEHS601A Automation and Control Engineering [ACE – OE-II]

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

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Pre-requisite: Engineering Mechanics, Fluid Mechanics, Basic Mathematics

Course Objectives:

Course prepares students to

1 To familiarize with the basic concepts of Industrial Automation
2 To acquaint with the concept of low cost automation with Hydraulic and Pneumatic systems.
3 To acquaint with the basic concepts of the Industrial Fluid Power and Factory Automation.
4 To familiarize with the working of different types of controllers and control actions.

Course Outcomes:

Students will be able to

1 Identify the elements of automation systems, levels of automation and types of automation.
2 Describe assembly line automation, Transfer system, and its components.
3 Analyze different hydraulics and pneumatics circuits for Industrial applications.
4 Study of control system and its types.
5 Develop the basic ladder logic using PLC for different industrial applications.

Unit/Module: 1 Introduction to Automation 4 hours CO: 1

Definition, Automation in Production system, Need of automation, Societal issues of automation, Automation strategies, levels of automation, types of automation, Architecture of an Industrial automation system.

Unit/Module: 2 Hydraulics and Pneumatics devices 6 hours CO: 2

Different types of Hydraulics and Pneumatics devices,

DCV: All possible configuration and valve designation for Single acting and double acting actuators

FCV, PCV, Actuator and auxiliary elements in hydraulic and pneumatic system, Industrial applications and Case studies.

Unit/Module: 3 Hydraulic Systems 8 hours CO: 3

ISO symbols for Hydraulics, Basics of Hydraulic system, Hydraulic Power Pack, Actuators, Circuits using Sequencing and cascading method, Design of Electro-Hydraulic circuits, Case studies and Industrial Applications. Digital and Servo hydraulic control circuits.

Unit/Module: 4 Pneumatic Systems 6 hours CO: 4

ISO symbols for Pneumatics, Basic circuits using linear and rotary pneumatic actuators, Circuits using Cascade method and shift register method, Design of Electro-pneumatic circuits using solenoids to operate single acting and double acting actuators.

Unit/Module: 5 Assembly line Automation and control 6 hours CO: 5

Automated Material handling systems, automated inspection, transfer lines, part placing and part escapement, AGV's and conveyors

Control System: Open loop, Close Loop, Mathematical Modelling of basic systems :Hydraulic, Pneumatic, Thermal and Fluid systems, Case Studies

Unit/Module: 6 Controllers 6 hours CO: 6

Programmable Logic Controller: Basics of PLC, PLC operating cycle, Architecture of PLC, PLC Ladder Programming, Logic Gates, Timers, Counters, Concept of Latching and Interlocking, Selection of PLC for different industrial applications.

Control Actions: On-Off controller, Proportional controller (P),Integral Controller(I) ,Derivative Controller(D),Compound Controller actions: PI,PD,PID

Total Lecture hours: 36 hours

Text Books:

1 Anthony Esposito, "Fluid Power with Applications",7th Edition, 2008,PHI Publication.
2 M.P.Groover, "Automation, Production System and Computer Aided Manufacturing",3rd Edition,PHI Publication,New Delhi.
3 M.P.Groover, "Industrial Robotics: Technology, Programming and Applications
4 Ogata, "Modern Control Engineering"
5 Nagrath and Gopal "Mathematical Modelling, Simulation and Analysis", MGH Pub
6 Gary Dunning, "Introduction to Programmable Logic controller", Thomas Learning, edition, 2001.
7 Handbook of design, manufacturing and Automation: R.C. Dorf, John Wiley and Sons.

Reference Books:

1 C D Johnson, "Process Control Instrumentation Technology", Prentice Hall of India, New Delhi. ISBN: 8120309871
2 Vickers "Industrial Hydraulics" Manual, 3rd Edition, Vickers Inc.

20OE601B AUTOMOTIVE 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 operation of basic automotive System components
2 To discuss sensors and actuators in automotive applications
3 To describe the system view of automotive control systems and In-vehicle Communication Protocols
4 To introduce diagnostic methodologies and safety aspects in automotive system

Course Outcomes:

After completion of the course, students will be able to

CO 1 Explain the functioning of automotive systems
CO2 Identify key components of automotive control systems and represent in terms of block diagram
CO3 Develop a model for simple systems using model based development.
CO4 Compare communication protocols, safety systems and diagnostic systems Estimate

Unit 1: Fundamentals of Automotive Systems (10)

Overview of an Automotive System, Basics of Spark Ignition, Compression Ignition Engines, Need of Electronics in Automobiles, Ignition systems, Transmission systems, Suspension system, Braking system, Steering system, Fuel Delivery system, Alternator and battery charging circuit, Basics of Hybrid Electric Vehicles.

Unit II: Automotive Sensors, Actuators, Control Systems (08)

Systems approach to Control and Instrumentation: Concept of a system, Analog and Digital system, Basic Measurement system, Types of Control Systems, 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, Variable Valve Timing (VVT), BLDC motor, Electronic Engine Control, Engine Management System strategies for improving engine performance and efficiency.

Unit III: Microcontrollers / Microprocessors in Automotive Domain, Model Based Development (09)

Critical review of Microcontroller / Microprocessor (Architecture of 8-bit /16-bit Microcontrollers with emphasis on Ports, Timers/Counters, Interrupts, Watchdog Timer and PWM), Criteria to choose the appropriate microcontroller for automotive applications, Automotive grade processors, Fuel Maps and Ignition Maps, Introduction to Model Based Development.

Unit IV: Automotive Communication Protocols (07)

Overview of Automotive Communication Protocols, CAN, LIN, FLEXRAY, MOST, Communication Interface with ECUs, Interfacing with infotainment gadgets, Application of telematics in automotive domain: GPS and GPRS, Relevance of Protocols such as TCP/IP, Bluetooth, IEEE 802.11x standard, in automotive applications.

Unit V: Safety Systems in Automobiles, Diagnostics, Standards (08)

Active Safety Systems: Anti-lock Braking System (ABS), Traction Control System, Electronic Stability Program, Passive Safety systems: Airbag System, Advanced Driver Assistance System (ADAS), Anti-theft systems, Fundamentals of Diagnostics, Self Diagnostic System, On-Board Diagnostics and Off-Board Diagnostics, Importance of Reliability in Automotive Electronics, Reliability Testing with example, Environmental and EMC Testing for Automotive Electronic Components, ISO, IEC and SAE Standards.

Text Books:

1 Williams B. Ribbens**, "Understanding Automotive Electronics**", *Newnes*, (7th Edition), (2003).
2 Robert Bosch**, "Automotive Electronics Handbook"**, *John Wiley and Sons*, (1st Edition), (2004).

Reference Books:

1 Ronald K Jurgen, **"Automotive Electronics Handbook",** *McGraw-Hill*, (2nd Edition), (1999).
2 James D Halderman, **"Automotive Electricity and Electronics",** *PHI Publication* , (1st Edition), (2005).
3 Tom Denton, **"Automobile Electrical & Electronic Systems",** *Routledge*, (4th Edition), (2002).
4 Tom Denton**, "Advanced Automotive Diagnosis",** *Elsevier*,(2"d Edition), (2006).
5 V.A.W. Hillier, **"Fundamentals Automotive Electronics",** *Oxford University Press*, (6th Edition), (2014).
6 Mehrdad Ehsani, Ali Emadi, Yimin Gao, **"Modern Electronic, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design"**, *CRC Press*, (2nd Edition), (2009).
7 Terence Rybak, Mark Steffka, **"Automotive Electromagnetic Compatibility (EMC)"**, *Springer*, (2004).

Online Resources:

1 **NPTEL Course "Fundamentals of Automotive Systems"** https://onlinecourses.nptel.ac.in › noc20_de06 › preview

20OE601C Avionics

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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

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*, (2nd Edition), (2003).
2 R. Szeliski, **"Computer vision algorithms and applications",** *Springer-Verlag*, (2nd Edition), (2010).

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).

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

20OE 601F Design Thinking

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite:

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
3 Susan Weins Chenk, "Hundred things every designer needs to know about people", New Riders Publication
4 Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", Wiley Publication
5 Roger L. Martin, "Design of Business: Why Design Thinking is the Next Competitive Advantage" Harvard Business Press
6 Karl Ulrich, "Design: Creation of Artifacts in Society" - 2011
7 Bala Ramadurai, "Karmic Design Thinking"
8 T. Amabile, "How to kill creativity", SAGE Publication - 2006
9 William Lidwell, Kritina Holden, Jill Butler, "Universal principles of Design ", Rockport Publishers
10 Bella Martin, Bruce Hanignton, Bruce M Hanington "Universal methods of design", Rockport Publishers - 2012
11 Roman Kizanie, "Empathy: Why it matters, how to get it", TarcherPerigee Publishers
12 Karla McLaren, "The Art of Empathy: A complete Guide to life's most essential skill", Sounds True Publishers

20OE601G e-Business

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 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 Outcomes:
By the end of this course, students will be able to

CO1	Explain the concepts of e-business and e-business models
CO2	Apply suitable principles and practices of designing and developing e-business website
CO3	Apply necessary back end system components required for successful e-business implementations
CO4	Outline the meaning of e-business security and how it impacts the business
CO5	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 (07)
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 (07)
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 (07)

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 (08)

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 V: Launching an e-Business and e-business trends (06)

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

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 Book:

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).

20OE601H - Electric Vehicles

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:

1 Understand and identify and integrate EV subsystems
2 Learn and find energy storage requirements for vehicle application
3 Comprehend design of battery thermal management system
4 Undestand calculations of motor power ratings for an EV application
5 Study suitable type of sensors for EV applications
6 Study appropriate control strategy for EV

Course Outcomes:
Students should be able to

1 To identify and integrate EV subsystems
2 To calculate energy storage requirements for vehicle application
3 To select and design battery thermal management system
4 To calculate motor power ratings for an EV application
5 To select a suitable type of sensors for EV applications
6 To select appropriate control strategy for EV

Unit 1: Introduction to hybrid and electric vehicles: (6)

Engineering case, legislative push, incentives, market pull. EV : micro to mild to PHEV to HEV to REEV to EV - Hybrid-Electric Vehicle Power trains, Vehicle Energy Storage System Design, System and sub-systems, Modelling and design of EVs as a system, Motors & motive power spilting concepts, and interface within power train system

Unit 2: Power train architecture: (6)

Parallel, Series and Combined, Types of EVs, Vehicle layout and packaging options, Duty Cycles in Indian cities; performance, Components of Power Train**,** Auxiliary Inverter, HV-LV DC-DC converter, Traction Inverter, Gear Trains, Integration of power train components, regenerative brakes

Unit 3: Introduction to Energy Storage (6)

Energy storage requirements for vehicle applications, Storage technologies and metrics for comparison, Distribution of Energy, Storage Form of Energy, Intermediary Conversion, Control and Diagnostic, Ragone Chart, Theory of Ragone Plots. Ragone Plot of a Battery

Unit 4: BMS, Packing and Charging: (6)

Battery Management Systems (BMS), Lithium-Ion Batteries Aging Effects. Battery characterization and testing systems, Thermal management & Battery life cycle, Modular battery packs, packaging, thermal control, Changing Systems and Infrastructure

Unit 5: Electric Drives (6)

DC motors, induction motors and synchronous motors, permanent magnet motors, BLDC, switched reluctance motors, Switched Reluctance Motors (SRM),Permanent Magnet Synchronous Motor (PMSM)

Unit 6: Sensors in Electric Vehicles: (6)

MEMS Sensors for Engine Management, Battery Monitoring Sensors, State of the Charge Sensing, Sensors for Passenger Safety, Sensors for Skidding and Rollover Detection, Tire Pressure Sensors, Electronic Stability Control of Vehicles, Sensors for Antitheft, Vehicle Navigation Sensors. EV sensors of Texas Instruments, STM, NXP, etc.

Books:

1 Mehrdad Ehsani, Yimin Gao, Sebastian E.Gsay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Celll vehicles-Fundamentals - Theory and Design", CRC Press
2 Energy Storage by Robert A. Huggins, Springer Publication
3 Chang Liang Xia,Permanent Magnet Brushless Dc Motor Drives and Controls, Wiley 2012.
4 Katsuhiko Ogata, "Modern Control Engineering" 5th edition, Prentice Hall of India Private Ltd., New Delhi, 2010.
5 Cooper W.D & Hlefrick A.D., Electronic Instrumentation Measurement Technique, III Edition, Prentice Hall of India – 1999

20OE 601I 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 gamification mechanics to solve a problem.
4 To make use of gamification 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 develop game using game mechanics.
4 To apply tools of gamification to real life applications.

Gamification is about applying game concepts, driving engagement into non game environments/contexts like a website designing, online community for interactive discussion, a fun way of learning management system for engagement of stakeholders etc.

Gamification is NOT about designing fancy games, video games, virtual reality games etc. Therefore this course does NOT cover games and game design aspects. Course will also discuss the negative impact and influence of games (when played in excess) on young minds like addiction to video games, over spending time for games.

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 verses 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 Re-enforcement, Game Mechanics in depth, Putting it together, Case study of 8 queens problem.

Unit V: Game Mechanics and Applications (7)

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.

20OE 601J Geographical Information Systems

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 basics of GIS
2 Understand representation of GIS models
3 Relate GIS and DBMS for various applications, analyze and visualize the spatial data
4 apply GIS to supply chain management

Course Outcomes:
After completion of the course, students will be able to
1 Apply basics of GIS to database design
2 Make use of various data models to given data
3 Apply data editing techniques to spatial data
4 Apply spatial data analysis to GIS data
5 Create maps using ArcGIS
6 Apply GIS in supply chain management

Unit I: Introduction to GIS (05)
Define GIS, GISystems, GIScience, Spatial and Geoinformation, Components of GIS, Recent trends and applications of GIS; Data structure and formats, Spatial data models – Raster and vector, Database design- editing and topology creation in GIS, Linkage between spatial and non-spatial data, Data inputting in GIS. Rectification, Transformation Methods; Root Mean Square (RMS) Error

Unit II: Data Types and data models (05)
Data Types; Spatial Data; Non-Spatial Data, Data Input; Existing GIS Data, Metadata; Conversion of Existing Data, Creating New Data, Data Models; Vector Data Model; Raster Data Model; Integration and Comparison of Vector and Raster Data Models.

Unit III: Data Exploration and spatial data editing (08)
Attribute Data in GIS, Attribute Data Entry, Manipulation of Fields and Attribute Data, Data Exploration; Attribute Data Query, Raster Data Query, Map- Based Data Manipulation, Types of of Digitizing Errors, Causes for Digitizing Errors; Topological Editing and Non-topological Editing; Other Editing Operations; Editing Using Topological Rules.

Unit IV: Spatial data Analysis (08)

Spatial Data: Definition, Analysis, Processes & Steps, Software and Tools, Geodatabase Model, Role of Databases in GIS, Creating, Editing and Managing, Classification scheme of Vector-Based and Raster- Based GIS Operation Raster- Based Techniques: Methods of reclassification, overlay analysis, Digital Terrain Analysis and Modeling- TIN and DEM, Surface representation and analysis, Slope and Aspect, Geographic Visualization Data Classification

Unit V: ArcGIS (08)

Introduction, Geographical terms, ArcMap main window, Coordinate system, Georeferencing, Generation of vector referencing, Table administration, Geoprocessing tools, spatial analysis, Design and publication, API for ArcGIS

Unit VI: Trends and applications (08)

Need for GIS network analysis in SCM, data for GIS logistic service, understanding logistic management, types of GIS services, supply chain audit, ISRO-Bhuvan, Web GIS

Text Books:

1 "Fundamentals of GIS", Franz Pucha et al, 2018
2 "Principles of Geographic Information Systems",Kang-tsung chang, 2017

Reference Books:

1 "Essentials of Geographic Information Systems",Jonathan E. Campbell Michael Shin, 2018
2 "Introduction to GIS",Víctor Olaya

20OE601K MULTIMEDIA SYSTEMS

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

Examination scheme:
In Semester: 50 Marks
End Semester: 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/

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, 6thEdition (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/

20OE801B Cyber Physical System

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20EC404 Embedded System, 20EC603 Control Systems

Course Objectives:

1 To introduce modeling of the Cyber Physical System (CPS).
2 To analyze the CPS.
3 To explain the software modules.

Course Outcomes:

After completion of the course, students will be able to

1 Categorize the essential modeling formalism of CPS
2 Analyze the functional behavior of CPS based on standard modeling formalisms
3 Apply specific software for the CPS using existing synthesis tools
4 Design CPS requirements based on operating system and hardware architecture constraints

Unit I: Cyber Physical Systems (CPS) applications and Characteristics (07)

CPS in the real world, Basic principles of design and validation of CPS, CPS: From features to software components, Mapping software components to Electronic Control Unit (ECU), CPS Performance Analysis: effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Formal methods for Safety Assurance of CPS.

Unit II: CPS physical systems modeling (07)

Stability Analysis: CLF (Common Lyapunov function), MLF (Multiple Lyapunov function), stability under slow switching, Performance under Packet drop and Noise.

Unit III: CPS computer systems modeling (07)

CPS SW Verification: Frama-C, C Bounded Model Checker (CBMC), Secure Deployment of CPS: Attack models, Secure Task mapping and Partitioning, State estimation for attack detection, Hybrid Automata Modelling: Flow pipe construction using Flowstar (Flow*), Polyhedral Hybrid Automaton Verifier (Phaver) tools (Reliability testing).

Unit IV: Operating systems and hardware architecture support for CPS (07)

CPS SW stack RTOS, Scheduling Real Time control tasks. Principles of Automated Control Design: Dynamical Systems and Stability, Controller Design Techniques, CPS HW platforms: Processors, Sensors, Actuators, CPS Network.

Unit V: Analysis and verification of CPS (07)

Advanced Automata based modeling and analysis: Basic introduction and examples, Timed and Hybrid Automata, Definition of trajectories, Formal Analysis: Flow pipe construction, Reachability analysis, Analysis of CPS Software, Weakest Preconditions, Bounded Model checking.

Unit VI: CPS case studies (07)

Automotive Case study: Vehicle ABS hacking, Power Distribution Case study: Attacks on Smart grid.

Text Books:

1 Lee, Edward Ashford, and SanjitArunkumarSeshia, "Introduction to embedded systems: A cyber physical systems approach", MIT Press, (2nd Edition), (2017).
2 Rajeev Alur, "Principles of Cyber-Physical Systems". MIT Press, (1st Edition), (2015).
3 Wolf, Marilyn, "High-Performance Embedded Computing: Applications in Cyber-Physical Systems and Mobile Computing". Elsevier, (1st Edition), (2014).

Reference Books:

1 P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer-Verlag, (1st Edition), (2009).
2 Raj Rajkumar, Dionisio De Niz , and Mark Klein, "Cyber-Physical Systems", *SEI Series in Software Engineering*, (1st Edition), (2018).
3 André Platzer, "Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics", *Springer*, (1st Edition), (2010).
4 Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", *CRC Press*, (2nd edition), (2011).

Online/Web/Other References:

1 Coursera course, Cyber Physical system modelling
https://www.coursera.org/learn/cyber-physical-systems

20OE801C Digital Control

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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.

20OE801D Industrial Engineering and Management

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:
The Industrial Engineering course prepares students to…
1 Understand type of organisation and calculate partial and total productivity
2 Learn the fundamental knowledge, skills, tools and techniques of methods study and work measurement.
3 Understand type of production environments, resource planning and control methods.
4 Learn basic resource scheduling techniques, human resource management and industrial safety norms.

Course Outcomes:
Students will be able to
1 Identify type of organisation and analyze partial and total productivity
2 Manage and implement different techniques of methods study and work measurement of process under consideration for improvement.
3 Analyze production environment under consideration w.r.to its resource planning and control.
4 Apply basic resource scheduling and human resource management techniques.

1 Introduction to Industrial Management and Productivity Analysis 6

1 Industrial management: Functions and principles of management; Organisation: Concept, characteristics, structures and types of organisation- (formal line, military, functional, line and staff organisation);
2 Productivity analysis: Definition, measurement of productivity: productivity models and index (numerical); factors affecting the productivity; productivity improvement techniques;
3 Definition and scope of Industrial Engineering.

2 Method Study 7

1 Work Study: Definition, objective and scope of work-study.
2 Method Study : Definition, objective and scope of method study, activity recording and exam aids, Charts to record moments in shop - operation process charts, flow process charts, travel chart, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method;
3 Human factors in Work-Study;
4 Value Engineering and Value Analysis.

3 Work Measurements 6

1 Introduction: Definition, objectives and uses; Work measurement techniques:

2 Time study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination(numerical);

3 Work sampling: Need and procedure, sample size determinations (numerical);

4 Synthetic motion studies: PMTS and MTM. Introduction to MOST (numerical).

4 Production Management 7

1 Production Planning and Control: Types of production systems, functions of PPC, Aggregate production planning; Master Production Schedule; ERP

2 Forecasting techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality; (Numerical).

3 Supply Chain Management: Concept, Strategies, Supply Chain Network, Push and Pull Systems, Logistics, Distribution; Order Control strategies: MTO, MTA, MTS.

5 Facility Management 6

1 Facility Layout: Factors affecting facility location; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical);

2 Material Handling and Inventory Control: Principles, Types of Material Handling Devices; Stores Management, Inventory costs, Types of inventory models - Deterministic and Probabilistic, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis (Numerical).

6 Project Scheduling, Human Resource and Industrial Safety 6

1 Scheduling Techniques: CPM and PERT(Numerical);

2 Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training; Concept of KRA (Key Result Areas); Performance Appraisal (Self, Superior, Peer, 360^0);

Text Books:

1 Industrial Engineering and Production Management, M Mahajan, Dhanpat Rai and Co.
2 Industrial engineering and management by O. P. Khanna, Dhanpatrai publication
3 Industrial Engineering , Martend Telsang, S. Chand Publication.
4 Industrial Organisation & Engineering Economics by Banga and Sharma, Khanna publication.
5 Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
6 J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.

Reference Books:

1 Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008
2 Maynard's Industrial Engineering Hand Book By H.B. Maynard, KJell, McGraw Hill Education, 2001
3 Zandin K.B. - Most Work Measurement Systems, ISBN 0824709535, CRC Press, 2002.

Assignment based evaluations are designed. **This evaluation is treated as T1-Marks**. Marks will be calculated (at the end of semester) on the basis of successful completion / submission of assignments explained to you time to time on the basis of syllabus content. [Note: these assignments are part of activity based learning. Hence, students are to work in a group to complete following assignments].

Assignment Details	Mapped COs
1. Case study based Assignment on Method Study. [Data may be collected from: 1) Day to day activity : Workshop, Library, Admin area, Canteen, Parking 2) Students visiting industrial area for project 3) Quality concept Assignments in a Group.]	**CO1**
2. Hands on Assignment on application of Work Measurement technique(s). [1) Using stopwatch work measurement can be completed. (E.g. in workshop)]	**CO1, CO1**
3. Simulation / Assignment on Routing & Scheduling Model. [Open Source Softwares 1) Flexsim (Videos are available online) 2) Arena - Student Version 3) Pro model – Student Version 4) Excel templates available online. Note: Backward / Forward Scheduling concepts are to be included.]	**CO1, CO4**
4. Assignment on simulation of Manufacturing System / Service System Operations for demand forecasting of the given product using any two methods. [1) Data from shops malls, manufacturing company, etc.]	**CO1, CO4**
5. Assignment on simulation determination of EOQ and plot the graphs. [1) Use of any freeware available.]	**CO1, CO4**
6. Assignment on analysis of Manufacturing / Service Operation for Capacity Planning. [1) Define capacity term for the real life environment you are working for (e.g. foundry= tons of casting, hospital = no. of bed, etc.) 2) Study and collect the data of Variation in demand and capacity planning. 3) Analysis the pattern of data set and report… how they manage the change in capacity.]	**CO1, CO4**
7. Case study based assignment on supply chain model. [1) Select any real life supply chain (any engineering product processing, vendors for vegetable grocery, etc.) 2) Identify all major supply chain elements and prepare supply chain diagram and report.]	**CO1, CO4**
8. Assignment on analysis of (selected) plant layout modeling / Simulation for bottleneck / line balancing. [Plant layout with its detail (with Scale) and identify the type.]	**CO1, CO4**
9. Assignment on analysis of material handling system - for the selected plant layout. [This assignment must be completed with the help of plant layout visited in earlier assignment.]	**CO1, CO4**
10. Case study based assignment on identification of Key Result Areas for performance appraisal for selected company (3600 feedback). [Real life case studies.]	**CO1, CO4**
11. Assignment on industrial safety audit of selected work environment. [Download standard questionnaire and visit any work environment and submit it as assignment.]	**CO1, CO4**
Note: If student groups working with industry for their project, they are advised to collect data related to above mentioned assignments for submission.	

20OE 801E Introduction to Cyber Crime and Forensics

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

Examination scheme:
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 organisation

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 Carer Opprtunities 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 Intoduction 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

20OE801F Instrumentation in Food and Agriculture

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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 Hours / Week

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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 Applicatio 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. Ste counting device iii. Speed measuring device iv. Calorie spent measuring device v. Time spent i 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 Silent Intelligence: The Internet of Things", Publisher: Lightning Source Inc; 1st Edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978- 0989973700.

20OE801H QUANTUM COMPUTING

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisite: 20BS04 Physics, 20BS01 Linear Algebra & Univariate Calculus,20BS03 Multivariate Calculus

Course Objectives:

1 To give an introduction to quantum computation
2 To explain the basics of quantum mechanics
3 To analyze quantum circuits using qubit gates
4 To elaborate difference between classical and quantum information theory
5 To explain quantum algorithms
6 To explain noise and error correction

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe the basics of quantum computation
CO2 Apply the concepts of quantum mechanics
CO3 Design of quantum circuits using qubit gates
CO4 Comparison between classical and quantum information theory
CO5 Utilize quantum algorithms
CO6 Apply noise and quantum error correction

Unit I: Introduction to Quantum Computation (03)

Quantum bits, Bloch sphere representation of a qubit, multiple qubits.

Unit II: Background Mathematics and Physics (08)

Hilbert space, Probabilities and measurements, Entanglement, Density operators and correlation, Basics of quantum mechanics, Measurements in bases other than computational basis.

Unit III: Quantum Circuits (08)

Single qubit gates, Multiple qubit gates, Design of quantum circuits.

Unit IV: Quantum Information and Cryptography

Comparison between classical and quantum information theory, Bell states, Quantum teleportation, Quantum Cryptography, No cloning theorem.

Unit V: Quantum Algorithms

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 VI: Noise and error correction

Graph states and codes, Quantum error correction, fault-tolerant computation.

Text Books:

1 Michael Nielsen and Isaac Chuang, **"Quantum Computation and Quantum Information"**, *CambridgeUniversity Press, UK*, (10th Edition), (2012).
2 Phillip Kaye, Raymond Laflamme and Michele Mosca,**"An Introduction to Quantum Computing"**, *Oxford University Press, UK*, (1st Edition), (2007).

Reference Books:

1 N. David Mermin, **"Quantum Computer Science An Introduction"**,*Cambridge University Press*, UK, (1st Edition), (2007).
2 NosonYanofsky and MircoMannucci, **"Quantum Computing for Computer Scientists"**, *Cambridge University Press*, (1st edition), (2008).

Online Resources:

1 NPTEL Course **"Quantum Computing"**
https://onlinecourses.nptel.ac.in/noc19_cy31/

20OE801I RENEWABLE ENERGY SOURCES

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

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:
To make students

1 Understanding basic characteristics of renewable sources of energy and technologies for their utilization.
2 Learning engineering approach for renewable energy projects.
3 For analyze energy potential of renewable sources of energy.

Course Outcomes:
Students will be able to

1 Understand of different renewable sources of energy and technologies for their utilization.
2 Select engineering approach to problem solving when implementing the projects on renewable sources of energy.
3 Undertake simple analysis of energy potential of renewable sources of energy.
4 Describe main elements of technical systems designed for utilisation of renewable sources of energy.

Unit/Module: 1 Solar Energy 8 hours CO: 1

Solar potential, Solar radiation geometry, Solar radiation data, radiation measurement, Types of Solar Collectors, Collection efficiency, Applications of Solar Energy, Solar Desalination system, Solar dryer, Solar Energy storage. Solar PV Principle, Photo-cell materials, Applications.

Unit/Module: 2 Wind Energy 7 hours CO: 2,3

Wind parameters and wind data, Power from wind, Site selection, selection of components, Blade material, Wind energy conversion systems and their classification, Construction and working of typical wind mill, wind farms, present status.

Unit/Module: 3 Biomass Technology 7 hours CO: 2,3

Introduction to biomass technology, Combustion and fermentation, Biomass gasification, types of gasifire, Pyrolysis, various applications of Biomass energy, Bio-fuel types, and applications.

Unit/Module: 4 Ocean – Tidal – Geothermal Energy 6 hours CO: 3

Introduction to OTEC, open and closed cycle OTEC systems, Energy through waves and tides. Geothermal Energy, Energy generation through geothermal system, types of geothermal resources, Introduction of tidal systems, Environmental impact.

Unit/Module: 5 Hydrogen - Fuel Cell – Hybrid Energy System 7 hours CO: 4

Introduction to hydrogen and fuel cell technology, applications of hydrogen and fuel cell technology. Need for hybrid energy systems, Case studies of hybrid energy system such as Solar-PV, Wind-PV, Micro hydel- PV, Biomass-Diesel systems.

Total Theory hours: 35 hours

Text Books:

1 Solar Energy by Dr. S.P.Sukhatme Tata McGraw Hill.
2 Non Conventional Energy Sources by G.D.Rai.- Khanna Publishers.
3 Energy Technology by S. Rao, Dr. B.B.Parulekar Khanna Publishers.

Reference Books:

1 Fan Lin You,Hong ye (2012), Renewable Energy Systems, Advanced conversion technologies and applications, CRC Press
2 John. A. Duffie, William A.Beckman (2013) Solar Engineering of Thermal processes, Wiley
3 Godfrey Boyle (2017), Renewable Energy, power for sustainable future, Oxford University Press.
4 A.R.Jha (2010), Wind turbine technology, CRC Press.

20OE 801J Soft Computing

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Course Objectives:

1. To understand basics in soft computing
2. To understand concepts of fuzzy logic and fuzzy sets
3. To understand supervised neural network architecture, training and testing algorithms and tools for the same
4. To understand unsupervised neural network architecture, training and testing algorithms
5. To understand concept for optimization, evolutionary programming and genetic algorithm and tools for the same
6. To understand concept swarm intelligent systems and tools for the same

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

1 Identify various soft computing and artificial neural network constituents to solve the problems in engineering domain
2 Experiment with fuzzy logic principles
3 Apply Supervised learning algorithms in artificial neural networks to simple real life problems
4 Apply Unsupervised learning algorithms in artificial neural networks to simple real life problems
5 Apply principles of genetic algorithm in solving engineering optimization problems
6 Apply principles of swarm intelligence in solving engineering optimization problems

Unit I: Introduction to Intelligent systems, soft tools and Artificial Neural network (07)

Soft computing constituents and conventional Artificial Intelligence, Artificial Neural network: definition, advantages of artificial neural network, Fuzzy Set Theory, Genetic algorithm, hybrid systems: neuro fuzzy, neuro genetic, fuzzy genetic, soft computing, Introduction to Artificial Neural Network: Fundamental concepts, basic models of artificial neural network, important terminologies of ANNs, McCulloch- Pitts Neuron, linear separability.

Unit II: Fuzzy logic and fuzzy sets (07)

Introduction to fuzzy logic, fuzzy sets, fuzzy set operations, properties of fuzzy sets, classical relation, fuzzy relation, membership function, fuzzification, Methods of membership value assignments, lambda-cuts for fuzzy set, lambda-cuts for fuzzy relations, defuzzification.
Introduction to tools for fuzzy logic using MATLAB/ Python

Unit III: Supervised Learning Networks (07)

Introduction, Perceptron Networks: Perceptron learning rule, Architecture, perceptron training algorithm for single output classes, perceptron training algorithm for multiple output classes, perceptron network testing algorithm, Back Propagation Network: flowchart for training process, training algorithm, linear factors of back- propagation networks, number of training data, number of hidden layer nodes, testing algorithm of back- propagation networks. Introduction to tools for Supervised Learning Networks using MATLAB/ Python

Unit IV: Associative Memory Networks and Unsupervised Learning Networks (07)

Associative Memory Networks: Introduction, Training algorithm for pattern association: Hebb rule, Auto-associative Memory networks, Bidirectional associative memory: architecture, discrete bidirectional associative memory, Unsupervised Learning Networks: Introduction, Fixed wright competitive nets: max net, Kohonen Self organizing feature maps

Unit V: Genetic Algorithm (07)

Introduction, Traditional Optimization and Search Techniques, biological background, genetic algorithms and search space, genetic algorithm vs. traditional algorithms, basic terminologies in in genetic algorithm, simple GA, operations in genetic algorithm: encoding- binary, octal, selection- Roulette wheel selection, random selection, crossover- single point cross over, two point crossover, mutation- flipping, interchanging, stopping condition for genetic algorithm flow, constraints in genetic algorithm. Introduction to tools for Genetic Algorithm using MATLAB/ Python

Unit VI: Swarm Intelligent Systems (07)

Introduction, background of Ant Intelligent systems, Importance of the Ant Colony Paradigm, Ant colony systems, Development of Ant colony systems, Applications of Ant Colony Intelligence, the working of ant colony systems, practical swarm intelligent systems: The basic of PSO method, Characteristic features. Introduction to tools for Swarm Intelligent Systems using MATLAB/ Python

Text Books:

1 S.N. Sivanandam- **"Principles of Soft Computing",** Third Edition, Wiley India- ISBN 9788126577132, 20018
2 B K Tripathy, J Anuradha, "Soft Computing- Advances and Applications", Cengage India, ISBN: 78-8131526194, 1st, 2018
3 P.Padhy, **"Artificial Intelligence and Intelligent Systems"** Oxford University Press, ISBN 10: 0195671546, 2005

Reference Books:

1 De Jong, **"Evolutionary Computation: A Unified Approach",** Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006

2 J. S. R. Jang, CT Sun and E.Mizutani, **"Neuro-Fuzzy and Soft Computing" ,** PHI PVT LTD, ISBN 0-13-261066-3. 2015

3 S. Rajsekaran and G.A. Vijayalakshmi Pai, **"Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications"** , Prentice Hall of India, ISBN: 0451211243, 2003

4 1. Sinha N.K., **" Soft Computing And Intelligent Systems: Theory And Applications"**, ISBN-13: 978-0126464900, Elsevier. 2007.

20OE 801K Software Testing and Quality Assurance

Teaching Scheme:
Lectures : 3 hours/week
Tutorial : --

Examination Scheme:
In-Semester : 50 Marks
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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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

20OE802-B Automobile Engineering (AE)

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

Examination scheme:
ISE**:** 50 Marks
ESE**:** 50 Marks
Credits: 3

Course Objectives:
To make students

1 To study layout of the vehicles.
2 To understand function of various components of automotive systems
3 To understand use of alternative fuels for vehicle.

Course Outcomes:
Students will be able to

1 Identify different layouts of automobile vehicle and engine auxiliary systems.
2 Explain latest transmission, steering, braking and suspension systems in vehicle.
3 Explain EV, HEV, latest trends in AI technologies
4 Understand energy sources, current emission norms and emission control systems.

Unit/Module: 1 Vehicle Structure and Engine auxiliary systems 6 hours CO: 1
Vehicle construction and different layouts, chassis, frame and body, components of engine. Electronically controlled gasoline injection system for SI engines. Electronically controlled diesel injection system, electronic ignition system. Introduction to Vehicle Maintenance and Servicing.

Unit/Module: 2 Transmission Systems 6 hours CO: 2
Introduction to transmission system, Automatic transmission system (fluid coupling, clutch less drive, fluid flywheel – torque converter), Semi-automatic transmission, continuously variable transmission (CVT), dual clutch hybrid transmission

Unit/Module: 3 Steering, Brakes and Suspension Systems 6 hours CO: 2
Introduction to Steering geometry and its function, Power Steering. Introduction to suspension system, Active and passive Suspension. Introduction to Braking Systems, Regenerative breaking, Anti-lock Braking System (ABS), EBS and Traction Control.

Unit/Module: 4 Electric and hybrid vehicles 6 hours CO: 3

Concept of electric and hybrid vehicle, EV and HEV fundamentals, architecture of EV and HEV power train, drives and energy sources in EV and HEV, Artificial intelligence technologies such as Autonomous Vehicles, computer vision assist drivers to improve safety, improve services such as vehicle inspection or insurance. Role of IoT to secure communication between vehicles as well as vehicles and infrastructure components

Unit/Module: 5 Modern Energy Sources and optimizing supply chain 6 hours CO: 4

Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LNG), Bio-fuels, lithium-ion battery, hydrogen fuel cell in Automobiles, Introduction to Optimization of Supply Chain in Automotive Industry

Unit/Module: 6 Emission control in automobiles 6 hours CO: 4

Emission and Fuel Roadmap Euro 6 / BS V norms (proposed 2020-21), Effect of car emissions on human health and the environment. Exhaust gas re-circulation (EGR) and Engine emission control (three-way catalytic converter system SCR and particulate filter).

Text Books:

1 Kirpal Singh, Automobile Engineering Vol 1 and 2, Standard Publishers, 7th Edition, 1997
2 M. Chris and M. A. Masrur, Hybrid Electric Vehicles, Wiley Publications, 2nd Edition, 2017
3 Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Reference Books:

1 K. K. Jain and R. B. Asthana, Automobile Engineering, Tata McGraw Hill Publishers, New Delhi, 1999.
2 Barry Hollembeak, "Automotive Electricity and Electronics" Cengage Learning, Cliftorn Park, USA 2007.
3 Dr. K. R. Govindan, Automobile Engineering, Anuradha Publications, Chennai, 2013.
4 Joseph Heiner, Automotive Mechanics, Litton Education Publishing Ins., New York, 1999.
5 Angelin, Automotive Mechanics, Tata McGraw Hill Pub. Comp. Ltd., 10th Edition, 2004.
6 Josep Aulinas, Hanky Sjafrie, AI for Cars, Chapman and Hall/CRC Press, 1st Edition.

20OE802C AUTONOMOUS ROBOTS

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

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

CO 1	Explain and classify different components used in developing autonomous robot
CO2	Select sensors, actuators and grippers for autonomous robot
CO3	Apply formulations to obtain kinematics, dynamics and trajectory planning of autonomous robot
CO4	Develop path planning and navigation algorithm for autonomous robot
CO5	Design robot for automation

Unit I: Introduction to Robotics (10)
Definition of robotics, Types of robots, Components of Robot system, Classification of robots , Robot architecture, Robot locomotion, Specification of robot, Robot sensors for position, Acceleration sensors, Proximity, Velocity sensors, Force sensors, Tactile sensor, Camera and robot vision, Actuators and end effectors.

Unit II: Introduction to Mechanics of Robotic Arm (10)
Position and orientation description, Coordinate transforms, Homogeneous transform, Denavit and Hartenberg (DH) parameters, Forward and inverse kinematic analysis, Dynamics and inverse Dynamics of robots, Newton–Eller formulation, Trajectory and Path planning, Application of robotic arm.

Unit III: Mobile robot Kinematics and Dynamics (08)
Forward and inverse kinematics, holonomic and nonholonomic constraints, Kinematic models of simple car and legged robots, Dynamic simulation of mobile robots.

Unit IV: Localization (06)

Odometric position estimation, Belief representation, Probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, Positioning beacon systems.

Unit V: Introduction to Planning and Navigation (08)

Path planning algorithms based on Simultaneous Localization and Mapping (SLAM) algorithm, A-star, D-star, Voronoi diagrams, Probabilistic Road Maps (PRM), Rapidly exploring Random Trees (RRT), Markov Decision Processes (MDP), Stochastic Dynamic Programming (SDP).

Text Books:

1 R. Siegwart, I. R. Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, *The MIT Press*, (2nd Edition), (2011).
2 Francis X. Govers, **"Artificial Intelligence for Robotics",** *Packt Publishing Ltd., United Kingdom*, (1st Edition), (2018).
3 Robin R. Murphy, **"Introduction to Artificial Intelligence for Robotics"**, *The MIT Press*,(2nd Edition), (2000).
4 S. K. Saha, **"Introduction to Robotics"**, *Tata McGraw Hill*, (2nd Edition), (2014).

Reference Books:

1 K. S.Fu, R. C. Gonzalez, C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence" ,** *Tata McGraw Hill* **,** (2nd Edition), (2008).
2 Robert J. Schilling, **"Fundamentals of Robotics- Analysis and Control",***Prentices Hall India*, (1st Edition), (2008).

Online Resources:

1 NPTEL Course **"Wheeled Mobile Robot"**
https://nptel.ac.in/courses/112/106/112106298/

20OE802D Building Automation and Energy Audit

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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

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/

20OE802G Industrial Drives and Control

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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]

20OE802H Smart Sensors and Systems

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 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, W ater 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]

20OE802I Wireless Networks

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

Examination scheme:
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 3

Prerequisites: Nil

Course Objectives:

1 To explain the importance of wireless communication and multiple access techniques
2 To elaborate the behavior of communication system for indoor and outdoor wireless networks
3 To introduce 3G, 4G cellular network components and 5G future wireless network
4 To explain MIMO technology
5 To introduce visible light communications

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

CO1 Explain fundamentals of wireless communication and multiple access techniques
CO2 Analyze the behavior of communication system for indoor and outdoor wireless networks
CO3 Apply 3G, 4G cellular network standards and describe 5G future wireless network
CO4 Interpret MIMO technology its advantages and limitations
CO5 Explain LiFi networking and technology for indoor network access

Unit I: Introduction to wireless communication (08)

Fundamentals of Wireless Communication: Advantages, Limitations and Applications, Frequency Spectrum, Radio and Infrared Frequency Spectrum, Wireless Media, Spread spectrum, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA.

Unit II: Wireless indoor and outdoor networks (08)

WLAN, WiFi, Bluetooth, Zigbee, Ultra Wideband communication, Infrared, UHF narrowband, WiMax, Limitation of indoor networks.

Unit III: Cellular Network (08)

Spectrum reuse and re-framing, Cell cluster concept, Co-channel and adjacent channel interference, Cell site, call blocking and delay, Channel allocation strategies, 3G and 4G standard.

Unit IV: Future Wireless networks (10)

Introduction to 5G, Modulation techniques for 5G, Architecture, MIMO, Massive MIMO, Limitations and applications.

Unit V: Visible Light Communications (08)

LiFi Technology, LiFi Networking, LiFi technology for indoor network access, Applications.

Text Books:

1 T. Rappaport, "**Wireless Communications - Principles and Practice**", *Prentice Hall* , (2nd Edition) , (2011).
2 Vijay Garg, "**Wireless Communications and networking**", *Elsevier*, (1st Edition), (2007).
3 **Jonathan Rodriguez,** "Fundamentals of 5G Mobile Networks"**, *Wiley*, (1st Edition),(2015).**
4 Mohamed Gado, Doaa Abd El-Moghith, "**Li-Fi Technology for Indoor Access**", *LAMBERT Academic Publishing*, (1st Edition), (2015).

Reference Books:

1 Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "**3G Evolution HSPA and LTE for Mobile Broadband"**, *Academic Press*, (2nd Edition) , (2008).
2 Anurag Kumar, D.Manjunath, Joy kuri, "**Wireless Networking**", *Elsevier*, (1st Edition), (2011).
3 Simon Haykin, Michael Moher, David Koilpillai, "**Modern Wireless Communications**", *Pearson Education* , (1st Edition), (2013)
4 Aditya K. Jagannatham, "**Principles of Modern Wireless Communications Systems***", McGraw Hill Education (India) Private Limited*, (1st Edition), (2016).

Online Resources:

1 NPTEL Course on **"Introduction to Wireless and Cellular Communications",** https://nptel.ac.in/courses/108/106/106106167/#
2 NPTEL Course on **"Advanced 3G and 4G Wireless Mobile Communications**", https://nptel.ac.in/courses/117/104/117104099/