Basic Sciences and Humanities

Autonomous Programme Structure (Revision-1) F. Y. B. Tech. Sem-I
E&TC / Instru / Mech 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
20BS04	Physics	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
20ES04	Engineering Graphics	2	1	0	50	50	0	100	3
20BS04L	Physics Lab	0	0	2	25	0	0	25	1
20ES02L	Fundamentals of Programming Language- I Lab	0	0	2	25	0	0	25	1
20ES04L	Engineering Graphics Lab	0	0	2	25	0	0	25	1
20ES07L	Technical Skill Development Lab	0	0	2	25	0	0	25	1
Total		**13**	**3**	**8**	**300**	**225**	**0**	**525**	**19**
Grand Total		**24**			**525**			**525**	**19**

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

Cummins College of Engineering For Women ★ MKSSS's
Karve Nagar, Pune 411052.

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

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)

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 Objectives:

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)**

20ES02 Fundamentals of Programming Language-1 (ETC,Instru)

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

20ES02 Fundamentals of Programming Language-1 (Mech)

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 the building blocks of computer system.
2. To develop problem solving ability by developing an algorithm, flowchart for the given problem.
3. To implement the logic / solution for giving problem using a 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 the program developer.
3. Make use of variables, data types, operators, expressions, strings and arrays for program development.
4. Solve the given problem using functions.

__Unit – I: Introduction (05)

Problem solving, problem solving by using computer and Logic building, Introduction to computer, Anatomy of a computer, Python interpreter, Python language elements, Lines and indentation, identifiers, keywords, operators, delimiters and literals, statements, Numbers: Integers, complex, floating point, Variable types, assignments

Unit – II: Operators and Expressions (05)

Sequences: strings, lists, numpy arrays, tuples, Boolean values, Dictionaries, Numeric operations, Conditional expression

Unit – III: Loops and Functions (04)

Loops, Functions, file operations, exceptions, inbuilt libraries and functions for scientific computing and plotting.

Text Books:

1. Reema Thareja, "Python Programming using problem solving Approach", Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

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

20ES04 Engineering Graphics

Teaching Scheme
Theory: 2 Hrs/week
Tutorial: 1 Hr/week
Credits: 3

Examination Scheme:
In semester: 50 Marks
End semester: 50 Marks

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 object
CO2 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, sectional orthographic projections, Missing views.

(08)

Unit – 3

Isometric Views Isometric axes, Isometric scale, isometric projections and views, construction of isometric view from given orthographic views**.**

(08)

Unit – 4

Development of Solids Parallel line development, radial line development, methods to transfer points for development of prisms, pyramids, cylinder and cone.

(05)

Unit – 5

Engineering Curves Construction of ellipse, parabola, hyperbola, involute, cycloid, Archimedean spiral, 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
3. Dhananjay A. Jolhe, 'Engineering Drawing', Tata McGrawHill Publishing Co. Ltd.

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.

20ES02L Fundamentals of Programming Language -I Lab (ETC, Instru)

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 a 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

20ES02L Fundamentals of Programming Language Lab -1(Mech)

Teaching Scheme:
Practical: 2 Hr/week
Credits:01

Examination Scheme:
In-Sem: 25 Marks

Course Objectives:
To facilitate the learners:
1.To learn the fundamentals of python programming for logic building.
2.To implement solution of a given problem using appropriate data type, operators of python language.
3.To understand the decision and iteration interpretation in a programming language.
4.To implement the logic using list, strings, functions and structures of python 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 python program using appropriate data type, operators.
3. Implement the given problem using appropriate control structures available in the python language.
4. Identify different functions for a problem to construct a modular solution.

List of assignments to be done in Python:
1. Learn logic building using tools such as 'scratch'.
2. Demonstration of installation and configuration of Anaconda and Spyder.
3. A) Accept input (number, name) from the user and print the same.
   B) Display the numbers from 1 to 10.
4. Create an empty dictionary, add elements to the dictionary, update the key values and display the elements of the dictionary.
5. A) Create a tuple, add elements to the tuple and display the elements of the tuple.
   B) Swap two numbers using tuples and display the initial and swapped contents of the tuples.
6. Perform string manipulation functions (concatenation, substring, comparison, palindrome)
7. Find the maximum or minimum number in a given list.
8. Calculate factorial using functions.
9. Generate Fibonacci series using recursion.
10. Implement file operations.
11. Calculate area/circumference of a circle for a given radius using:

a. formula
b. inbuilt function from numpy library.

12. Plot sin(x) and cos(x) functions for values of x between 0 and pi. Use inbuilt libraries numpy and matplotlib.

20ES04L Engineering Graphics Lab

Teaching Scheme	**Examination Scheme**
Practical: 2 Hrs/week	In Semester: 25 marks
Credits: 1	

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 a rapid 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

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
E&TC / Instru / Mech 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
20BS02	Chemistry	3	0	0	50	50	0	100	3
20ES01	Basic Electrical and Electronics Engg.	3	0	0	50	50	0	100	3
20ES05	Fundamentals of Programming Language- 2 (E/IN)	3	0	0	50	50	0	100	3
20ES05M	Engineering Mechanics (Mech)	2	1	0					
20ES06	Geo Informatics	3	0	0	50	50	0	100	3
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
20ES05L	Fundamentals of Programming Language- 2 Lab	0	0	2	25	0	0	25	1
20ES05ML	Engineering Mechanics Lab	0	0	2					
20ES06L	Geo Informatics Lab	0	0	2	25	0	0	25	1
Total		**15**	**2**	**8**	**350**	**250**	**00**	**600**	**20**
Grand Total		**24**			**600**			**600**	**20**

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

Cummins College of Engineering For Women ★ MKSSS's Karve Nagar, Pune 411052.

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

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).

20BS02 Chemistry

Teaching Scheme
Lectures: 3Hrs/week
Credits: 3

Examination Scheme
In-Semester: 50 Marks
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)

20ES05 Fundamentals of Programming Language-2 (ETC, Instru)

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)

20ES05M Engineering Mechanics (Mech)

Teaching scheme	**Examination scheme**
Lectures: 2hrs/week	In-Sem Exam: **50** Marks
Tutorial: 1hr/week	End-Sem Exam: **50** Marks
Number of Credits: 3	

Course Objectives:

1. To familiarize the **concepts of equilibrium and friction**.
2. To study and analyze the motion of moving particles and bodies**.**

Course Outcomes:

CO1: Apply the concept of force, moment and equilibrium in two and three dimensional systems with the help of FBD

CO2: Estimate force of friction, C.G. and Moment of Inertia of the bodies.

CO3: Analyze the motion of a particle to find the relation between velocity and acceleration.

CO4: Analyze particles in motion using force and acceleration, work-energy and impulse-momentum principle.

Unit-I: Rigid body: Statics (06)

Equivalent force systems, Equations of equilibrium, free body diagram, reactions.

Static, intermediately and partial constraints, two and three force systems.

Structures: 2D truss, method of joints, method of selection. Frame, beams, types of loading and supports. Shear force and bending moment diagrams.

Unit-II: Friction (03)

Dry friction (static and kinetic) wedge friction, disk friction, belt friction, journal bearings, wheel friction and rolling resistance

Unit-III: Center of Gravity and Moment of Inertia (04)

First and second moment of inertia and mass. Radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M.I. by direct method. Composite bodies.

Unit-IV: Kinematics of Particles (04)

Rectilinear motion, curvilinear motion, rectangular, normal-tangential, polar, cylindrical co-ordinates, relative and constrained motion, space curvilinear motion.

Unit-V: Dynamics of Particles (03)

Force, mass and acceleration, work-energy, impulse-momentum principle, impact of bodies.

Unit-VI: Kinetics of Rigid Bodies (04)

Translation, fixed axis rotation, general planner motion, work-energy, power, potential energy, impulse-momentum and associated conservation principle, Euler equation of motion and its applications.

Text-Books:

1. R. C. Hibbeler, 'Engineering Mechanics (statics and Dynamics), 12th Edition, Pearson
2. A. Nelson, 'Engineering Mechanics (statics and Dynamics), 12th Edition, Mc Graw Hill Education.

Reference Books:

1. Timoshenko and Young, 'Engineering Mechanics', Tata Mc-Graw Hill, New Delhi.
2. Mclean, and Nelson, 'Theory and problems of Engineering Mechanics (Statics and Dynamics)', Schaum Series.
3. Beer and Johnson, 'Vector Mechanics for Engineers-Dynamics' McGraw Hill Education.
4. Engineering Mechanics (Statics and Dynamics)', Dorling Kindersley (India) Pvt. Ltd. Pearson Education.
5. Dr. R. K. Bansal , Sanjay Bansal, 'A Text book of Engineering Mechanics', Lakshmi publications.

20ES06 GEO-INFORMATICS

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

20BS02L Chemistry Laboratory

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

Continuous assessment
Term Work: 25 Marks

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.
8. 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.

20ES05L Fundamentals of Programming Language Lab-2 (ETC, Instru)

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.

20ES05ML Engineering Mechanics Lab (Mech)

Teaching scheme **Examination scheme**

Practical: 2hrs/week In-Sem Exam: **25** Marks

Number of Credits: 1

Course Objectives:

1. To demonstrate the basic principles of Engineering Mechanics namely Engineering Statics and Engineering Dynamics.

Course Outcomes:

CO1: Verify law of Force Polygon

CO2: Verify the law of moments using parallel force apparatus

CO3: Analyze co-efficient of friction, C.G. and M.I. of the system

CO4: Estimate mechanical advantage, velocity ratio and Mechanical efficiency of a mechanical system

List of Experiments

1. To verify the law of force polygon.
2. To verify the law of moments using parallel force apparatus. (simply supported type).
3. To determine the co-efficient of friction between wood and various surface (like leather, wood, aluminum) on an inclined plane.
4. To find the forces in the members of jib crane.
5. To determine the mechanical advantage, velocity ratio and mechanical efficiency of a screw jack.
6. To determine the mechanical advantage, velocity ratio and mechanical efficiency of the wheel and axle.
7. Verification of force transmitted by members of given truss.
8. To verify law of moments using bell crank lever.
9. To find the C.G. and Moment of Inertia of an irregular body experimentally and verify using computational method.

20ES06L GEO-INFORMATICS Lab

Teaching Scheme:

Practical : 2 Hr/Week

Credit1: 1

Examination Scheme:

Term Work: 2**5** 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

Autonomous Program Structure of Second Year B. Tech. Third Semester (Electronics and Telecommunication Engineering) Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20BSEC301	Calculus and Probability	3	1	0	50	50	0	0	100	4
20EC301	Electronic Circuits and Applications	3	1	0	50	50	0	0	100	4
20EC302	Signals and Systems	3	1	0	50	50	0	0	100	4
20EC303	Data Structures and Algorithms	3	0	0	50	50	0	0	100	3
20HS301	Universal Human Values-II	2	1	0	50	50	0	0	100	3
20EC301L	Electronic Circuits and Applications Lab	0	0	4	25	0	0	25	50	2
20EC303L	Data Structures and Algorithms Lab	0	0	2	25	0	0	25	50	1
20AC301	Audit Course	0	0	1	0	0	0	0	0	No Credit
	Total	**14**	**4**	**7**	**300**	**250**	**0**	**50**	**600**	**21**
	Grand Total	**25**			**550**		**50**			

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20BSEC301 CALCULUS AND PROBABILITY

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

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

Prerequisite: 20BS01 Linear Algebra and Univariate Calculus, 20BS03 Multivariate Calculus

Course Objectives:

1. To familiarize the students with various techniques in Calculus and Probability
2. To equip the students to deal with advanced level of Mathematics and applications that would be essential for their disciplines
3. To introduce concept of Probability and Probability distribution to analyze problems

Course Outcomes:

After completion of the course, students will be able to

CO1	Obtain the probability of random events using probability distribution
CO2	Find the Solution of Higher order Linear differential equation
CO3	Find the complex form of Fourier series of periodic function, Compute amplitude and phase spectrum
CO4	Obtain the mathematical transform of given function, Use transform technique to solve differential equation
CO5	Apply the concepts of vector calculus to find vector differentiation and vector integration

Unit I: Probability and Probability Distributions (08)

Theorems on Probability, Conditional Probability, Baye's theorem, Random Variables: Discrete and continuous, Probability density function, Mathematical expectations, Variance, Probability Distributions: Binomial, Poisson, Normal.

Unit II: Higher Order Linear Differential Equation and Applications (07)

Higher order Linear Differential Equation with constant coefficients, Complementary function, Particular integral, General method, Short cut methods, Method of variation of parameter, Cauchy's and Legendre's Differential Equation, Applications to L-R-C circuit, Forced response, Natural response.

Unit III: Complex Fourier series and Fourier Transform (08)

Periodic functions, Dirichlet's conditions, Complex form of Fourier series, Parseval's Identity, Fourier Transform, Fourier Transform of special functions, Inverse Fourier Transform, Fourier integral theorem, Properties of Fourier Transform: Linearity, Change of Scale, Shifting, Modulation theorem, Convolution theorem.

Unit IV: Laplace Transform (08)

Definition of Laplace and Inverse Laplace transform, Properties and Theorems, Laplace Transform of standard functions, Laplace Transform of some special functions viz.

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Periodic, Heaviside unit step, Unit impulse and Ramp function, Inverse Laplace Transform, Initial value problems.

Unit V: Vector Differential Calculus (05)
Physical interpretation of vector differentiation, Vector differential operator, Gradient, Divergence, Curl, Directional derivative, Scalar potential, Vector identities.

Unit VI: Vector Integral calculus (06)
Line integral, Surface integral, Work done, Green's Lemma, Gauss' Divergence Theorem, Stokes Theorem.

Text Books:

1. B. V. Ramana, **"Higher Engineering Mathematics",** *Tata McGraw Hill Educations*,(26th Reprint 2016).
2. B. S. Grewal, **"Higher Engineering Mathematics"**, *Khanna publishers, Delhi,* (40th Edition), (2008).

Reference Books:

1. Erwin Kreyszig, **"Advanced Engineering Mathematics",** *Wiley Eastern Ltd.,* (8th Student Edition), (2004).
2. Peter V. O'Neil, **"Advanced Engineering Mathematics"**, *Thomson Brooks / Cole, Singapore,* (5th Edition), (2007).
3. S.C. Gupta, V. K. Kapoor, **"Fundamental of Mathematical Statistics"**, *S. Chand & Sons,* (10th Edition), (2002).
4. C. R. Wylie, L.C. Barrette, **"Advanced Engineering Mathematics",** *McGraw Hill Publications, New Delhi,* (6th Edition), (2003).
5. Joel Hass, Christopher Heil, Maurice Weir, **"Thomas' Calculus"**, *Pearson India,* (13th Edition), (2016).

Online Resources:

1. NPTEL Course **"Transform Calculus and its Applications in Differential Equations"**
   https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course **"Probability Theory and Applications"**
   https://nptel.ac.in/courses/111/104/111104079/

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20EC301 ELECTRONIC CIRCUITS AND APPLICATIONS

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

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

Prerequisite: 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:
1. To understand semiconductor devices such as JFET and MOSFET, Its characteristics, Parameters and its applications
2. To understand Operational amplifier, Concept, Parameters and applications
3. To understand Linear and non-linear applications of Op-Amp
4. To understand Characteristics of Active filters and Operating principles of PLL

Course Outcomes:
After completion of the course, students will be able to
CO1 Interpret the characteristics of JFET and MOSFET
CO2 Analyze parameters of JFET and MOSFET towards its application as an Amplifier
CO3 Illustrate the significance of internal stages of Op-Amp, Interpret and calculate performance parameters of Op Amp and PLL
CO4 Design and Analyze Linear and Nonlinear applications of Op Amp and Butterworth filters

Unit I: JFET **(07)**
Introduction, Types, Construction of JFET, Characteristics (Transfer and Drain) and working of JFET, Schockley's equation, JFET biasing and DC analysis, JFET as an amplifier and its configurations (CS/CD/CG), CS amplifier analysis.

Unit II: MOSFET **(07)**
Two terminal MOS structure, EMOSFET-construction, Symbols, Ideal EMOSFET V-I characteristics, Additional MOSFET structures (DMOSFET and CMOS), Non-ideal V-I characteristics of EMOSFET (Finite output resistance, Body effect, Breakdown effect, Temperature effect, Subthreshold conduction), MOSFET biasing and DC circuit analysis, MOSFET small signal amplifier (CS configuration).

Unit III: Op-Amp Basics **(07)**
Block diagram of Op-Amp, Differential amplifier configurations, Symbol and ideal equivalent circuit of Op-Amp, Differential amplifier analysis for dual-input balanced-output configuration, DC and AC characteristics of Op-Amp, Methods for improving CMRR of differential amplifier.

Unit IV: Linear Applications of Op-Amp **(08)**
Inverting and Non-inverting amplifier, Voltage follower, Summing amplifier, Difference amplifier, Instrumentation amplifier, Ideal integrator, Errors in ideal integrator, Practical integrator, Ideal differentiator, Errors in ideal differentiator, Practical differentiator.

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Unit V: Non-Linear Applications of Op-Amp (07)

Comparator, Characteristics of comparator, Applications of Comparator, Schmitt trigger, Square wave generator, Triangular wave generator, Need of precision rectifier, Half wave and Full wave precision rectifiers.

Unit VI: Active Filters and PLL (06)

First order and second order active LP Butterworth filter, Filter design and frequency scaling, Block diagram of PLL, Characteristics of PLL, Applications of PLL.

Text Books:

1. R. L Boylestad, L. Nashlesky, **"Electronic Devices and Circuits Theory"**, *Prentice Hall of India*, (11th Edition), (2013).
2. Donald Neaman, **"Electronic Circuit Analysis and Design"**, *Tata McGraw Hill*, (3rd Edition), (2007).
3. Ramakant A. Gaikwad, **"Op Amps and Linear Integrated Circuits"**, *Prentice Hall*, (4th Edition), (2000).
4. Salivahanan and Kanchanabhaskaran, **"Linear Integrated Circuits"**, Tata *McGraw Hill Education*, (1st Reprint 2008).

Reference Books:

1. Sergio Franco, **"Design with Operational Amplifiers and Analog Integrated Circuits"**, McGraw Hill Education, (3rd Edition), (2002).
2. Sedra Smith, **"Microelectronic Circuits"**, Oxford Publications, (5th Edition), (2004).
3. David A. Bell, **"Electronic Devices and Circuits"**, Oxford, (5th Edition) (2008).
4. Millman Halkias, **"Integrated Electronics- Analog and Digital Circuits and Systems"**, *Tata McGraw Hill*, (2nd Edition) (2010).

Online Resources:

1. https://www.ti.com
2. NPTEL Course **"Analog Electronic Circuits"** https://nptel.ac.in/courses/108/105/108105158/
3. NPTEL Course on **"Analog Circuits"** https://nptel.ac.in/courses/108/101/108101094/

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20EC302 SIGNALS AND SYSTEMS

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

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

Prerequisite: 20BS01 Linear Algebra and Univariate Calculus, 20BS03 Multivariate Calculus

Course Objectives:

1. To represent continuous and discrete time signals and systems mathematically
2. To classify signals and systems into different categories
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains
4. To make students familiar with the concept of Correlation and Spectral Density

Course Outcomes:

After completion of the course, students will be able to

CO1 Classify basic Signals and Systems on the basis of characteristics
CO2 Perform operations on Signals and identify Systems
CO3 Apply convolution theorem to find the response of the Linear Time Invariant (LTI) system
CO4 Analyze signals and systems using Fourier Transform and Z Transform
CO5 Apply the concepts of correlation and spectral density on Continuous Time and Discrete Time signals

Unit I: Introduction to Signals (11)

Definition of Signals and Systems, Conversion of analog signal to digital signal, Classification of signals: Continuous Time (CT) and Discrete Time (DT), Even, Odd, Periodic and aperiodic, Deterministic and random, Energy and power, Operations on signals: Amplitude scaling, Time scaling, Time shifting and Folding, Precedence rule, Addition, Multiplication, Differentiation, Integration, Elementary signals: Impulse and its properties, Step, Ramp, Exponential, Sine, Rectangular, Triangular, Signum and Sinc.

Unit II: System Classification (10)

System: Definition, Classification: linear and nonlinear, Time variant and invariant, Causal and non-causal, Static and dynamic, Stable and unstable, Invertible and non-invertible, System modelling: Input output relation, Impulse response, Definition of impulse response, Convolution integral, Convolution sum, Properties of convolution, System interconnection, System properties in terms of impulse response, Step response in terms of impulse response.

Unit III: Fourier Transform (07)

Overview of CTFS and CTFT, Introduction to DTFT and properties, Inverse Fourier transform, Applications of FT.

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Unit IV: Z Transform (07)

Need of Transform, Definition of unilateral and bilateral Z transform, Properties of Z transform, Inverse Z transform, Analysis of LTI DT System, Stability and Causality considerations of LTI system.

Unit V: Correlation and Spectral Density (06)

Definition of Correlation and Spectral Density, Correlogram, Analogy between correlation and convolution, Auto-correlation and Cross correlation for CT and DT signals and their relationship with energy / power spectral densities.

Text Books:

1. Simon Haykins and Barry Van Veen, **"Signals and Systems"**, *Wiley India,* (2nd Edition), (2004).
2. Lathi B. P, **"Signals, Systems and Communication"**, *BS Publication, (*1stEdition*),* (2009).
3. Rao Ganesh, **"Signals and Systems: A Simplified Approach"** *Pearson Education India, (*4th Edition),(2010).
4. Simon Haykins, **"An Introduction to Analog and Digital Communications"**, *Wiley India,* (2nd Edition), (2008).

Reference Books:

1. Alan V Oppenheim,S. Willsky, S. Hamid, **"Signals and Systems"**, *Pearson Education,* (2nd Edition), (2015).
2. Charles Phillips, **"Signals, Systems and Transforms"**, *Pearson Education,* (4thEdition), (2004).
3. Mrinal Mandal and Amir Asif, **"Continuous and Discrete Time Signals and Systems"**, *Cambridge University Press,* (1st Edition), (2007).

Online Resources:

1. NPTEL Course **"Signals and Systems"**
   https://nptel.ac.in/courses/117101055/

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20EC303 DATA STRUCTURES AND ALGORITHMS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20ES02 Fundamentals of Programming Language I

Course Objectives:

1. To recall the primitive data types, concepts of logic building and problem solving
2. To understand data representation, implementation and applications of linear and non-linear data structures
3. To learn and apply different algorithms on different types of data structures
4. To learn the concept and understand the importance of time and space complexity

Course Outcomes:

After completion of the course, students will be able to

CO1 Classify and categorize data structures that make up for a programming language
CO2 Infer to the modelled data structures from the premise of the baseline models
CO3 Apply algorithms on linear and non-linear data structures for performing different operations on data
CO4 Categorize the choice of data structures and its memory allocation on the basis of data definition, data access and manipulation

Unit I: Introduction to Data and Data Structures (07)

Concepts and definition of Data, Data type, Data object, Data structures, Searching Methods: Algorithms for Sequential Search, Indexed Sequential Search and Binary Search, Sorting Methods: Algorithms for Selection sort, Bubble sort, Insertion sort, Quick sort, Merge sort, Introduction to Time complexity and Space complexity, Brief overview of the Big Oh and other notations as performance metrics for the algorithms.

Unit II: Pointers, Structures and Functions in C (07)

Pointers: Basic concepts, Pointer declaration and initialization, Scale factor, Pointer to a pointer, Pointers and arrays, Structures in C: Concept, Comparison with arrays as a data structure, Array of Structures, Pointers and Structures, Concept of ordered list and polynomial representation using array of structures.
Functions: Type of functions and their categories, Parameter passing by value, Parameter passing by reference, Recursive functions, Bitwise Operators.

Unit III: Linked Lists (07)

Concept of Lists, Single linked list: algorithms for Creation, Insertion, Deletion and traversals of above data structure, Concept of Doubly Linked List and Circular Linked List, Applications of Linked lists, Abstract Data Type (ADT), List as an ADT, Generalized Linked List (GLL): Concept, Parenthesized enumeration, Representation of multivariable polynomials using GLL.

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Unit IV: Modeled Data Structures - Linear (07)

Stacks: Definition and example, Representation using arrays and linked list, Applications of Stacks: Concept of infix, Postfix and Prefix expressions, Algorithm to convert infix expression to a postfix expression, Algorithm to evaluate a postfix expression, Queues: Definition and example, Representation of queue using array and linked list, Concept of Circular queue, Concept of priority queue, Applications of Queue.

Unit V: Modeled Data Structures – Non Linear (Trees) (07)

Difference between Linear and Non-linear data structures, Binary Trees (BT): Basic terminology, Types of Binary Trees, Binary Search Tree (BST): Difference between BST and BT. Representation of BST(Static and Dynamic), Algorithms for BST traversals: Preorder, Inorder and Postorder (recursive), Primitive operations on BST: Create, Insert, Delete, Algorithm for Non-recursive in-order traversals for BST.

Unit VI: Modeled Data Structures – Non Linear (Graphs) (07)

Graphs: Concepts and terminology, Types of graphs: Directed graph, Undirected graph, Planar graph, Representation of graph using adjacency matrix, Adjacency list, Traversals: Depth First Search (DFS) and Breadth First Search (BFS). Minimal Spanning Tree (MST): Kruskal's algorithm, Prim's algorithm, Algorithm to find the shortest path: Dijktras algorithm.

Text Books:

1 Seymour Lipschutz, **"Data Structures with C",** Schaum's Outlines, *McGrawHill Education (India) Pvt. Ltd*, (1st Edition), (2017).
2 E Balgurusamy, **"Programming in ANSI C"**, *McGraw-Hill*, (8th Edition), (2019).

Reference Books:

1 Yedidyah Langsam, Moshe J. Augenstein, Aaron M.Tenenbaum, **"Data structures using C and C++"**, *PHI Publications*, (2nd Edition), (2004).
2 Ellis Horowitz, Sartaj Sahni, "**Fundamentals of Data Structures in C"**, *Universities Press*, (2nd Edition), (2008).

Online Resources:

1 NPTEL Course **"Programming, Data Structures and Algorithms using C"**
https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/

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20HS301 UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY

Teaching Scheme
Lectures: 2 Hours / Week
Tutorial: 1Hour/Week

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

Prerequisite: Nil

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

After completion of the course, students will be able to

CO1 Understand human values which is only the solution of most of the present-day problems and a sustained solution could emerge only through understanding of value-based living
CO2 Compare desires of 'I' and 'Body' distinctly. If any desire appears related to both, students are able to see that the feeling is related to I while the physical facility is related to the body
CO3 Develop Natural acceptance (intention) which is always for living in harmony which leads to fulfillment in relationships.
CO4 Understand the whole existence to see the interconnectedness in the Nature
CO5 Make use of sustainable solutions to the problems in the society and the Nature

Module 1 Introduction to Value Education (06)

Understanding Value Education: Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility : Happiness and Prosperity – Current Scenario : Method to Fulfill the Basic Human Aspirations.

Module 2 Harmony in the Human Being (06)

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to ensure self-regulation and Health.

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Module 3 Harmony in the Family and Society (06)

Harmony in the Family – the Basic Unit of Human Interaction: Values in Human-to-Human Relationship - 'Trust' the Foundational Value in Relationship, -'Respect' as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order.

Module 4 Harmony in the Nature/Existence (04)

Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Coexistence at All Levels - The Holistic Perception of Harmony in Existence.

Module 5 Implications of the Holistic Understanding – a Look at Professional Ethics (06)

Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession.

Text Books:

1. R. R. Gaur, R. Asthana, G. P. Bagaria, **"The Textbook A Foundation Course in Human Values and Professional Ethics"**, *Excel Books, New Delhi,* (2nd Revised Edition), (2019).
2. R. R. Gaur, R. Asthana, G. P. Bagaria, **"Teachers' Manual for A Foundation Course in Human Values and Professional Ethics",** *Excel Books, New Delhi,* (2nd Revised Edition), (2019).

Reference Books:

1. A. Nagaraj,**"Jeevan Vidya: EkParichaya"**, *Jeevan Vidya Prakashan, Amarkantak,* (1999).
2. A.N. Tripathi, **"Human Values"**, *New Age Intl. Publishers, New Delhi*, (2004).
3. Mohandas Karamchand Gandhi, **"The Story of My Experiments with Truth",** *Prakash books Publishers, Daryaganj, New Delhi.*
4. E. F. Schumacher, **"Small is Beautiful"**, *Harper Collins Publishers, Noida, Uttar Pradesh*, (2010).
5. Cecile Andrews, **"Slow is Beautiful"**, *New Society Publishers, Canada.*
6. J. C. Kumarappa, **"Economy of Permanence**", *Sarva Seva Sangh Prakashan, Wardha, Sevagram*, (2017).
7. Pandit Sunderlal, "**Bharat Mein Angreji Raj",** *Prabhat Prakashan, New Delhi* (2018).
8. Dharampal, **"Rediscovering India",** Society for Integrated Development of Himalayas, (2003).
9. Mohandas Karamchand Gandhi, **"Hind Swaraj or Indian Home Rule",** *Navajivan Publication House, Ahemadabad.*
10. Maulana Abdul Kalam Azad**, "India Wins Freedom",** *Orient BlackSwan,*(1989).
11. Romain Rolland**,"Swami Vivekananda",** *Advaita Ashrama Publication, Ramkrishna Math,* (2nd Edition), (2010).
12. Romain Rolland, "**Gandhi",** *Srishti Publishers & Distributor,* (2002).

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20EC301L ELECTRONICS CIRCUITS AND APPLICATIONS LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical:25 Marks
Credits: 2

Course Objectives:

1. To identify and characterize the device such as JFET and MOSFET.
2. To measure Op-Amp performance parameters and understand the difference between ideal and practical values for different ICs.
3. To design and implement linear and non-linear applications of Op-Amp and verify the functionality

Course Outcomes:

After completion of the course, students will be able to

CO1 Interpret characteristics of JFET and MOSFET
CO2 Design biasing circuits for JFET amplifier and analyze performance of JFET amplifier
CO3 Select an appropriate Op-Amp IC for given application and analyze their performance
CO4 Design Op-Amp based circuits and analyze their performance

List of Experiments:

1. Plot V-I characteristics of JFET.
2. Implement biasing circuits for JFET and verify DC operating point.
3. Implement JFET CS amplifier and calculate A_V, R_i and R_o.
4. Plot V-I characteristics of MOSFET.
5. Measure Op-Amp parameters and compare with the ideal specifications:
   - Input bias current,
   - Input offset current,
   - Input offset voltage,
   - Slew rate,
   - CMRR.
6. Design, Build and Test Integrator for given frequency f_a.
7. Design, Build and Test three Op-Amp Instrumentation amplifier for typical application.
8. Design, Build and Test Schmitt trigger and plot transfer characteristics.
9. Design, Build and Test Square and Triangular waveform generator.
10. Build and Test half and full wave precision rectifier.
11. Simulate JFET CG and CD amplifier.
12. Simulate and verify virtual ground and virtual short concept in inverting and non-inverting configuration of Op-Amp.
13. Simulate and verify the response of Differentiator for given frequency f_a.
14. Simulate and verify the response of Ist and IInd order Butterworth low pass filter.
15. Build and Test a small project using Op-Amp IC or suitable discrete components.

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20EC303L DATA STRUCTURES AND ALGORITHMS LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical:25 Marks
Credits: 1

Course Objectives

1. To recall the concepts of procedural programming language paradigm
2. To understand the significance of data structures and its use
3. To understand and implement data searching and sorting methods
4. To understand and implement algorithms for solving given problems

Course Outcomes

After completion of the course, students will be able to

CO1 Utilize the principal algorithms of sorting and searching on the given data
CO2 Implement basic linear data structures like arrays, records and linked lists
CO3 Analyze the requirement and implement stacks and queues from the base models
CO4 Build, represent and traverse non-linear data structures

List of Experiments:

1. Write a program to reorder the data using sorting techniques like: bubble, selection, insertion, quick and merge sort.
2. Write a program to locate data using sequential and binary search techniques.
3. Create a database of students using an array of structures with attributes; roll no., name, program, course, marks obtained for different subjects with their total and average. Implement the following operations on the database:
   a) Display the database in a tabular form.
   b) Modify (should be able to modify each field of the database).
   c) Append (add a new record to the existing database).
   d) Search for a particular record from the database.
   e) Sort the records in the database.
4. Write a program to add two polynomials using array of structures. The display should include the polynomials that are added and the resultant polynomial in descending order of the exponents.
5. Write a program to create a singly linked list using dynamic memory allocation functions. Implement the following operations on the linked list:
   a) Display.
   b) Insert a node in the linked list (at front, at end, in the middle).
   c) Delete a node from the linked list (at front, at end, in the middle).
   d) Display the linked list in reverse.
   e) Revert the linked list.
6. Write a program to model an array as a stack (Static implementation of Stack) and perform the following operations on it:
   a) Push
   b) Pop
   c) Display

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7. Write a program to model a singly linked list as a stack (Dynamic implementation of Stack) and perform the following operations on it:
   a) Push
   b) Pop
   c) Display
8. Write a program to evaluate a postfix expression using a stack. The input expression should be a postfix one.
9. Write a program to model an array as a queue (Static implementation of Queue) and perform the following operations on it:
   a) Add
   b) Delete
   c) Display
10. Write a program to model a linked list as a queue (Dynamic implementation of Queue) and perform the following operations on it:
    a) Add
    b) Delete
    c) Display
11. Create a Binary Search Tree and perform the following operations on it:
    a) Recursive traversals on the tree (display elements of the tree).
    b) Search a node in the tree.
12. Create a graph and represent it using an adjacency matrix.
    Implement BFS and DFS traversals.

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Autonomous Program Structure of Second Year B. Tech. Fourth Semester (Electronics and Telecommunication Engineering) Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours/ Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20EC401	Digital Electronics	3	1	0	50	50	0	0	100	4
20EC402	Analog and Digital Communication	3	1	0	50	50	0	0	100	4
20EC403	Machine Learning with Python	3	0	0	50	50	0	0	100	3
20EC404	Embedded Systems	3	0	0	50	50	0	0	100	3
20EC405	Object Oriented Programming	3	0	0	50	50	0	0	100	3
20EC401L	Digital Electronics Lab	0	0	2	25	0	25	0	50	1
20EC402L	Analog and Digital Communication Lab	0	0	2	25	0	25	0	50	1
20EC403L	Machine Learning with Python Lab	0	0	2	25	0	25	0	50	1
20EC404L	Embedded Systems Lab	0	0	4	25	0	0	25	50	2
20EC405L	Object Oriented Programming Lab	0	0	2	25	0	0	25	50	1
20AC401	Audit Course	0	0	2	0	0	0	0	0	No Credit
	Total	**15**	**2**	**14**	**375**	**250**	**75**	**50**	**750**	**23**
	Grand Total	**31**			**625**		**125**			

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MKSSS CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

20EC401 DIGITAL ELECTRONICS

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

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

Prerequisite: 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1. To solve the Sum of Products (SOP) and Product of Sum (POS) equations using K-map
2. To design Combinational logic circuits such as Adder, Multiplexer, De-multiplexer, Decoder, Comparator
3. To design sequential circuits like Counters, Shift Registers
4. Study various types of Programmable Logic Devices (PLDs)

Course Outcomes:

After completion of the course, students will be able to

CO1 Illustrate reduction of logical expressions using k-map and realize the functions using logic gates
CO2 Design combinational and sequential digital logic circuits
CO3 Design digital systems using Finite State Machines
CO4 Classify digital logic families and implement combinational logic circuits using PLD

Unit I: Fundamentals of Digital Logic (08)

Number system: Hex Number, Standard representation of logic functions, Truth table, SOP and POS forms, Canonical form, Min and Max terms, Minimization of logical functions up to 4 variables using K-map, Don't care conditions.

Unit II: Combinational Logic Design (08)

Circuit designs using Adders, Subtractors, Code converters, Digital Comparators, Multiplexers, De-multiplexers, Decoders, Encoders, Parity generator and checker, Arithmetic logic unit.

Unit III: Sequential Logic Design (08)

1 bit memory cell, Clocked SR, JK, T, D and MS-JK flip-flop, Use of preset and clear terminals, Excitation table for flip-flops, Conversion of flip-flops, Applications of flip-flops: Registers, Shift registers, Sequence Generators, Counters: Synchronous and Asynchronous counters.

Unit IV: State Machines (10)

Mealy and Moore machines representation, State diagram, State table, State assignment, Design of State Machines using State assignment and State reduction, Design of sequence detector using Finite State Machine (FSM), Applications of FSM**:** Traffic light controller, Lift controller, Vending Machines.

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Unit V: Digital Logic Families and Programmable Logic Devices (08)

Classification of logic families, Characteristics of digital ICs: Speed of operation, Power Dissipation, Figure of merit, Fan in, Fan out, Current and Voltage parameters, Noise immunity, Operating temperatures and Power supply requirements, Introduction to PLDs and their types: PAL, CPLD and FPGA, Interfacing of TTL to CMOS and CMOS to TTL, Comparison between CPLD and FPGA.

Text Books:

1. R .P Jain, **"Modern digital electronics"**, *TMH Publication,* (3rd Edition), (2007).
2. Anand Kumar, **"Fundamentals of digital circuits"**, *PHI Publication,* (1st Edition), (2001).
3. Stephen D. Brown and Zvonko G Vranesic, **"Fundamentals of Digital Logic with Verilog Design"**, *Pearson Education*, (2nd Edition),(2008).

Reference Books:

1. Wakerly, **"Digital Design Principles and Practices"**, *Pearson Education*, (3rd Edition), (2004).
2. M. Morris Mano, **"Digital Logic and Computer Design"**, *Pearson Education,* (3rd Edition), (2004).

Online Resources:

1. NPTEL Course **"Digital Circuits and Systems"**
   https://nptel.ac.in/courses /117/106 /117106086/

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20EC402 ANALOG AND DIGITAL COMMUNICATION

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

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

Prerequisite: 20EC302 Signals and Systems

Course Objectives:

1. To introduce analog modulation and demodulation techniques
2. To study sampling process and pulse analog modulation techniques
3. To explore source coding techniques PCM, DPCM, DM, ADM
4. To explain conversion of digital data to digital signal
5. To explore binary and M-ary digital modulation techniques

Course Outcomes:

After completion of the course, students will be able to

CO1	Interpret generation and detection of Amplitude modulation and Frequency modulation
CO2	Apply sampling process and describe pulse analog modulation techniques with their generation and detection
CO3	Apply source coding techniques and evaluate Bitrate, Bandwidth and Signal-to-noise ratio
CO4	Interpret and apply data formats, Multiplexing, Synchronization and Intersymbol Interference and Matched filter for reliable baseband transmission
CO5	Analyze bandpass modulation techniques and evaluate: Bit rate, Bandwidth and Euclidean distance

Unit I: Analog Modulation (06)

Amplitude Modulation, Types of AM: DSB-SC, SSB-SC, DSB-FC, Spectrum of AM, Modulation Index, Technical AM standards, AM generation and detector, Super heterodyne radio receiver, Angle modulation, Bandwidth of FM, FM generation, FM detectors, FM- Superheterodyne radio receiver.

Unit II: Pulse Analog Modulation (05)

Sampling Process: Sampling theorem (time and frequency domain), Types of sampling, Aliasing, Aperture effect, Pulse analog modulation techniques - PAM, PPM, PWM.

Unit III: Digital Transmission of Analog Signal (08)

Block diagram of digital communication system, Pulse Code Modulation (PCM) Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, Delta Modulation (DM), Adaptive Delta Modulation(ADM), Differential Pulse Code Modulation(DPCM), Adaptive Differential Pulse-Code Modulation (ADPCM).

Unit IV: Baseband Digital Transmission (08)

Digital Multiplexing: Multiplexers and hierarchies, Data formats and their spectra, Synchronization: Bit Synchronization, Scramblers, Frame Synchronization, Inter-symbol Interference, Equalization, Eye diagram.

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Unit V: Bandpass Digital Techniques (09)

Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), M-Ary PSK, Quadrature Amplitude Shift Keying (QASK), Binary Frequency Shift Keying (BFSK), M-Ary FSK, Minimum shift keying (MSK), Introduction to GMSK.

Unit VI: Optimal Reception of Digital Signal (06)

Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver, Error probability for BASK, BPSK and BFSK.

Text Books:

1. George Kennedy, **"Electronic Communication Systems"**, *McGraw-Hill*, (5th Edition), (2013).
2. Simon Haykin, Michael Moher, "**Communication Systems**", *Wiley*, (5th Edition), (2009).
3. Donald L. Schilling, GoutamSaha, Herbert Taub, "**Principles of Communication System**", T*ata McGraw-Hill Education Pvt. Ltd*, (4th Edition), (2015).

Reference Books:

1. B.P Lathi, **"Modern Digital and Analog Communication Systems"**, Oxford University Press, (3rd Edition), (2003).
2. Bernard Sklar, **"Digital Communications Fundamentals and Applications"**, *Prentice Hall P T R*, (2nd Edition), (2009).
3. A. B. *Carlson* and P. B. Crilly, **"Communication Systems"**, *McGraw-Hill*, (5th Edition), (2002).
4. T. L. Singal, **"Analog and Digital Communication"**, *Tata McGraw-Hill*, (1st Edition), (2012).

Online Resources:

1. NPTEL Course **"Principles of Communication Systems "**
   https://nptel.ac.in/courses /108/104/108104091/
2. NPTEL Course **"Principles of Digital Communications"**
   https://nptel.ac.in/courses /108/101/10810113/

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20EC403 MACHINE LEARNING WITH PYTHON

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20BS01 Linear Algebra and Univariate Calculus, 20BS03 Multivariate Calculus, 20BSEC301 Calculus and Probability

Course Objectives:

1. To explain the basics of Python Programming Language
2. To discuss and describe the concepts of Machine learning (ML)
3. To apply ML algorithms on real world datasets for regression and prediction
4. To apply and analyse ML algorithms on real world datasets for classification and clustering

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain python fundamentals
CO2 Apply python for problem solving
CO3 Explain machine learning concepts and algorithms
CO4 Apply machine learning concepts and algorithms for prediction and classification problems
CO5 Analyze the performance of machine learning algorithms

Unit I: Python Fundamentals and Libraries (08)

Data Types, Operators, Indexing and Slicing, Strings, Lists, Arrays, Tuples, Conditional statements, Control Flow, Sets, Dictionaries, Arithmetic and Boolean Operations, Data frames, Python editors, Python libraries: Numpy, Matplotlib, Scikit learn, Pandas.

Unit II: Fundamentals of Machine Learning (08)

Basic concepts in machine learning, Parametric and non-parametric modeling, Overfitting and Underfitting, Feature selection, Dimensionality reduction techniques- PCA, LDA; Training, Testing and Validation errors, Confusion matrix and Evaluation Parameters.

Unit III: Regression (09)

Introduction to Regression, Simple linear regression, Multiple linear regression, Non-Linear Regression, Evaluation metrics in regression models.

Unit IV: Classification (09)

Introduction to Classification, K-Nearest Neighbours, Decision Trees and Random Forest Algorithm, Logistic Regression, Logistic regression vs Linear regression, Support Vector Machine, Introduction to Bayesian probability, Naive Bayes algorithm, Evaluation metrics in classification.

Unit V: Clustering (08)

Introduction to Clustering, K-Means Clustering, Hierarchical Clustering and Density-Based Spatial Clustering of Applications with Noise (DBSCAN) Clustering.

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Text Books:

1. Vinod Chandra S. S., Anand Hareendran S., "**Artificial Intelligence and Machine learning**", *PHI*, (1st Edition) (2014).
2. U. Dinesh Kumar and Manaranjan Pradhan, "**Machine Learning using Python**", *John Wiley & Sons* (1st Edition), (2020).
3. Mark Lutz, "**Programming Python",** *O'Reilly Media, Inc.,* (4th Edition), (2010).
4. Ethem Alpaydın "**Introduction to Machine Learning**", *The MIT Press,* (2nd Edition), (2010).
5. Christopher Bishop, "**Pattern Recognition and Machine Learning**", *Springer,* (1st Edition), (2007).

Reference Books:

1. Chris Albon, **"Machine Learning with Python Cookbook",** *O'Reilly Media*, Inc., (1st Edition), (2018).
2. Aurélien Géron, **"Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow",** *O' Reilly Media, Inc.,* (2nd Edition), (2019).
3. Kevin Murphy, **"Machine Learning: A Probabilistic Perspective",** *MIT Press,* (1st Edition), (2012).

Online Resources:

1. NPTEL Course on **"Machine Learning"** https://nptel.ac.in/courses/106/106/106106202/
2. NPTEL Course on **"Introduction to Machine Learning"** https://onlinecourses.nptel.ac.in/noc21_cs85/preview
3. NPTEL Course on **"Introduction to Machine Learning"** https://onlinecourses.nptel.ac.in/noc21_cs70/preview

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20EC404 EMBEDDED SYSTEMS

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, 20ES02 Fundamentals of Programming Language I

Course Objectives:

1. To explain the applications of microprocessors and microcontrollers.
2. To introduce the architecture and features of typical microcontrollers.
3. To interface real world I/O devices
4. To explain hardware and software development tools

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe architecture of microcontrollers
CO2 Develop program for on chip peripheral
CO3 Develop program for externally interfaced peripheral device
CO4 Design microcontroller-based system using sensors

Unit I: Introduction to Embedded System (08)

Embedded system: Need of Embedded System - Applications, Classification and working of Embedded System (block diagram), Embedded system characteristics, Microprocessors and Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Architecture of a Microcontroller, Microcontroller Family, Microcontroller selection process for application, Microcontroller Application Development tools: Simulator, Emulator, ISP, Cross assembler.

Unit II: Microcontroller Architecture (06)

Microcontroller architecture, Pin configuration, RESET, Crystal interface, Program Status Word (PSW), Internal memory organisation, Port Structure: GPIO (LED interface), Stack and Stack Pointer, Serial communication: Concept of RS 232C.

Unit III: On-chip Peripherals (07)

Microcontroller On-chip peripherals: Counters/Timers, ADC and DAC, Introduction to sensors and transducers - LM35 sensor interface, Calibration, Interrupts.

Unit IV: Real World Interfacing – External Peripheral Interface (06)

Interfacing LCD, switch, Stepper motor, Relays, buzzer and DC motor control using PWM.

Unit V: Sensor Interface (06)

Interface sensors: Accelerometer, Gas sensor, Temperature and Humidity Sensor: DHT-11, Float sensor, Gyro sensor.

Unit VI: Design a Minimum System Using Microcontroller (09)

Case Study: Temperature monitoring and controlling, Home automation system.

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Text Books:

1. Mohammad Mazidi, Janice Mazidi and Rolin McKinlay, **"The Microcontroller and Embedded Systems using Assembly and C"**, Pearson Education, (2nd Edition), (2014).
2. C. Ravichandran, M. Arulalan, **"Microcontroller-based system design"**, *Suchitra Publication*, (1st Edition), (2017).

Reference Books:

1. Myke Predko, **"Programming and customizing the microcontroller"**, *Tata McGraw Hill*, (2nd Edition), (2014).
2. Kenneth Ayala ``**The MICROCONTROLLER-Architecture, Programming and Applications",** *West Publishing Company*, (3rd Edition), (2014).

Online Resources:

1. www.intel.com
2. www.microchip.com

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20EC405 OBJECT ORIENTED PROGRAMMING

Teaching scheme
Lecture: 3 hours/week

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

Prerequisite: 20ES05 Fundamentals of Programming Language II

Course Objectives:
1. Recall the concepts and techniques of the OOP paradigm
2. Understand and utilize commonly used classes and object as superclass
3. Develop ability to understand and use interfaces, enums and Java collection framework
4. Understand the importance of streams, APIs and the concept and usage of multithreading

Course Outcomes:
After completion of the course, students will be able to
CO1 Utilize common Java constructs such as Interfaces, Enums, Lambdas, Streams and built-in classes such as String, Arrays to develop programs
CO2 Analyze the application requirement and choose appropriate collection from Java Collections Framework for storing data
CO3 Apply the concepts of multithreading
CO4 Analyze the design requirement and identify the appropriate design pattern to be applied

Unit I: Classes and Objects (07)
Basics of stack, heap, memory allocation (objects/primitives and instance/local variables). Nested classes, Inner classes, Method local classes, Anonymous classes, Object as superclass: Object class methods, importance and implementation of to String(), equals(), hashCode() methods, Immutability of objects, Wrapper classes like Byte, Double, Float, Integer, Long, Short, Autoboxing and unboxing. Commonly used classes: String, StringBuilder, Objects, Arrays, Math.

Unit II: Interfaces, Enums and Annotations (07)
Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type, Common interfaces: Comparable, Comparator, Iterable, Iterator, Runnable, Enums: Declaring Enum, adding fields to Enum, Enum class in Java, Built in methods, Abstract method implementations in Enum, Annotations: Basics, Declaring annotation type, Predefined annotations, Annotation processing overview.

Unit III: Generics and Collections (08)
Generics: Introduction to generics, Generic types, Generic methods, Bounded type parameters, generics and inheritance, Wildcards, Java Collection Framework (JCF): Introduction to JCF, Structure of JCF (program to interface, use of generics, Collection interface), Commonly used collections with implementations: Features, Methods offered and complexity analysis for: List (ArrayList, LinkedList), Set (HashSet, LinkedHashSet, TreeSet), Map (HashMap, LinkedHashMap, TreeMap), Queue (ArrayBlockingDeque, Priority Queue), Exploration of Javadocs to understand interface and implementations.

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Unit IV: Java 8 Useful Features (07)

Java 8 interfaces: Default and Static Methods, Lambdas, Method references, Streams: Introduction, Examples, Intermediate operations: filter, Map, Flat Map, Distinct, Limit, sorted, Terminal operations: for Each, to Array, Collect and reduce, Date Time APIs: Problems with existing Date and Calendar, Local Date, Local Time, Local Date Time, Zoned Date Time, Period and Duration.

Unit V: Multithreading (07)

Multithreading vs multiprocessing, Thread, Runnable, memory model (Thread stack, frames, method stacking, stack overflow), Need for synchronization: race conditions, Happens before guarantee, Examples, Use of atomic classes, Deadlock, Starvation, Use of volatile, Publisher/Subscriber model: wait, notify/notify all.

Unit VI: Design Patterns (06)

Purpose of using design patterns, types of design patterns: Creational, Structural, Behavioral, Common design patterns such as: singleton, Factory, Builder, Proxy, Façade, Observer, Model View Controller (MVC).

Text Books:

1 Herbert Schilt, **"JAVA Complete Reference"**, *Tata McGraw Hill*, (9th Edition), (2014).
2. Eckel B., **"Thinking in Java"**, *Pearson Education*, (3rd Edition), (2017).

Reference Books:

1. Joshua Bloch,**"Effective Java"**, Addison-Wesley Professional, (3rd Edition), (2017).

Online Resources:

1. NPTEL Course **"Programming in Java"**
   https://nptel.ac.in/courses/106/105/106105191/

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20EC401L DIGITAL ELECTRONICS LAB

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objectives:
1. To solve the SOP and POS equations using K-map
2. To design different Combinational logic circuits
3. To design different Sequential circuits
4. To study various types of PLDs

Course Outcomes:
After completion of the course, students will be able to
CO1 Design and Implement digital circuits
CO2 Analyze combinational and sequential circuits
CO3 Implement Combinational Logic Circuits using PLDs
CO4 Utilize software tools for the simulation of digital circuits

List of Experiments:
1. Design and implement Full Adder and Full Subtractor circuit using Decoder IC.
2. a) Design and implement 8:1 Multiplexer.
   b) Design and analysis of logic functions using Multiplexer.
3. Design and implement 1- digit BCD adder using IC 7483.
4. a) Design and implement an 8-bit Magnitude comparator using IC 7485.
   b) Design and analyze the 5 bit Magnitude comparator using single IC 7485.
5. a) Design Asynchronous MOD-N counter using IC 7490.
6. a) Design and implement Synchronous Up/ Down counter.
   b) Design and analyze Synchronous MOD-NN up counter.
7. Implement Boolean expression using PLD.
8. Design and simulate Finite State Machines.

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20EC402L ANALOG AND DIGITAL COMMUNICATION LAB

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objective

1. To demonstrate generation and detection of AM and FM signals
2. To comprehend PCM, DM, ADM waveform coding techniques
3. To observe data format along with spectral analysis
4. To explore binary and M-ary shift keying techniques

Course Outcome

After completion of the course, students will be able to

CO1 Measure and calculate modulation index, spectrum of AM and FM signal
CO2 Measure and compare bit-rate, signal-to-noise ratio, quantization error of waveform coding techniques
CO3 Plot and analyse spectrum of data formats
CO4 Measure and compare bandwidth, and bit-rate of digital modulation techniques
CO5 Interpret communication standards for analog and digital techniques with technical presentation

List of Experiments:

1. Measure modulation index and observe waveforms of AM and FM (generation and detection)
2. Simulate Super heterodyne radio receiver for FM on suitable software
3. For the given kit measure Bit-rate, Signal to noise ratio and Quantization error for PCM
4. Measure and plot slope overload and Granular noise in Delta modulation and ADM
5. Measure spectrum of BFSK signal
6. Measure and compare bit rate and bandwidth of BPSK and QPSK signals
7. Interpret spectral analysis of line codes (NRZ, RZ, Polar RZ, Bipolar (AMI), Manchester) generated on the given kit
8. Simulate and compare error probability for Binary and M-ary Shifting keying
9. Seminar presentation on Communication Standards

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20EC403L MACHINE LEARNING WITH PYTHON LAB

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objectives:

1. To explain the basics of Python Programming Language
2. To apply the concepts of Machine Learning (ML) for data visualization and analysis
3. To apply ML algorithms for regression and prediction problems
4. To apply ML algorithms for classification and clustering

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply Python programming to read and visualize datasets
CO2 Develop an algorithm and write program for solving regression from real world applications
CO3 Develop an algorithm and write program for classification of data from real world applications
CO4 Develop an algorithm and write program using clustering algorithms

List of Experiments:

1. A) Introduction to Python and Python libraries.
   B) Download/Access and read datasets (Kaggle) in Python.
2. Write a program in Python for data visualization and calculate statistical summary.
3. Develop an algorithm and solve real world regression/prediction problems using ML techniques such as linear regression.
4. Develop an algorithm and solve real world regression/prediction problems using ML techniques such as logistic regression.
5. Develop an algorithm and solve real world problems using Naive bayes Algorithm / SVM
6. Develop an algorithm and solve real world problems using Decision tree / Random Forest Algorithm.
7. Develop an algorithm and solve real world problems using K-means clustering algorithm.
8. Develop an algorithm and solve real world problems using Hierarchical clustering algorithm.

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20EC404L EMBEDDED SYSTEM LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical :25Marks
Credits: 2

Course Objective

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore students to development tools required for embedded system

Course Outcome

After completion of the course, students will be able to

CO1 Implement given problems using development tools required for embedded system
CO2 Develop program for on chip peripheral
CO3 Develop program for externally interfaced peripheral device
CO4 Design microcontroller-based system using sensors

List of Experiments:

1. Introduction to Studio 7 and programming Arduino board, Arduino CC (IDE)
2. Introduction to Simulator TinkerCad (online).
3. Interfacing LEDs with different patterns (GPIO)
4. Interfacing switch, LED, relay and buzzer (GPIO)
5. Interfacing Stepper motor (GPIO)
6. Develop the program to generate different waveforms using DAC.
7. Write program to transmit and receive data serially
8. Interfacing LCD Display.
9. Interface ADC and display the data on LCD as well as on serial port.
10. Interface LM 35 sensor to internal ADC and display the value on LCD.
11. Toggle GPIO port with fixed time interval using On-chip timer (without interrupt).
12. Toggle GPIO port with fixed time interval using On-chip timer (with interrupt).
13. DC Motor Speed Control using PWM.
14. Interface following sensors to ADC of microcontroller.
    1. Accelerometer
    2. Gas sensor
    3. Temperature and Humidity sensor DHT-11
15. OPEN ENDED PROBLEM : Interface
    1. Float sensor
    2. Gyro sensor
    3. IR sensor for counting movement or open and close the door using DC motor

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20EC405L OBJECT ORIENTED PROGRAMMING LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Objectives

1. To recall the concepts and techniques of the OOP paradigm
2. To utilize the commonly used classes and object as super class
3. To implement interfaces, enums and the Java collection framework
4. To understand the importance of streams, APIs and the concept and usage of multithreading

Course Outcomes

After completion of the course, students will be able to

CO1 Develop Java programs using common Java constructs
CO2 Develop Java programs by applying appropriate design pattern
CO3 Analyse the application requirement and write programs using appropriate collection from Java Collections Framework
CO4 Apply the concept of multithreading to solve given problems

List of Experiments:

1. Write a program to explore Object class methods (toString, equals, hashcode)
   a) Create an Employee class with fields first name and last name.
   b) Create and print Employee class objects.
   c) Create multiple Employee class objects and compare whether they are equal or not.
2. Declare an interface and create an anonymous class that implements it.
3. Write a program to create a Person class with fields; first name and last name and getter setters. Modify it to make it immutable. In the Person class, add a field of type Address, which has fields as city and pin code with getters and setters. Prove that the Person class is now mutable. Modify the classes such that Person becomes immutable again.
4. Write a program to concatenate two strings e.g. "hello" and "world" and check if the result of concatenation equals "helloworld" (using equals() and ==). Trim the strings to get the two strings back.
5. Write a program to declare an Enum representing days of the week. Add fields to indicate the day name and number. Print the days using values().
6. Write a program to implement basic arithmetic calculator using Enum. Calculator should support operations: addition, subtraction, multiplication and division.
7. Create a set of movies (Movie class having name and imdb rating). Print the list of movies in the ascending order of their names. Now print the movies in descending order of imdb rating, using comparator interface.
8. Create a list of names of your friends. Check if a name of a friend is present in the list. Remove a name from the list and add another. Print the list to see where the added name is appearing in the list.

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9. Dissecting equals and hashcode contract - Create 4 objects from a student class (which has name and roll number as fields). All objects should have the same name and roll numbers. Add the objects to a set when – (i) the class does not have equals and hashcode overridden (ii) when the class has these methods overridden. Inspect what happens in these two cases and justify the contract.
10. Create a map of device ids and subscribers associated with it. Create a list of all device ids associated with a subscriber.
11. Given a stream of amplitude values of a sampled signal (as a List), filter out the samples having amplitudes above and below the threshold values (upper threshold: 4.5V and lower threshold: 0.5V). These filtered samples are to be passed through the multiplier system (multiplication factor = 2). Create a list of signal values at the output of the multiplier system. Find min and max amplitudes in the result.
    Example:
    Input: {0.45, 1.0, 2.2, 3.5, 4.7, 5.0, 0.21, 1.2}
    Output: {2.0, 4.4, 7.0, 2.4}
    Min: 2.0, Max: 7.0
12. Write a program to demonstrate deadlock using two threads and two locks. Hint: Threads need to acquire locks in opposite order.
13. Write a Maven project to generate a QR code. Hint: Use QRGen (https://github.com/kenglxn/QRGen) as dependency.

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Autonomous Program Structure of Third Year B. Tech. Fifth Semester (Electronics and Telecommunication Engineering)

Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20EC501	Digital Signal Processing	3	1	0	50	50	0	0	100	4
20EC502	VLSI Design	3	0	0	50	50	0	0	100	3
20EC503	Advanced Processors	3	0	0	50	50	0	0	100	3
20PEEC501	Programme Elective-I	3	0	0	50	50	0	0	100	3
20PEEC502	Programme Elective II*	3	0	0	50	50	0	0	100	3
20OEHS501	Open Elective I	3	0	0	50	50	0	0	100	3
20EC501L	Digital Signal Processing Lab	0	0	2	25	0	25	0	50	1
20EC502L	VLSI Design Lab	0	0	2	25	0	25	0	50	1
20EC503L	Advanced Processors Lab	0	0	4	25	0	0	25	50	2
20EC504L	Mini Project	0	0	2	25	0	25	0	50	1
20PEEC501L	Programme Elective Lab-I	0	0	2	25	0	0	25	50	1
20AC501	Audit Course : Self Expression	0	0	2	0	0	0	0	0	No Credit
	Total	**18**	**1**	**14**	**425**	**300**	**75**	**50**	**850**	**25**
	Grand Total	**33**			**725**		**125**			

***NPTEL / Swayam Course**

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

Programme Elective-I			Programme Elective-I Lab		
Sr. No.	**Course Code**	**Course Title**	**Sr. No.**	**Course Code**	**Course Title**
1	20PEEC501A	Information Theory and Coding Techniques	1	20PEEC501LA	Information Theory and Coding Techniques Lab
2	20PEEC501B	Mechatronics	2	20PEEC501LB	Mechatronics Lab
3	20PEEC501C	Digital Image Processing	3	20PEEC501LC	Digital Image Processing Lab
4	20PEEC501D	Introduction to Internet of Things	4	20PEEC501LD	Introduction to Internet of Things Lab
Programme Elective-II*					
Sr. No.	**Course Code**	**Course Title**			
1.	20PEEC502	***NPTEL / Swayam Course**			

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

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20EC501 DIGITAL SIGNAL PROCESSING

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

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

Prerequisite:20EC302 Signals and Systems

Course Objectives:

1. To introduce basics of Digital Signal Processing (DSP), Analog to Digital and Digital to Analog conversion
2. To apply transform techniques for analysis of signals
3. To compare analog and digital filters and design digital filters
4. To understand practical DSP systems and their applications

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply sampling theorem to obtain discrete time signals and sampling rate conversion for Multirate DSP systems
CO2 Apply Discrete Fourier Transform and Short Time Fourier Transform on discrete time signals
CO3 Design and build FIR, IIR and Multirate digital filters
CO4 Analyze signals in frequency domain and performance of DSP algorithms
CO5 Design and simulate real-world applications of DSP

Unit I: Introduction to Digital Signal Processing (08)

Basic elements of Digital Signal Processing (DSP) and their requirement, Advantages of Digital over Analog Signal Processing, Sampling of analog signals, Sampling theorem in time domain, Recovery of analog signals, Mapping between analog to digital frequency, Block diagram representation of DT LTI systems: Direct form (I and II), Cascade form, Parallel form, Linear phase structure.

Unit II: Discrete Fourier Transform (09)

Overview of Discrete Time Fourier Transform (DTFT), Frequency domain sampling, Discrete Fourier Transform (DFT), Properties of DFT, Circular convolution, Computation of linear convolution using circular convolution, Decimation in Time (DIT) and Decimation in Frequency (DIF) Radix-2 FFT algorithms, Computational complexity of FFT algorithms, Bit-reversal, In-place computation, Introduction to Short Time Fourier Transform (STFT), Applications of FFT: Spectrum analyzer, Spectrum analysis of non-stationary signals.

Unit III: FIR Filter Design (08)

Ideal filter requirements, Comparison of analog and digital filters, Frequency response of Linear phase Finite Impulse Response (FIR) filters, Types of FIR filter, Design of linear phase FIR filter

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using windowing method, Characteristics and comparison of different window functions, Finite word length effects in FIR filter design, Applications of FIR filter: Speech processing, Telecommunication systems.

Unit IV: IIR Filter Design (09)

Characteristics of ideal and practical frequency selective filters, Comparison of Butterworth, Chebyshev and Elliptic filters, Design of Infinite Impulse Response (IIR) filters from analog filters, IIR filter design by Impulse Invariance method, Bilinear Transformation, Frequency warping effect, Finite word length effects in IIR filter design, Applications of IIR filter: Biomedical Signal Processing, Image Processing.

Unit V: Multirate Digital Signal Processing (08)

Need of multirate systems, Interpolation by I factor, Decimation by D factor, Sampling rate conversion by I/D factor, Frequency domain analysis of multirate DSP system, Design of multirate filters, Polyphase implementation, Applications of multirate DSP: Audio systems, Sub-band coding.

Text Books:

1. John G. Proakis, D. G. Manolakis, **"Digital Signal Processing"**, *Pearson Prentice Hall*, (3rd Edition), (2007).
2. Emmanuel C. Ifeachor, B. W. Jervis, **"Digital Signal Processing–– A practical approach"**, *Pearson Education*, (2nd Edition), (2002).
3. S. Salivahanan, **"Digital Signal Processing"**, *McGraw Hill*, (3rd Edition), (2011).
4. Li Tan and Jean Jiang, **"Digital Signal Processing Fundamentals and Applications**", *Academic Press*, (2ndEdition), (2013).

Reference Books:

1. S. K. Mitra, **"Digital Signal Processing: A Computer Based Approach"**, *McGraw Hill*, (2nd Edition), (2013).
2. A. Nagoor Kani, **"Digital Signal Processing"**, *Tata McGraw Hill*, (2nd Edition), (2012).
3. Alan V. Oppenheim, **"Discrete-Time Signal Processing"**, *Pearson Education India*, (2nd Edition), (2013).
4. Vinay K. Ingale, John G. Proakis, **"Digital Signal Processing using MATLAB"**, *Cengage Learning*, (3rd Edition), (2009).

Online Resources:

1. http://freevideolectures.com/Course/2317/Digital-Signal-Processing-IIT-Delhi
2. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
3. NPTEL Course **"Digital Signal Processing and its Applications"**https://nptel.ac.in/courses/108/101/108101174/
4. NPTEL Course on **"Digital Signal Processing"** https://nptel.ac.in/courses/108/105/108105055/

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20EC502 VLSI DESIGN

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite:20EC401 Digital Electronics

Course Objectives:

1. To introduce VLSI Design Flow
2. To explain the design hierarchy, syntax, lexical conventions, data types and modeling styles in Verilog
3. To illustrate the design and implementation of digital circuits using Verilog
4. To elaborate the FPGA architecture
5. To illustrate the design digital circuits using CMOS logic

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

CO1 Explain VLSI design flow
CO2 Design digital systems using Verilog HDL
CO3 Analyze the architecture of FPGA for logic synthesis
CO4 Realize digital circuits using CMOS logic

Unit I: Introduction to VLSI Design (07)
Philosophy of VLSI, Evolution of IC Technology (SSI to VLSI), VLSI Design flow, VLSI Based Integrated Circuit Architecture (Overview of Mobile SoC or Microcontroller SoC, logic, control, memory, interconnect, etc.), EDA Tools used in VLSI, VLSI Design Consideration, Application of VLSI IC.

Unit II: **Physical IC Design Flow (07)**
Hierarchical Modelling, Top-down and Bottom-up design methodology, Module Based Physical Design Flow, Floor-planning Steps, Netlist Binding, Timing and Clock Tree synthesis, clock net shielding, Power Planning, Routing and Design Rule Check, Parasitic Extraction, IC Fabrication process.

Unit III: Modeling Digital System using HDL (12)
Modules and Ports, Lexical conventions, Data types, System tasks, Compiler directives, Delay specification, Expressions, Operators, Operands in Verilog, Gate-Level Modeling, Modeling using basic Verilog gate primitives, Dataflow Modelling, Continuous assignments, Delay specification, Behavioral Modeling, Structured procedures, Initial and always, Blocking and non-blocking statements, Delay control, Conditional statements, Multiway branching, Loops, Sequential and parallel blocks, Task and function.

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Unit IV: Design and Synthesis with FPGA (08)

Spectrum of PLD's, ASIC Vs FPGA Design flow, Architecture of FPGA, Programming Technologies, Dedicated Components in FPGA, Implementing logic in FPGA, Metastability, Specification and Application of FPGA, Design for synthesis, Synthesis of Case statement, Unintentional latch creation, Synthesis of if statement, Synthesis of Arithmetic components.

Unit V: Digital CMOS Circuit (08)

CMOS Inverter, Inverter VTC, Power Dissipation, Technology Scaling, MOSFET parasitic, Transmission gates, Lambda Design Rules, CMOS combinational logic design.

Text Books:

1. S. Palnitkar, **"Verilog HDL – A Guide to Digital Design and Synthesis",** *Pearson Publication*, (3rd Edition), (2010).
2. Neil H. E. Weste, David Money Harris, **"CMOS VLSI Design: A Circuit & System Perspective",** *Pearson Publication*, (4th Edition), (2010).
3. Pong P. Chu, "**FPGA Prototyping by Verilog Example: Xilinx Spartan3 Version**", *Wiley-Interscience*, (1st Edition), (2008).

Reference Books:

1. Jr. Roth, Charles H., Lizy Kurian John, Byeong Kil Lee, "**Digital System Design using Verilog**", *Cengage India Private Limited*, (1st Edition), (2017).
2. Wyane Wolf, **"Modern VLSI Design (System on Chip)",** *PHI Publication*, (3rd Edition), (2002).
3. Stephen Brown, Zvonko Vranesic, **"Fundamentals of Digital Logic with Verilog Design"**, *McGraw-Hill Education*, (3rd Edition), (2013).
4. Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim, "**CMOS Digital Integrated Circuits, Analysis and Design**" *McGraw Hill Education*, (4thEdition), (2019).

Online Resources:

1. NPTEL Course **"Hardware modeling usingVerilog"**https://nptel.ac.in/courses/106/105/106105165/
2. NPTEL Course **" CMOS Digital VLSI Design"**https://onlinecourses.nptel.ac.in/noc21_ee09/preview
3. https://www.udemy.com/course/vlsi-academy-physical-design-flow/

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20EC503 ADVANCED PROCESSOR

Teaching Scheme
Lectures: 3 Hours / Week

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

Course Objectives:

1. To introduce the architecture and features of ARM processor
2. To explain the applications of ARM based architecture
3. To interface I/O devices to ARM processor for real world applications
4. To explain hardware and software development tools

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain architecture of ARM core based processor
CO2 Develop algorithm and test the program for on chip peripheral of ARM based processor.
CO3 Develop algorithm and test the program for externally interfaced peripherals to the ARM based processor
CO4 Illustrate use of embedded operating system for CORTEX based processor and develop algorithm for the interfaced peripheral devices

Unit I: Introduction to ARM CORE (09)

ARM and RISC design philosophy, Introduction to ARM core and its versions, Multiple core concepts : dual, quad etc., ARM7, ARM9 and ARM11 features, Advantages and suitability in embedded applications, Registers : CPSR, SPSR, ARM7 data flow model, Programmers model, Modes of operations.

Unit II: Introduction to ARM7 Based Microprocessor (07)

ARM7 based processor: Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider), Memory Map, GPIO : Pin Connect Block (interfacing with LED), Serial communication programming for transmission and reception from computer, Programming for UART.

Unit III: On Chip Peripherals (06)

On chip ADC using with and without interrupt, On chip DAC for waveform generation, Interface EEPROM using I2C, LM35 sensor interface and calibration, Interrupts, Counters and Timers.

Unit IV: Real World Interfacing – External Peripheral Interface (06)

Interfacing of GSM, GPS, GLCD, KEYPAD, Bluetooth module, Wi-Fi module.

Unit V: ARM CORTEX (07)

Introduction to ARM CORTEX series, Improvement over classical series and advantages for embedded system design, CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, Need of operating system in developing complex applications in embedded system, Desired features of operating system and hardware

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support from processor, Firmware development using CMSIS standard for ARM Cortex.

Unit VI: ARM Cortex based development Board (07)

Introduction of ARM Cortex based development board: Features and processor used. Installing different OS on ARM cortex based board and its booting sequence. Interface external peripheral devices.

Text Books:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, **"ARM System Developer's Guide-Designing and Optimizing Software"**, *Elsevier Publication*, (1st Edition), (2004).
2. Joseph Yiu, **"Definitive Guide to Arm Cortex-M23 and Cortex-M33 Processors"**, (1st Edition), (2020).

Reference Books:

1. Tammy Noergaard, **"Embedded Systems Architecture",** *Elsevier Publications*, (2nd Edition), (2004).
2. Dr. K. V. K. K. Prasad**, "Programming for embedded systems"**, *Wiley – Dreamtech India Pvt. Ltd*., (1st Edition), (2008).

Online Resources:

1. LPC 214x User manual (UM10139) :- www.nxp.com
2. LPC 17xx User manual (UM10360) :- www.nxp.com
3. ARM architecture reference manual: - www.arm.com
4. NPTEL course on, "**Embedded System Design with ARM",** https://onlinecourses.nptel.ac.in/noc20_cs15/preview
5. NPTEL course on, "**ARM based development",** https://nptel.ac.in/courses/117/106/117106111/

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20PEEC501A INFORMATION THEORY AND CODING TECHNIQUES

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite:20BSEC301 Calculus and Probability, 20BS01 Linear algebra and Univariate Calculus

Course Objectives:

1. To introduce the basic concepts of information theory
2. To demonstrate channel capacity for types of channels
3. To explain source coding techniques for data compression
4. To demonstrate the error detection and correction capability of block codes, cyclic codes, BCH, RS codes and Convolution codes

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

CO1 Explain and measure entropy, mutual information and channel capacity for Channel models
CO2 Apply Shannon-Fano, Huffman and Lempel-Ziv technique for data compression
CO3 Analyse Hamming distance, error-correcting and error detecting capability for block codes, cyclic codes, BCH, and RS codes
CO4 Design and apply convolution encoding and decoding for error correction

Unit I: Information Theory and Source Coding (08)
Introduction to information theory, Entropy and its properties, Discrete memoryless channels and Mutual information, Source coding theorem, Huffman coding, Shannon-Fano coding, Lempel-Ziv algorithm, Run Length Encoding, Arithmetic coding.

Unit II: Information Capacity and Channel Coding (08)
Channel capacity, Discrete memoryless channel, Channel coding theorem, Information capacity theorem, Linear Block codes: Matrix description, Error detection and correction capability, Encoding and decoding circuit, Single parity check codes, Repetition codes, Hamming code and Interleaved code.

Unit III: Cyclic Codes (08)
Galois field, Primitive element, Primitive polynomial, Minimal polynomial and generator polynomial, Cyclic Codes: Encoding for systematic and non-systematic cyclic code, Syndrome decoding of cyclic codes, Circuit implementation of cyclic codes.

Unit IV: BCH and RS Codes (09)
Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes.

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Unit V: Convolution Code **(09)**

Convolution code: Introduction of convolution code, Transform domain and Time domain approach, Graphical representation: State diagram, Tree diagram and Trellis diagram, Convolution decoding: Sequential and Viterbi.

Text Books:

1. Simon Haykin, Michael Moher, **"Communication Systems"**, *Wiley*, (5th Edition), (2009).
2. Ranjan Bose, **"Information Theory Coding and Cryptography"**, *Tata McGraw- Hill*, (3rd Edition), (2016).
3. Todd K. Moon, **"Error Correction Coding - Mathematical Methods and Algorithms"**, *John Wiley & Sons, Inc.***"**, (1stEdition), (2005)

Reference Books:

1. Bernard Sklar, **"Digital Communications fundamentals and Applications"**, *Prentice Hall P T R*, (2nd Edition), (2009).
2. Jorge Moreira, **"Patrick Farrell, "Essentials of Error-Control Coding"**, *John Wiley and Sons*, (1st Edition), (2006).

Online Resources:

1. NPTEL **"An introduction to Coding theory"**
   https://nptel.ac.in/courses/108/104/108104092/
2. NPTEL **"Error Control Coding: An Introduction to Convolutional Codes"**
   https://nptel.ac.in/courses/117/104/117104120/

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20PEEC501B MECHATRONICS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20ES 01Basic Electrical and Electronics, 20EC301Electronics Circuit and Applications

Course Objectives:

1. To discuss the concepts and key elements of Mechatronics system
2. To explain principles and characteristics of Sensors and Transducers
3. To describe working principle of Hydraulic and Pneumatic systems and its applications
4. To give example of applications of Mechatronics Systems

Course Outcomes:

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

CO1 Classify , Compare and Explain functionality of components used to develop Mechatronics systems
CO2 Select specific component such as sensors/transducers and actuators used to develop Mechatronics systems
CO3 Analyze performance, approaches, procedures and results related to components used in Mechatronics System
CO4 Design signal conditioning circuit from the given components for specific task
CO5 Interface Hydraulics and Pneumatics circuit from the given components for specific task
CO6 Design a Mechatronics system for a given task

Unit I: Elements of Mechatronics Systems (07)

Introduction to Mechatronics, Key element/components, Level of Mechatronics system, Phases of Mechatronics design process, Integrated design approach, Advantages, and Disadvantages of Mechatronics systems, Mechanical components: Cam, Gears, Gear-train, Servomechanism and its application.

Unit II: Sensors and Transducers (12)

Overview of Sensors and Transducers, Classification and their Characteristics, Temperature measurement using Thermistor, RTD, Themocouple, Semiconductor (AD590, LM35, LM75), Force and Pressure measurement using Strain gauge, Load Cell, Piezoelectric, Differential Pressure Sensor, Displacement and Position measurement using Potentiometer, LVDT, RVDT, Proximity, Optical Encoder, Ultrasonic transducer, LDR and IR Sensors, Level and Flow measurement using Float Level, Capacitive Level sensor, IR Level Sensor, Ultrasonic transducer, Turbine type and Ultrasonic transducer, Vibration and acceleration measurement using Piezoelectric accelerometer, MEMS ICs.

Unit III: Signal Conditioning (08)

Signal conditioning: its necessity, Amplification, Filtering and Impedance Matching, Protection, 4-20mA Transmitters and receivers. Design of signal conditioning circuits for sensors and transducers.

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Unit IV: Hydraulic and Pneumatic System (06)

Introduction to Hydraulic and Pneumatic Actuating system, Physical Components of Hydraulic and Pneumatic systems, Types of Actuators/Cylinders and their applications, Comparison of hydraulic and pneumatic systems, Pressure relief Valve, Pressure regulator valve and Directional Control Valve.

Unit V: Electric Actuators (05)

Selection criteria and specifications of stepper motors, DC motors, Servomotors, Solenoid valves, Solid State relays and Electromechanical relays, Electro-Pneumatic and Electro-Hydraulics Directional Control Valve, Driving circuit for electric actuators and interfacing with microcontrollers.

Unit VI: Mechatronics Systems Applications (04)

Mechatronics Systems in Automobile, Engine Management systems, Antilock Brake systems (ABS), Washing machine, Pick and place robot, Mobile robot, and Case studies on real life application.

Text Books:

1. Bolton W., **"Mechatronics - Electronic systems in Mechanical and Electrical Engineering"**, *Pearson Education Ltd.*, (6th Edition), (2016).
2. K. P. Ramachandran, G. K. Vijayaraghavan and M.S. Balasundaram, **"Mechatronics-Integrated Mechanical Electronic Systems"**, *Wiley Publication*, (1st Edition), (2008).
3. David Alciatore and Maichael B. Histand, **"Introduction to Mechatronics and Measurement Systems"**, *Tata McGraw Hill*, (4th Edition), (2013).

Reference Books:

1. Doeblin E.O., **"Measurement System-Application and Design",** *Tata McGraw Hill, New Delhi*,(4th Edition), (2004)
2. Mahalik N. P., **"Mechatronics - Principles, Concepts and Applications",** *Tata McGraw Hill, New Delhi*, (2th Edition), (2014)

Online Resources:

1. **NPTEL Course "Mechatronics"**
   http://nptel.ac.in/courses/112103174/
2. **NPTEL Course " Mechatronics"**
   https://nptel.ac.in/courses/112/107/112107298/

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20PEEC501C DIGITAL IMAGE PROCESSING

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20BSEC301 Calculus and Probability. 20EC302 Signals and Systems.

Course Objectives:

1. To understand the basic concepts of image processing like relations between pixels, distance measures, statistical parameters, colour models, noise models and operations on images
2. To study different image enhancement, segmentation, representation and restoration techniques
3. To study image analysis in spatial and transform domains for image compression and filtering
4. To study different applications of Image processing

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain basic concepts of image processing, transform domain filtering, image restoration, color models and compression basics
CO2 Compute distance measures and perform arithmetic, logical, geometric, set and spatial transformation operations on images
CO3 Apply and analyze spatial domain image enhancement and compression techniques
CO4 Perform image representation, image segmentation and image classification techniques
CO5 Apply morphological operations on an image and select appropriate image processing modules to develop an image processing application

Unit I: Digital Image Fundamentals and Operations on Images (08)

Components of Image Processing System, Basic image processing classes, Element of Visual Perception, Sampling and Quantization, Relationship between pixels and Distance Measures, Statistical parameters, Basic operations on images, Morphological image processing, dilation, erosion, opening, closing.

Unit II: Image Enhancement (09)

Image Enhancement in Spatial Domain, Point, mask and global operations, Basic Gray Level transformations, Histogram, histogram equalization, Basics of Spatial Filtering, Smoothing, linear and non-linear filters, Sharpening filters, First and Second order derivatives, Image filtering in Frequency Domain, Low pass, High pass, Correspondence between Filtering in Spatial and Frequency Domain.

Unit III: Image Transforms and Colour Models (08)

Colour Image Processing, Colour Fundamentals, Colour Models, Pseudocolouring, Converting Colours to different models, Need for compression, Data Redundancies, Image Compression Model, Lossy and Lossless compression, 2-D Discrete Fourier Transform, Discrete Cosine Transform, JPEG compression.

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Unit IV: Image Segmentation, Representation and Classification (09)

Image analysis, Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, image representation, boundary representation by chain codes, Fourier descriptors, Shape number, Signatures, Types of classification algorithms, K-Nearest Neighbours, K-means, Decision Tree.

Unit V: Image Restoration and Applications of Image Processing (08)

Image restoration, Restoration model, Degradation causes, Noise models, Inverse filter, Weiner filter, Fingerprint recognition, Character recognition, Face recognition, Medical applications, Remote sensing, CBIR.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "**Applications of Image Processing and Morphological Image Processing**", *Pearson Education*, (2nd Edition), (2012).
2. S. Jayaraman, Esakkirajan, Veerakumar, **"Digital Image Processing"**, *McGraw Hill Education*, (1st Edition,), (2012).

Reference Books:

1. Anil Jain, **"Fundamentals of Digital Image Processing"**, *Prentice Hall*, (1st Edition), (1989).
2. Pratt W. K**, "Digital Image Processing",** *John Wiley*, (2nd Edition), (2001).

Online Resources:

1. **NPTEL Course "Digital Image Processing"**
   http://nptel.ac.in/courses/117/105/117105135/
2. **NPTEL Course " Digital Image Processing"**
   https://nptel.ac.in/courses/117/105/117105079/

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20PEEC501D INTRODUCTION TO INTERNET OF THINGS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC404 Embedded Systems

Course Objectives:
1. To explore various components of Internet of Things such as Sensors, internetworking and cyber space
2. To design Internet of Things circuits and solutions

Course Outcomes:
After completion of the course, students will be able to
CO1 Apply concepts to explain Internet of Things (IoT) architecture, protocols, models and devices used to develop IoT systems
CO2 Identify appropriate protocols, models and devices to develop IoT system
CO3 Compare and contrast IoT and M2M, IoT physical devices, networking and protocols techniques
CO4 Design IoT system for the given application

Unit I: Introduction to Internet of Things (07)
Internet of Things fundamentals: Sensing, Actuation, Internet of Things (IOT) Architecture and protocols: Communication Protocols, Sensor Networks, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Challenges in IOT, Communication models and APIs; IoT Enabling Technologies.

Unit II: Machine to Machine to Internet of Things (08)
The Vision-Introduction, From machine to machine (M2M) to Internet of Things (IoT), M2M towards IoT-the global context, Case study, Differing characteristics between M2M and IoT, Definitions, M2M Value Chains, Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards consideration, IoT Value Chains, Industrial IoT (IIoT).

Unit III: IOT Physical Devices and Objects (08)
Introduction to IoT tools, Implementation of IoT with Arduino and Raspberry-Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Unit IV: IOT Networking and Addressing techniques (07)
RFID technology, Wireless Sensor Networks, IPv6 Protocol Overview, comparison of IPv4 and IPv6, IPV6 tunneling, IPsec in IPv6, Quality of Service in IPv6

Unit V: IOT Protocols and Cloud offerings (07)
IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN, MQTT protocol, Introduction to cloud storage models and communication API's, web services for IoT.

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Unit VI: Domain Specific Applications of Internet of Things (05)

Home automation - hardware approach - Industry applications, Surveillance applications.

Text Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, **"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",** *Academic Press*, (1st Edition), (2014).
2. Vijay Madisetti and Arshdeep Bahga, **"Internet of Things (A Hands-on-Approach)",** *VPT* , (1st Edition), (2014).
3. Francis da Costa, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** *Apress Publications*, (1st Edition), (2013).
4. Cuno Pfister, "**Getting Started with the Internet of Things**", *O'Reilly Media*, (1st Edition), (2011).

Reference Books:

1. Honbo Zhou, **"The Internet of Things in the Cloud: A Middleware Perspective",** *CRC Press*, (1st Edition), (2012)
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), **"Architecting the Internet of Things",** *Springer*, (1st Edition), (2011)
3. Olivier Hersent, David Boswarthick, Omar Elloumi , **"The Internet of Things – Key Applications and Protocols",** (1st Edition), *Wiley*, (2012)

Online Resources:

1. NPTEL Course "**Introduction to IOT"**
   https://nptel.ac.in/courses/106/105/106105166/

MKSSS'S CUMMINS COLLEGE OF ENGG FOR WOMEN KARVENAGAR PUNE-52.

20EC501L DIGITAL SIGNAL PROCESSING LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Oral: 25 Marks
Credits: 1

Course Objectives:

1. To apply sampling theorem on CT signals to find DT signals
2. To interpret the spectral representation of signals
3. To verify digital filter design and its performance
4. To perform sampling rate conversion on DT signals
5. To build programming skills for performing signal processing operations

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply sampling theorem and select the appropriate sampling to avoid aliasing
CO2 Develop programs to implement DFT and convolution operation
CO3 Analyze spectral representation of signals and window functions
CO4 Simulate the design of digital filters for given specifications, verify with theoretical results and analyze finite word length effects on design of digital filters
CO5 Demonstrate effect of sampling rate conversion

List of Experiments:

1. Verify sampling theorem and study aliasing effects.
2. Implement a function to find the DFT of a discrete time sequence.
3. Compute linear and circular convolution between sequences.
4. Analyze characteristics of different window functions.
5. Design FIR filter (LP/HP/BP/BS) for the given specifications using windowing method.
6. Design Butterworth filter using impulse invariance/bilinear transformation method.
7. Analyze effects of finite word length on performance of digital filters.
8. Apply sampling rate conversion (up-sampling/down-sampling) on discrete time signals and analyze the time and frequency domain effects.

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20EC502L VLSI DESIGN LAB

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objective

1. To explore HDL based design approach
2. To simulate, synthesize and prototype design using PLD
3. To elaborate CMOS logic based design approach
4. To prepare layout using suitable CMOS process
5. To verify the DRC and simulate the layout for different performance parameter

Course Outcomes

After completion of the course, students will be able to

CO1 Model and simulate digital systems using Verilog HDL
CO2 Implement digital systems using suitable PLD
CO3 Design CMOS layout for given digital logic
CO4 Apply lambda rules to verify the designed layout

List of Experiments:

1. Model a Combinational circuit using Verilog HDL and implement it using PLD.
2. Model a Sequential circuit using Verilog HDL and implement it using PLD.
3. Model SRAM / FIFO using Verilog HDL and implement it using PLD.
4. Write a Verilog Code for LCD and interface it with PLD.
5. Design a layout for Inverter and Universal logic gates using selected CMOS technology.
6. Design a layout for Multiplexer using selected CMOS technology.
7. Design a layout for Boolean expression selected CMOS technology.
8. Design a layout for 1-bit RAM cell using selected CMOS technology.
9. Open Ended Assignment

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20EC503L ADVANCED PROCESSOR LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
ISE: 25 Marks
Practical :25 Marks
Credits: 2

Course Objective

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore cortex-based card size hardware system
5. To explore multicore programming

Course Outcomes:

After completion of the course, students will be able to

CO1	Apply software development tools for embedded processor based applications.
CO2	Develop algorithm and test program for on chip peripherals.
CO3	Develop algorithm and test program for externally interfaced peripheral devices.
CO4	Develop an Embedded application using simulation tool

List of Experiments:

1	Introduction to ARM development board and KEIL Micro vision - 5 IDE development tools.
2	Write a program to flash LEDs interfaced to GPIO.
3	Write a program to receive and transmit data on serial communication.
4	Interface GSM with ARM processor for sending and receiving messages, call connection.
5	Interface GPS to ARM processor and extract Latitude and Longitude from the string.
6	Write a program to generate waveform using on chip DAC.
7	Interface GLCD module to GPIO of ARM processor and write a program to display images.
8	Interface sensor to ADC and write a program to display calibrated data on LCD as well as serial port.
9	Write a program to toggle GPIO port with fixed time interval using on chip timer (without interrupt).
10	Write a program to toggle GPIO port with fixed time interval using on chip timer (with interrupt).
11	Install OS in Raspberry Pi. Write C Program and compile using GCC.
12	Interface LCD to Raspberry Pi.
13	Interface camera and write program to capture images and create video. OR Multi-core programming in Raspberry Pi.
14	Open ended assignment *

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20EC504L MINI PROJECT

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objectives:

1. Explain the Product Development Cycle through the mini project
2. Inculcate electronic hardware implementation skills by:
   a) Learning PCB artwork design using an appropriate EDA tool
   b) Learning soldering and effective trouble-shooting practices
   c) Understanding the significance of aesthetics and ergonomics while designing electronic products
3. Demonstration and Technical documentation of mini project in a team

Course Outcomes:

After completion of the course, students will be able to,

CO1	Identify and formulate a real life problem statement
CO2	Select an appropriate methodology to solve the identified problem
CO3	Design and validate the solution by using EDA tools
CO4	Estimate the time and cost budget required for developing the working model
CO5	Build a working model by analyzing / troubleshooting and testing the circuit in a team.
CO6	Draft a technical report, deliver a seminar and demonstrate/discuss the working model in a team

Guidelines:

1. Project group shall consist of not more than 3 students per group.
2. Project design ideas should be adopted from recent society/community based issues.
3. Application notes from well known component manufacturers may also be referred for designing.
4. Hardware components are mandatory.
5. Layout versus schematic verification is mandatory.
6. **Engineering Design Consideration(s) should be from one of these areas**:-

- Societal
- Environmental
- Ethical
- Health/Safety

Sustainability

Domains for projects may be from the following, but not limited to:

- Electronic Communication Systems
- Power Electronics
- Biomedical Electronics
- Audio, Video Systems
- Mechatronics Systems
- Embedded Systems
- Instrumentation and Control

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Monitoring: (for students and teachers both)

Suggested Plan for various activities to be monitored by the teacher.

** Formation of groups of students. Students should interact with the community/stakeholders to Identify the problem statements.

Text Books:

1. Thomas C Hayes, Paul Horowitz, **"The Art of Electronics"**, *Cambridge University Press*, (3rd Edition), (2015).
2. Jim Williams, **"Analog Circuit Design: Art, Science and Personalities"**, *EDN series for Design Engineers*, (1st Edition), (2013).
3. M. Ashraf Rizvi, **" Effective Technical Communication"** ,*Tata McGraw Hill Education Pvt. Ltd.*, (1st Edition), (2005).

Reference Books:

1. A.E. Ward, Angus, **"Electronic Product Design",** *Stanley Thorne Publishers, UK*, (1st Edition) (1996).
2. Meenakshi Raman, Sangeeta Sharma, **"Technical Communication, Principles and Practice"**, *Oxford University Press*, (2nd Edition), (2012).
3. C. Murlikrishna, Sunita Mishra, **"Communication Skills for Engineers"**, *Pearson Education India*, (2nd Edition), (2011).
4. Kim Fowler, **"Electronic Instrument Design"**, *Oxford University Press*, (1st Edition), (2015).
5. Kimmo Karvinen and Tero Karvinen,**"Make: Arduino Bots and Gadgets",** *O' Reilly Media, Inc.*, (1st Edition), (2011).

Online Resources:

1. https://www.electronicsforu.com/
2. https://circuitcellar.com/category/article-materials-and-resources/
3. http://www.edn.com
4. Application notes of IC manufacturers

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20PEEC501LA INFORMATION THEORY AND CODING TECHNIQUES LAB

Teaching Scheme

Practical: 2 Hours / Week

Examination Scheme

In Semester: 25 Marks
Practical :25 Marks
Credits: 1

Course Objectives:

1. To determine entropy and channel capacity of noisy and noiseless channel
2. To explore source coding techniques for data compression
3. To develop the error detection and correction capability of block codes, cyclic codes, BCH, and RS codes.
4. To understand encoding and decoding of convolution codes

Course Outcomes:

After completion of the course, students will be able to

CO1 Develop program to calculate entropy, mutual information and channel capacity of noisy and noiseless channel
CO2 Develop program for source coding techniques for data compression
CO3 Develop program for error detection and correction linear block codes and cyclic codes
CO4 Develop program for channel performance improvement against burst errors with BCH codes
CO5 Simulate convolution encoding and decoding for error correction
CO6 Implementation of encoding and decoding of real life signals

List of Experiments:

1. Write a program for determination of various entropies, mutual information and compare channel capacity of channel Noise free channel, Binary symmetric channel and Noisy channel. (Programming in C)
2. Write a program for generation and evaluation of variable length source coding using Shannon – Fano coding and decoding / Huffman Coding and decoding / Lempel Ziv Coding and decoding
3. Implement algorithms for coding and decoding of Linear Block Code (LBC).
4. Implement algorithms for coding and decoding of Cyclic Codes.
5. Implement algorithms for Encoding with Convolution codes.
6. Implement algorithms for decoding of convolution codes.
7. Implement algorithms for encoding of BCH (Bose-Chaudhuri Hocquenghem) algorithm.
8. Mini project: Implementation of algorithms for encoding and decoding of real life signals

Note: - 3 to 7 simulation using MATLAB

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20PEEC501LB MECHATRONICS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester : 25 Marks
Practical:25 Marks
Credits: 1

Course Objectives:

1. To Measure displacement, velocity, liquid level, liquid flow using sensors
2. To identify and interface components of electro-hydraulic/electro-pneumatic and hydraulic/pneumatic systems
3. To explore real life application of Mechatronics Systems

Course Outcomes:

After completion of the course, students will be able to

CO1 Measure load, velocity, flow and level using analog and digital sensors
CO2 Analyze characteristic and performance of sensors and actuators
CO3 Interface components of electro-hydraulic/electro-pneumatic and hydraulic/pneumatic to build circuits
CO4 Develop and demonstrate application of Mechatronics system using suitable hardware

List of Experiments:

1. Weight measurement using Load Cell.
2. Velocity and Angular Displacement measurement using optical encoder.
3. Liquid flow measurement using Turbine flow sensor.
4. Liquid level measurement using capacitance sensor.
5. Design of Signal Conditioning Circuit for Load Cell
6. Design 4 to 20mA current transmitter.
7. Interface hydraulic/ electro - hydraulic system component to actuate single acting and double acting cylinders.
8. Interface pneumatic/ electro-pneumatic system component to actuate single acting and double acting cylinders.
9. Design Mechatronics system for any application.

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20PEEC501LC DIGITAL IMAGE PROCESSING LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical :25 Marks
Credits: 1

Course Objective

1. To practice the basic image processing techniques
2. To explore digital image enhancement techniques in spatial and transform domain
3. To understand image compression, colour model conversions, segmentation and restoration techniques
4. To explore the applications using image processing techniques

Course Outcome

After completion of the course, students will be able to

CO1 Perform basic operations and computations on images
CO2 Implement algorithms for image enhancement and image filtering
CO3 Perform image compression and colour model conversion
CO4 Apply image segmentation and restoration techniques
CO5 Develop an algorithm/application using various image processing techniques

List of Experiments: Matlab/Python

1. Perform basic operations on images (Create image/ operations/ distance measures).
2. Perform a) Histogram equalization b) Spatial domain filtering.
3. Perform a) DCT of an image b) Colour model conversion.
4. Perform Image segmentation (thresholding/region based) techniques
5. Perform Morphological operations on images / Wiener filtering.
6. Implement a Mini project (Application/algorithm) in image processing.

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20EC501LD INTRODUCTION TO IOT LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
Practical:25 Marks
Credits: 1

Course Objectives

1. To learn use of sensors and actuators in IOT
2. To learn IOT devices and protocols
3. To build an IOT application

Course Outcome

After completion of the course, students will be able to

CO1 Select sensors and actuators in IOT application
CO2 Interface sensors and actuators with IoT development module
CO3 Develop a program to monitor and control by using web server
CO4 Develop an IOT system for given application

List of Experiments:

1. Introduction to various sensors and various actuators & its Application.
   a) PIR Motion Sensor.
   b) Float Sensor.
   c) Moisture Sensor.
   d) Temperature Sensor.
   e) Touch Sensor.
   f) Infrared Sensor.
   g) Servo Motor
   h) RFID Sensor
   i) Humidity sensor
2. Introduction to ESP32 and Arduino IDE/Visual Studio Code.
3. Write a program to measure sensor data and display on serial monitor.
4. Write a program to control Actuators.
5. Write a program to control Actuators based on real time sensor data.
6. Implement a standalone web server using of ESP32.
7. Develop a web application through ESP32.
8. Mini Project: Develop an IoT system for given application.

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MKSSS's Cummins College of Engineering for Women, Pune
(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Autonomous Program Structure of Third Year B. Tech. Sixth Semester (Electronics and Telecommunication Engineering) Academic Year: 2022-2023 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20EC601	Wave Theory and Antenna	3	1	0	50	50	0	0	100	4
20EC602	Computer Networks and Security	3	0	0	50	50	0	0	100	3
20EC603	Control Systems	3	1	0	50	50	0	0	100	4
20HS601	Management for Engineers	3	0	0	50	50	0	0	100	3
20PEEC601	Programme Elective-III	3	0	0	50	50	0	0	100	3
20OE601	Open Elective-II	3	0	0	50	50	0	0	100	3
20EC602L	Computer Networks and Security Lab	0	0	2	25	0	25	0	50	1
20PEEC601L	Programme Elective-III Lab	0	0	2	25	0	0	25	50	1
	Total	18	2	4	350	300	25	25	700	22
	Grand Total	**24**			**650**		**50**			

Programme Elective-III			Programme Elective-III Lab		
Sr. No.	Course Code	Course Title	Sr. No.	Course Code	Course Title
1	20PEEC601A	Robotics	1	20PEEC601LA	Robotics Lab
2	20PEEC601B	Biomedical Electronics	2	20PEEC601LB	Biomedical Electronics Lab
3	20PEEC601C	Power Electronics	3	20PEEC601LB	Power Electronics Lab
4	20PEEC601D	Deep Learning	4	20PEEC601LD	Deep Learning Lab

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
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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

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20EC601 WAVE THEORY AND ANTENNA

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

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

Prerequisite:20ES01 Basic Electrical and Electronics Engineering, 20BSEC301 Calculus and Probability

Course Objectives:
1. To study Electrostatic and Magnetostatic laws
2. To study Maxwell's equations and wave propagation in different media
3. To explain transmission line fundamentals and apply them to solve the problems using Smith chart
4. To study antenna fundamentals and analyze different types of antennas and antenna arrays

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

CO1	Apply the relevant laws for solving the problems of Electrostatics and Magnetostatics
CO2	Interpret Maxwell's equations for static and dynamic field and calculate the average power of Electromagnetic wave using Poynting theorem
CO3	Formulate the wave equation and solve it for uniform plane wave
CO4	Determine transmission line parameters using Smith chart
CO5	Analyze wire antenna and antenna arrays and identify the suitable antenna for a given communication system

Unit I: Fundamentals of Electrostatics and Magnetostatics (09)
Coulomb's law and Electric field intensity, Electric flux and flux density, Types of charge distributions and their Electric field, Gauss's law, Biot Savart law, Ampere Circuital law, Magnetic field intensity and flux density, Boundary conditions.

Unit II: Electromagnetic Waves (09)
Faraday's law, Maxwell Equations in point form and integral form, Wave Equation, Uniform Plane wavesin free space, dielectric, and conducting medium, Linear, Circular & Elliptical polarization, Reflection of plane waves, Normal incidence, Oblique incidence, Electromagnetic power and Poynting vector.

Unit III: Transmission Lines (08)
Types of transmission lines, Dissipation less line, Voltage and Current on a transmission line, Input impedance, Open and short-circuited transmission line, Impedance mismatch, Standing waves, EMI, EMC, Smith chart and applications.

Unit IV: Wire Antennas and Antenna Arrays (10)
Antenna fundamentals, Types of antennas, Near and far field, Radiation mechanism, Antenna parameters, Infinitesimal dipole, Small dipole, Finite length dipole, Half wavelength dipole, Small circular loop antenna, Antenna arrays, Two element array, Array factor, Pattern multiplication, N-element linear array: Uniform amplitude and spacing, Broad side and End-fire array, N-element linear array: Non-uniform amplitude and uniform spacing, Binomial and Dolph Chebyshev-array.

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Unit V: LF to SHF Antennas (06)

Hertz & Marconi antennas, electrically short antennas, Beverage antenna, medium frequency antennas, Resonant & non-resonant antennas, VAntenna, Rhombic antenna, TW antennas, Loop antenna, Ferrite rod antenna, Whip antenna, Yagi Uda, Helical, Horn, Parabolic reflector, Microstrip patch antenna.

Text Books:

1. Mathew N. O Sadiku**, "Principles of Electromagnetics",** *Oxford University Press*, (4th Edition), (2009).
2. C.A. Balanis**, "Antenna Theory- Analysis and Design",** *John Wiley*, (4th Edition), (2016).

Reference Books:

1. John D Kraus, Ronald J Marhefka, Ahmad S Khan, **"Antennas for All Applications"**, *The McGraw Hill Companies*, (5rd Edition), (2017).
2. K. D. Prasad, **"Antenna and Wave Propagation"**, *Satya Prakashan New Delhi*, (2014).
3. John D Kraus, **"Antenna & Wave Propagation",** *McGraw Hill*, (4th Edition),(2010).

Online Resources:

1. Nptel Course **"Electromagnetic Theory**" https://nptel.ac.in/courses/108/104/108104087/
2. Nptel Course **"Antennas"** https://onlinecourses.nptel.ac.in/noc20_ee20/preview

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20EC602 COMPUTER NETWORKS AND SECURITY

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC401 Digital Electronics

Course Objectives:
1. To introduce network models and functions of each layer
2. To introduce networking protocols, architectures, and applications
3. To describe basic concepts of the threats for data and network and security mechanism
4. To provide theoretical and practical base regarding computer networks issues
5. To outline the basic network configurations

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain the principles of computer networking
CO2 Analyze networking protocols, inter-networking devices and their functions
CO3 Illustrate computer network applications based on Client-Server architecture
CO4 Identify the threats to the data and network and apply techniques to resolve them

Unit I: Physical Layer and Data Link Layer (10)
Networks models: OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Network performance measurement criterion, Data link control: Framing, Flow Control (Stop and Wait and Sliding Window Protocols), Error control (CRC), HDLC and PPP, Multiple access: Random access (Aloha, CSMA, CSMA/CD, CSMA/CA) protocols.

Unit II: Wired and Wireless LANS (07)
Wired LANS: Ethernet (IEEE 802.3), Ethernet standards (Ethernet, Fast Ethernet and Gigabit Ethernet) Wireless LANS: IEEE 802.11, Bluetooth IEEE 802.15, Connecting LANS, Connecting devices, VLAN, VxLANs, Ultra Wide Band.

Unit III: Network Layer (09)
Network layer functions, Logical addressing: IPv4, IPv6 addresses, IPv4 to IPv6 conversion , Unicast routing algorithms, Routers, L3 Switches, Network layer Protocols: ARP, RARP, ICMP and IGMP, Software Defined Networking.

Unit IV: Transport layer and Application Layer (08)
Process to Process Communication, Addressing, Transport layer protocols: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Stream Control Transport Protocol (SCTP), Quality of service (QoS): data flow characteristics, Internet Applications and protocols: Domain Name System (DNS), E-mail, FTP, HTTP.

Unit V: Data Security and Network Security (08)
Security goals, Attacks and Defense strategies, Cryptography: Substitution cipher, DES, AES and RSA algorithms, Digital signatures, Authentication protocols: One-Way Authentication, Dictionary Attacks, Network, Transport and application layer security, Attacks: DoS and DDoS, Session Hijacking and Spoofing, ARP Spoofing and Attacks on DNS, Viruses, Worms and Malware, Virus and Worm Features.

Text Books:

1. Behrouz A. Forouzan, **"Data Communication and Networking"**, *Tata McGraw-Hill*, (5th Edition), (2013).
2. Andrew S. Tannenbaum, **"Computer Networks",** *Pearson Education*, (4th Edition), (2003).
3. William Stallings**, "Cryptography and Network Security Principles and Practice"**, *Pearson Education,* (7th Edition), (2017).
4. Srilatha Vemula, Jason Gooley, Roddie Hasan, "**Cisco Software-Defined Access**" *Cisco Press* (1st Edition), (2020).

Reference Books:

1. Wayne Tomasi, **"Introduction to Data Communication and Networking"**, *Pearson Education*, (1st Edition), (2007).
2. James. F. Kurose and W. Ross, **"Computer Networking: A Top down Approach"**, Pearson *Education*, (3rd Edition), (2007).
3. Faranak Nekoogar, **"Ultra-Wideband Communications: Fundamentals and Applications"** Pearson *Education*, (1st Edition), (2005).
4. William Stallings, **"Data and Computer Communication"**, *Pearson Education*, (8th Edition), (2000).
5. Greg Tomsho, Ed Tittel, David Johnson, **"Guide to Networking Essentials"**, Thomson *India Learning*, (5th Edition), (2007).

Online Resources:

1. **NPTEL Course "Computer Networks"** https://nptel.ac.in/courses/106105081/
2. **NPTEL Course "Cryptography and Network Security"**https://nptel.ac.in/courses/106105031/
3. Yusnita Rahayu; Tharek Abd. Rahman; Razali Ngah, **"Ultra wideband technology and its applications"**in International Conf.on Wireless and Optical Communications Networks (WOCN '08).IEEE
4. **Software-defined networking: The new norm for networks**,Oct. 2012,[online] Available: https://www.opennetworking.org/images/stories/downloads/s_dne resources/white-papers/wp-sdn-newnorm.pdf.

20EC603 CONTROL SYSTEMS

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

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

Prerequisite: 20BSEC301 Calculus and Probability, 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1. To explain the components and types of control systems
2. To find response of first order and second order systems using standard input signals
3. To analyze feedback control system stability in time domain using Routh-Hurwitz criterion and Root Locus technique
4. To analyze feedback control system stability in frequency domain using Bode and Nyquist plot
5. To explain state space approach for control system analysis
6. To explain various types of controllers

Course Outcomes:

After completion of the course, students will be able to

CO1 Classify and explain different systems, interpret transfer function of physical components and construct system transfer function
CO2 Determine and analyze system response to find time and frequency domain specifications and steady state error
CO3 Examine system stability in time domain and in frequency domain
CO4 Examine the stability of system by plotting Root Locus, Bode and Nyquist plots
CO5 Analyze control system using state space approach
CO6 Apply controlling (P, D, I, PID) actions and determine its effect on various system parameters

Unit I: Control System Modeling (08)

Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph.

Unit II: Time Response Analysis (07)

Standard input signals, Time response analysis of First Order Systems, Time response analysis of Second Order Systems, Effect of ξ on Second Order System performance, Steady state errors and error constants, design specifications for Second Order Systems.

Unit III: Stability Analysis (07)

Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, Construction of Root Locus.

Unit IV: Frequency Response Analysis (08)

Frequency domain Versus Time domain analysis and its correlation, Bode Plots, Polar Plots and development of Nyquist Plots, Frequency domain specifications from the plots, Stability analysis from plots.

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Unit V: State Variable Analysis (07)

State space advantages and representation, Transfer function from State space, Physical variable form, Phase variable forms: Controllable canonical form, Observable canonical form, Solution of homogeneous state equations, State transition matrix and its properties, Computation of state transition matrix by Laplace transform method only, Concepts of Controllability and Observability.

Unit VI: Introduction to Controllers (05)

Classification of controllers, Introduction to P, D, I and PID controllers, Response of controllers to standard inputs, Determine effects of controlling action on various system parameters.

Text Books:

1. I. J. Nagrath, M. Gopal, **"Control Systems Engineering"**, *New Age International Publishers*, New Delhi, (5th Edition), (2007).
2. Katsuhiko Ogata, **"Modern Control Engineering"**, *PHI Learning Private Limited, New Delhi*, (5th Edition), (2010).

Reference Books:

1. B. C. Kuo, **"Digital Control Systems"**, *Oxford University Press, New York*, (2nd Edition), (1992).
2. Richard C. Drof, Robert N. Bishop, **"Modern Control Systems"**, *Addison Wesley Pub.Company*, (1st Edition), (2001).
3. C. D. Johnson, **"Process Control Instrumentation Technology"**, *Pearson Pub*, (6th Edition), (2006).

Online Resources:

1. NPTEL Course "Control Engineering"
   http://nptel.ac.in/courses/108101037/1

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20HS601 MANAGEMENT FOR ENGINEERS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: Nil

Course Objectives:
1. To develop understanding about the basics of management functions
2. To explain the concept of total quality management
3. To analyze cost and financial aspect of the business
4. To develop the strategic thinking and decision making abilities in the rapidly changing global business environment

Course Outcomes:
After completion of the course, students will be able to
1. Explain the principles and functions of management
2. Identify social responsibility and ethical issues involved in the Organization
3. Apply tools of quality management
4. Analyze the cost, financial aspects of business and the need of globalization

Unit I: Basics of Management (08)
Introduction, Definition of management, characteristics of management, functions of management: Planning, Organizing, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision making.

Unit II: Organizational Environments and Cultures (06)
External environments, Internal environments, Ethics and social responsibility.

Unit III: Quality Management (10)
Definition of quality, continuous improvement definition of quality, types of quality, quality of design, conformance and performance, phases of quality management, Quality Management Assistance Tools: Ishikawa diagram, Pareto Analysis, Pokka Yoke (Mi stake Proofing), Quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management, The ISO 9001:2015, Quality Management System Standard, Software quality management with respect to CMM level and ISO standard.

Unit IV: Cost and Financial Accounting (10)
Basic concepts of cost accounting, Classification and analysis of costs, Marginal costing, Break-even point, Cost Volume Profit analysis, key financial statements, financial analysis.

Unit V: Globalization (06)
Global trends and commerce, new opportunities offered by globalization, preparation for globalization, globalization drivers, implementation issues related to globalization, quality of global leadership.

Text Books:
1. Stephen P. Robbins, Mary Coulter, **"Management",** *Prentice Hall of India,* (8th Edition), (2014).
2. Charles W.L Hill, Steven L McShane, **"Principles of Management",** *McGraw Hill*

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Education, Special Indian Edition, (2007).

Reference Books:

1. Freeman-Bell, James Balkwill, **"Management in Engineering",** *Prentice Hall of India*, (2^{nd} Edition), (2005).
2. T. R. Banga, S.C. Sharma, **"Industrial organization and Engineering Economic",** *PHI Publication*, (25^{rd} Edition), (2002).
3. M.C. Shukla, **"Business Organization and Management",** *PHI Publication*, (2^{rd} Edition), (2002).
4. C. M. Chang, **"Engineering Management: meeting the Global Challenges",** Publisher: *CRC Press*, (2016).

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20PEEC601A ROBOTICS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20BS01Linear Algebra and Univariate Calculus, 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:

1. To explain fundamentals of robotic system
2. To introduce kinematics, dynamics and control for robotics systems
3. To introduce trajectory planning for motion
4. To describe application of robots in automation

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

CO1	Classify, Compare and Explain functionality of components used to develop robots
CO2	Select sensors, actuators and grippers for developing robots.
CO3	Apply formulations to obtain kinematics, dynamics and trajectory planning of manipulator
CO4	Explain path planning algorithms for robotic system
CO5	Analyze components, robot mechanics and algorithm used to develop robots
CO6	Build a Robotic system to perform a given task.

Unit I: Introduction to Robotics (06)
Definition of robotics, Components of Robot system, Classification of robots based on co-ordinate systems, Degrees of freedom, Links and Joints, Robot Specifications

Unit II: Robotic Sensors, Actuators and End Effectors (10)
Classification of sensors, Internal and External sensors, Position, Acceleration sensors, Proximity, Velocity sensors, Force sensors, Tactile sensor, Camera and Robot vision, Overview of actuators: Electric, Pneumatic and Hydraulic actuators, Classification of End Effectors and Types of Gripper.

Unit III: Transforms and Kinematics (07)
Pose of rigid body, Position and orientation description, Coordinate transforms, Homogeneous transform, Denavit and Hartenberg (DH) parameters, Forward and Inverse Kinematic Analysis.

Unit IV: Dynamics and Trajectory (07)
Dynamics and Inverse Dynamics of robots, Link inertia tensor and manipulator inertia tensor, Newton – Eller formulation. Trajectory planning, Joint space planning, Cartesian space planning and Position and Orientation trajectories.

Unit V: Robot Programming Methods (08)
Robot language classification, Robot language structure, Online and Offline Programming, Line Following Algorithms, Robot Navigation, Path planning algorithms based on Simultaneous Localization and Mapping (SLAM) algorithm.

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Unit VI: Application of Robot in Automation **(04)**

Application in Manufacturing: Material Transfer, Material handling, loading and unloading processing, spot and continuous arc welding & spray painting, Robot application in Medical, Progressive advancements in robots, Present trends and future trends in robotics.

Text Books:

1. S.K. Saha, **"Introduction to Robotics",** *Tata McGraw Hill*, (2nd Edition), (2014).
2. R. K. Mittal, I. J. Nagrath**, "Robotics and Control",** *Tata McGraw Hill, New Delhi"*, (1st Edition), (2003).
3. K.S. Fu, R.C .Gonzalez, C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence",** *Tata McGraw Hill* **,** (2nd Edition), (2008).
4. R. Siegwart, I. R. Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, *The MIT Press*, (2nd Edition), (2011).

Reference Books:

1. Robert Schilling, **"Fundamentals of Robotics: Analysis and Control",** *PHI. New Delhi*, (1st Edition), (2003).
2. S. R. Deb**, "Robotics Technology and Flexible Automation",** S. Deb, Tata McGraw Hill, (1st Edition), (2010).
3. Francis X. Govers, **"Artificial Intelligence for Robotics",** *Packt Publishing Ltd., United Kingdom*, (1st Edition), (2018).

Online Resources:

1. **NPTEL Course " Mechanics and Control of Robot Manipulator"**https://onlinecourses.nptel.ac.in/noc21_me108/
2. NPTEL Course **" Wheeled Mobile Robot"** https://nptel.ac.in/courses/112/106/112106298/

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20PEEC601B BIOMEDICAL ELECTRONICS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC302Signals and systems, 20EC404Embedded Systems, 20EC302Digital signal processing

Course Objectives:

1. To explain and analyse important organ systems in a human body
2. To understand different diagnostic and lifesaving biomedical equipment
3. To introduce AI/ML techniques used in Biomedical Applications
4. To explore signal conditioning and processing system for real life biosignals

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain and analyse important organ systems in a human body
CO2 Compare different diagnostic and lifesaving biomedical equipment
CO3 Develop a signal conditioning and processing system for real life biosignals
CO4 Select the appropriate AI/ML techniques for Reference biomedical signals

Unit I: Human Anatomy and Biomedical Electronic System (04)

Organ systems: Cardiovascular System, Nervous System and Respiratory System, Cell, Nerve cell, Action Potential, Introduction to Biomedical Electronics system, its advantages and applications.

Unit II: Biomedical Sensors, Signal Acquisition and Processing (10)

Transducers and Sensors: Temperature transducers, Infrared radiation thermometers, Clinical thermometers, Pressure transducers: Strain Gauge for pressure measurement, SpO2 sensor,
Sources of Biomedical Signals, Classification of Biomedical Signals, Bioelectric signals like ECG, EEG, EMG and EOG. Recording Electrodes, Motion artefacts, Electrodes for EEG, ECG and EMG, Isolation amplifiers, Differential Amplifiers, Instrumentation Amplifiers, Analysis of non-stationary signals, Time-variant system, Short time Fourier transform, Multi resolution Analysis (Wavelet), Introduction to Adaptive filters and its applications.

Unit III: Cardiovascular System (06)

Anatomy of Heart, Conducting system of the heart, Lead Configuration to acquire ECG, Einthoven Triangle, ECG Machine, Normal rhythm and Rhythm Abnormality (Arrhythmia), Heart Sounds (Phonocardiograph), Blood Pressure Measurement, Echocardiography.

Unit IV: Central Nervous System(CNS) and Peripheral Nervous System(PNS) (06)

Functional Components of a Human Nervous System, Electroencephalogram (EEG), Types and Significance of EEG Signal, 10-20 Electrode Placement System, Evoked Potential, EEG Machine, EEG Amplifier and Filters, EEG applications: Epilepsy, Sleep disorder and Human Brain-Computer Interface (HCI/BCI), Sensory (Pain, temp, touch, pressure) and Motor components , Muscles and EMG.

Unit V: Biomedical Equipment (08)

ICU equipment: Bedside Monitors, Central Monitoring System, Diagnostic Equipment: Block diagram of X-Ray machine, CT Scan and MRI machines, Ultrasound Imaging, Life saving equipment: Pacemakers, Defibrillators and Ventilators

Unit VI: Applications of AI and ML Techniques in Biomedical Field (08)

Overview of AI/ML (SVM, Clustering, KNN) techniques and Neural Networks, Representation of biomedical signals, Data exploration and processing, Applications to image analysis (X-rays) and Time-series (ECG and EEG signals)

Text Books:

1. Joseph J. Carr and John M. Brown, **"Introduction to Biomedical Equipment Technology"**, *Prentice Hall India*, (4th Edition), (2000).
2. R. Rangayyan, **"Biomedical Signal Analysis"**, *Wiley India Pvt. Limited*, (1st Edition), (2002).
3. R. S. Khandpur**, "Handbook of Biomedical Instrumentation",** *Tata McGraw Hill*, (2nd Edition), (2003).

Reference Books:

1. D. C. Reddy **"Biomedical Signal Processing: Principles and techniques",** *Tata McGraw*, (1st Edition), (2005).
2. Bruce, **"Biomedical Signal Processing & Signal Modeling",** *Wiley India Pvt. Limited*, (Wiley student edition), (2009).
3. John L. Semmlow, **"Bio-signal and Medical Image Processing",** *CRC Press*, (2nd Edition), (2009).

Online Recources:

1. NPTEL Course **"Biomedical Signal Processing"** https://nptel.ac.in/courses/108/105/108105101/:

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20PEEC601C POWER ELECTRONICS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20ES01: Basic Electrical and Electronics Engineering

Course Objectives:
1. To explain the power devices structure and characteristics
2. To study electrical motors and use power converters to control motor speed
3. To analyze the power converters
4. To calculate the performance parameters of power converters
5. To explain power converter applications

Course Outcomes:
After completion of the course, students will be able to
CO1 Describe the structure of power devices and their characteristics
CO2 Explain the construction and characteristics of electrical motors
CO3 Analyse power converters and determine their performance parameters
CO4 Select and justify the use of suitable power converter for the given application

Unit I: Power Devices (07)
SCR, Power MOSFET, IGBT: Construction, Turn on mechanism, Static and Dynamic Characteristics, Gate drive circuits, Isolation techniques, SCR specifications and ratings, Gate-cathode characteristic, Line and Forced commutation.

Unit II: Introduction to Motors (06)
DC motors (Shunt and Series): Working principle, Load characteristics, Speed-torque characteristic, Field control of series motor, Motoring and braking principle, Induction motor: Speed-torque characteristic, Operation of induction motor from non-sinusoidal supply, Basic blocks of drives.

Unit III: Phase Controlled Rectifiers (10)
Analysis of single-phase semi converters and full converters for R and R-L, R-L-E load, Quadrant operation of converter, Effect of freewheeling diode, Performance parameters, Fourier analysis of supply current, Three phases converters for R load, Speed control of dc motor using phase-controlled rectifiers.

Unit IV: AC Voltage Controllers (05)
Single Phase AC voltage controller for R and R-L load, Three Phase AC voltage controller for R load, Light dimmer, Induction heating.

Unit V: Inverters (08)
Single-phase half bridge and full bridge inverters for R and R-L load and their performance parameters, Three phase bridge inverters for R load (120° and 180° mode operation),
PWM inverters, Single pulse and multiple pulse inverters, Stator voltage control and variable frequency control of induction motors using VSI, ONLine and OffLine UPS.

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Unit VI: Choppers **(06)**

Step-down chopper with R and R-L load, Step-up chopper for R load, Control strategies for output voltage control, Two quadrant and Four quadrant choppers, Motoring and braking of dc motor using chopper, SMPS.

Text Books:

1. M. H. Rashid, **"Power Electronics Circuit, Device and Application",** *Prentice Hall (PHI),* (3rd Edition), (2009).
2. M. D. Singh and K. B. Khanchandani, **"Power Electronics",** *Tata McGraw-Hill,* (2nd Edition), (2008).
3. Nagarath, D. P. Kothari, "**Electrical machines"**, *Tata McGraw-Hill,* (3rd Edition), (1998).
4. Ned Mohan, T. M. Undeland, and W.P. Robbins, **"Power Electronics Converter Application and Design",** *John Wiley and Sons,* (3rd Edition), (2009).
5. Vedam Subramhanyam, **"Electric drives-Concepts and Applications",** *Tata McGraw-Hill,* (2nd Edition), (2011).

Reference Books:

1. M. S. Jamil Asghar, **"Power Electronics",** *Prentice Hall* **(***PHI), New Delhi,* (1st Edition), (2011).
2. P. C. Sen, **"Power Electronics"**, *John Wiley and Sons,* (1st Edition), (2008).

Online Resources:

1. **NPTEL Course "Power Electronics"** https://nptel.ac.in/courses/108/105/108105066/
2. **NPTEL Course "Fundamentals of Electric Drives"**https://nptel.ac.in/courses/108/104/108104140/

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20PEEC601D DEEP LEARNING

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC403 Machine Learning with Python

Course Objectives:

1. To introduce basic concepts and learning algorithms of Artificial Neural Networks
2. To become familiar with feedforward and recurrent neural networks
3. To build CNN model and elaborate effects of hyperparameters on its performance
4. To get detailed insight of deep learning algorithms and their applications to solve real world problems

Course Outcomes: *

After completion of the course, students will be able to

CO1 Explain basic concepts of neural network and its learning algorithms
CO2 Calculate feature map dimensions and learnable parameters in Convolutional Neural Network (CNN)
CO3 Analyze effects of hyperparameter tuning on the performance of L-layer deep networks and interpret results
CO4 Solve image recognition and classification problems using pretrained CNN architectures
CO5 Compare recurrent neural networks, their types for sequence data processing and explain gradient issues
CO6 Design a deep neural network architecture to solve real-world problems

Unit I: Basics of Artificial Neural Network (09)

Biological neuron, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron learning algorithm, Linear separability, Activation functions, Feedforward networks: Multilayer Perceptron, Gradient Descent, Backpropagation

Unit II: Deep Neural Networks (09)

Deep feedforward networks, Architecture design, Gradient based learning, Vanishing and exploding gradients, Regularization, Optimization methods (AdaGrad, AdaDelta, RMSProp, Adam, NAG) for training deep models, Hyperparameters.

Unit III: Convolutional Neural Networks (09)

Building blocks of Convolutional Neural Network (CNN), Convolution operation and layer, Kernels and Filters, Pooling layer, Stacking of layers, Cross-validation, Data augmentation, Transfer learning, Modern CNN architectures: AlexNet, VGGNet, GoogLeNet, ResNet, Autoencoder.

Unit IV: Sequence Modeling (09)

Recurrent Neural Network (RNN), Types of RNN, Bidirectional RNNs, Back propagation through time (BPTT), Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), Long Short-Term Memory (LSTM).

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Unit V: Applications of Deep Learning (06)

Applications of CNN: Object recognition, Image classification.
Applications of RNN: Speech, language, and text processing.

Text Books:

1. Laurene Fausett, **"Fundamentals of Neural Networks: Architectures, Algorithms and Applications"**, *Pearson Education*, (1st Edition), (2008).
2. S. N. Sivanandan and S. N. Deepa, **"Principles of Soft Computing"**, *Wiley India*, (2nd Edition), (2011).
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, **"Deep Learning"**, *MIT Press*, (1st Edition), (2016).
4. Josh Patterson and Adam Gibson, **"Deep Learning- A Practitioner's Approach"**, *O'Reilly Media*, (1st Edition), (2017).

Reference Books:

1. Francois Chollet, **"Deep Learning with Python"**, *Manning Publications*, (1st Edition), (2018).
2. Phil Kim, **"MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"**, *Apress*, (1st Edition), (2017).

Online Resources:

1. NPTEL Course **"Fuzzy Logic and Neural Networks"**
   https://onlinecourses.nptel.ac.in/noc21_ge07/preview
2. NPTEL Course **"Deep Learning"**
   https://onlinecourses.nptel.ac.in/noc21_cs76/preview

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20EC602L COMPUTER NETWORKS AND SECURITY LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Oral: 25Marks

-Course Objective

1. To configure network and client server applications
2. To use modern tools to analyse protocols
3. To implement routing algorithms
4. To implement encryption and decryption algorithms

Course Outcome

After completion of the course, students will be able to

	CO Statement
CO1	Demonstrate use of network commands
CO2	Experiment with protocol analyzer tool to study TCP/IP protocols
CO3	Utilize network simulation tool for studying IP routing protocols
CO4	Develop a program for cryptography and routing.

List of Experiments:

1. a. Study of network commands & IP address configurations.
   b. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable
   c. Implementation of LAN using star topology and connectivity between two computers using crossover UTP CAT5 cable.
2. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)
3. Study of any network simulation tools to create a network with three nodes & establish a TCP connection between node 0 & node 1 such that node 0 will send TCP packet to node 2 via node 1.
4. Study of Network simulation tools to configure and see behavior of IP routing protocols like RIP, BGP etc.)
5. a. Installation and configuration of Web Server and hosting web pages using HTML programming.
   b. Installation and configuration of FTP server for FTP communication.
6. Write C/Java code for socket programming.
7. Write a program for Encryption and Decryption(RSA, Substitution)
8. Write a program in C for the Shortest Path algorithm.
9. Simulate DDoS attacks on a server, in a lab environment.

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20PEEC601LA ROBOTIC LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester : 25Marks
Practical: 25 Marks
Credits: 1

Course Objectives:

1. To demonstrate robot working and degree of freedom using physical components
2. To demonstrate robot functioning using simulation software
3. To design microcontroller based robotic system for specific task

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain mechanical configuration of robot manipulation
CO2 Select sensors and actuators used in robot manipulation
CO3 Apply formulation to simulate to obtain work space, kinematics, Dynamics and trajectory path of robot manipulator
CO4 Develop robot for specified task

List of Experiments:

1. Velocity and Position measurement using optical encoder.
2. Interface Pneumatic system component to actuate single acting and double acting cylinders.
3. Plot of work space of 2-link planer arm using simulation software.
4. Simulation of Forward Kinematics and Inverse Kinematic of
    1. 3-Link Robot
    2. PUMA 560 Robots.
5. Simulation of Dynamics of 3 link robot
6. Simulation of Trajectory and Path planning of :
    1. 3-Link Robot
    2. PUMA 560 Robots.
7. Hardware simulation of 3 Link robotic arm.
8. Design Robot for any application.

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20PEEC601LB BIOMEDICAL ELECTRONICS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester : 25Marks
Practical: 25 Marks
Credits: 1

Course Objectives:
1. To understand signal acquisition of some of the bio signals
2. To explore and select appropriate signal conditioning techniques
3. To study different AI/ML techniques for analysis and automatic classification

Course Outcomes:
After completion of the course, students will be able to
CO1 Compare the performances of different sensors used in Biomedical Applications
CO2 Select and Apply appropriate signal conditioning techniques to the different biomedical signals
CO3 Implement spectral analysis techniques on Biomedical signals
CO4 Develop a microcontroller based system to acquire the real life biosignal and perform analysis of the same

List of Experiments:

1. Temperature measurement using AD590 / LM35/Digital sensor
2. Measure ECG and Heart rate (photoelectric transducers/ finger plethysmography) : Normal and after exercise, Raw signal and after signal conditioning
3. Measure EMG for different muscles while performing any actions
4. Measurement of unknown resistance by using a Strain Gauge/Load cell in the Wheatstone bridge and finding the sensitivity of the bridge
5. Measurement of blood pressure using sphygmomanometer and automatic digital BP instrument (Test points on a Trainer kit). Finding the systolic and diastolic values and calculate Mean Arterial Pressure (MAP)
6. Use of AI/ML techniques for analyzing the spectrum of ECG/EEG/PCG signals
7. Open ended assignment

20PEEC601LC POWER ELECTRONICS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester : 25Marks
Practical: 25 Marks
Credit: 1

Course Objectives:

1. To demonstrate torque-speed characteristic of dc and ac motors
2. To analyze synchronization in gate drive circuits of the power converters
3. To demonstrate the applications of power converters
4. To compare the output voltage waveforms of power converters for R and R-L loads
5. To examine the power converter using simulation tool

Course Outcomes:

After completion of the course, students will be able to

CO1 Test synchronization in gate drive circuits of power converters
CO2 Analyse the output of power converters for different values of firing angles and duty cycles
CO3 Apply power converters for speed control of motors
CO4 Analyse the power converter performance using simulation tool

List of Experiments:

1. Plot torque-speed characteristics of the DC motor and Induction motor.
2. Simulation of half controlled bridge rectifier and testing the effect of firing angle change on the output.
3. Speed control of a DC motor using a half controlled bridge rectifier circuit.
4. Analysis of the output of a single phase fully controlled bridge rectifier for R, R-L load and R-L with flywheel diode.
5. Test the gate drive circuit and analyse the effect of change of duty cycle on the output of Step-down chopper. Analyse the effect of using a filter at the output.
6. Simulation and analysis of full bridge inverter.
7. Analyse the waveforms of the triggering circuit, output of power circuit and measure the output voltage of ac voltage controller.
8. Speed control of induction motor using ac to ac converter/ inverter.

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20PEEC601LD DEEP LEARNING LAB

Teaching Scheme
Practical: 2 Hours /Week

Examination Scheme
In Semester : 25Marks
Practical: 25 Marks
Credits: 1

Course Objectives:

1. To implement Artificial Neural Networks (ANN), Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN)
2. To get familiar with deep learning frameworks and Python libraries used for Deep Learning
3. To apply ANN, CNN and RNN algorithms to solve real-world problems

Course Outcomes:

After completion of the course, students will be able to-

CO1	Apply neural network learning methods and transfer learning for classification/regression applications
CO2	Select a suitable Convolutional Neural Network architecture and hyperparameters to solve real-world image classification, object recognition problems
CO3	Develop an algorithm for text processing and time series prediction using Recurrent Neural Networks and Long Short-Term Memory
CO4	Analyze performance of Deep Learning models based on different evaluation metrics

List of Experiments:

1. Introduction to Python libraries (Keras, TensorFlow) for deep learning.
2. Write a program to implement a Perceptron learning algorithm.
3. Write a program to perform classification (on Kaggle dataset) using Backpropagation.
4. Develop an algorithm and write a program for image classification using Convolutional Neural Network.
5. Write a program to implement image recognition using transfer learning.
6. Develop an algorithm and write a program for object detection using Convolutional Neural Network.
7. Develop an algorithm and write a program to predict the stock prices based on historic data using Long Short-Term Memory/ Gated Recurrent Unit.
8. Develop an algorithm and write a program for text preprocessing and text summarization using Recurrent Neural Network.

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Autonomous Program Structure of
Final Year B. Tech. Seventh Semester
(Electronics and Telecommunication Engineering)
Academic Year: 2023-2024 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Practical	Oral		
20EC701	Internship/Project	0	0	30	200	0	0	100	300	15
20HS701	Economics and Personal Finance (Online)	2	0	0	100	0	0	0	100	2
	Grand Total	**32**							**400**	**17**

Credits	Marks	Teaching Hrs/week	Evaluation Mode
Internship / Project = 15	300	30	Presentations + Oral
HS-EPF (Online) = 2	100	2	ISE + ESE

Duration of Internship / Project :

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

For Internship / Project:
In-Sem-Reviews=Two ; ESE = One Review with External (Final)

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20HS701- Economics and Personal Finance

Teaching Scheme
Lectures: 2 Hrs/Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50 Marks
Credits: 2

Prerequisite: Nil

Course Objectives:

1. To enable students to acquire knowledge and develop an understanding of basic concepts and principles of Economics & Finance
2. To make students acquaint with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector
3. To sensitize students to the current economic issues of the nation
4. To develop an understanding of the role of institutions in the functioning of an economy
5. To understand Markets and behaviour of the firm
6. To enhance financial literacy of engineering students.

Course Outcomes:

After completion of the course, students will be able to

CO1	Demonstrate the importance of National and International economy in ones economic life
CO2	Analyse the behaviors of consumer, firms and market and its impact on corporate finance
CO3	Apply financial techniques to evaluate companies and investments
CO4	Develop Personal Financial strategies using various investment options and taxation

Unit I: Macro Economics : Understanding Indian Economy- Domestic and International **(03)**

Economics for Engineers, Definition and classification of Economics, Basic Economic Problems and Economic Systems, India Economy: Mixed economy, Sector-wise contributors Gross Domestic Product (GDP) of India, GDPs of other nations, Macroeconomics, Per Capita Income, Employment, Inflation calculation : Consumer Price Index (CPI), Wholesale Price Index (WPI), Fiscal Policy, Fiscal Deficit, Government expenditure and Taxation, Concept of Goods and Service Tax (GST), Monetary policy, Central Bank- Reserve Bank of India (RBI), Statutory Liquidity Ratio (SLR), Prime Lending Ratio (PLR), Cash Reserve Ratio (CRR).

Unit II: Microeconomics : Understanding behaviors of Consumers, Firms and Markets **(05)**

Consumer Behaviour, Concept of Demand and Supply, Determinants of Demand and Supply, Price Elasticity of Demand and Supply, Market Equilibrium and it's applications, Market and Market Structures- Perfect Competition, Monopolistic Competition, Oligopoly and Monopoly Cost Concepts, Product Costing and Pricing strategy.

Unit III: Personal Finance and Taxation I : Personal Financial strategies Background Concepts **(06)**

Financial analysis of a business firm: Statement of Profit and Loss, Balance Sheet, Analyzing various business firms though Ratio Analysis, Time value of money, Annuities. Calculations in Excel, International Trade and Comparative Advantage, International Financing : Foreign Exchange (FOREX) market and Exchange rates, Balance of Payment.

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Unit IV: **Personal Finance and Taxation II :** Personal Financial strategies **(07)**
Goal Setting and Tax, Credit and Risk Management

Understanding Personal Finance : Financial Goal, Importance, Opportunity Costs in Decision Making, The Time Value of Money, Basics of Financial Planning, Personal financial statements, Cash flow and debt management, Tax Management : Taxes, Direct and Indirect, Income Tax slabs and sections, Other taxes, Credit Management : Consumer Loans, Credit cards, Credit Rating, Credit Information Bureau (India) Limited (CIBIL), Interest Rates, Understanding Monetary Policy, Risk Management : Insurance- Life and General, Types of life Insurance, Unit Linked Insurance Plan (ULIPS), Health Insurance, Vehicle Insurance and other major types, Understanding Insurance riders and decision making while buying insurance.

Unit V: **Personal Finance and Taxation III : Personal Financial strategies** **(07)**
Investments in Bonds, Stocks and Mutual Funds, Retirement Planning

Investment in Government Securities : Bank Accounts, Government Securities, Bonds, Fixed Deposits, Gold Bonds, Investment in Stock Market : Introduction to Stock Market, Stock Exchange Sensitive Index (SENSEX), National Stock Exchange (NSE), Dematerialised account (Demat) Account, How to select stocks- Price per Earning (P/E) ratio, Fundamentals analysis, Investment in Mutual Funds : What is Mutual Fund, Types, Exchange Traded Funds, Net Asset Value (NAV), Factors for selection of Mutual Funds, Retirement Planning : Public Provident Fund (PPF), Employee Provident Fund (EPF) , National Pension Scheme (NPS) and other Pension Funds, Annuity calculations.

Text Books:

1. Paul A Samuelson, "**Economics"**, Indian Adaptation, Sudip Chaudhari,Anindya Sen, *Mc Graw Hill* (2010), 19th edition
2. Lawrence J Gitman, "**Principles of Managerial Finance"**, *Pearson*.(2016) 11th edition
3. Prasanna Chandra , "**Finance Sense: Finance for Non-finance Executives**", 5th edition, CFMTMH professional series in Finance
4. Monika Halan , "**Let's Talk Money**" Harper Business 2018
5. P V Subramanya, **"Retire Rich"** TV18 Broadcast Ltd., 2019
6. Abhishek Kumar, "**The Richest Engineer"**, Manjul Publishing House, 2016

Reference Books:

1. Lipsey, R.G. & Chrystal, K.A., "**Economics"**, 11th Edition, Oxford University Press, 2007
2. K.K.Dewett, "**Modern Economic Theory"**, S.Chand, 2005

Online Resources:

1. www.economicshelp.org
2. www.rbi.org
3. www.khanacademy.org

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Autonomous Program Structure of
Final Year B. Tech. Eight Semester
(Electronics and Telecommunication Engineering)
Academic Year: 2023-2024 onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem	End Sem	Oral	Practical		
20EC801	Broadband Communication Systems	3	0	0	50	50	0	0	100	3
20PEEC801	Program Elective-IV	3	0	0	50	50	0	0	100	3
20PEEC802	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
20EC801L	Broadband Communication Systems Lab	0	0	2	25	0	25	0	50	1
20PEEC801L	Program Elective–IV Lab	0	0	2	25	0	0	25	50	1
	Total	**15**	**0**	**4**	**300**	**250**	**25**	**25**	**600**	**17**
	Grand Total	**19**			**550**		**50**			

Programme Elective-IV			Programme Elective-IV Lab		
Sr. No.	**Course Code**	**Course Title**	**Sr. No.**	**Course Code**	**Course Title**
1	20PEEC801A	Microwave and Radar Engineering	1	20PEEC801LA	Microwave and Radar Engineering Lab
2	20PEEC801B	Remote Sensing	2	20PEEC801LB	Remote Sensing Laab
3	20PEEC801C	Industrial Automation	3	20PEEC801LC	Industrial Automation Lab
4	20PEEC801D	Embedded RTOS	4	20PEEC801LD	Embedded RTOS Lab

Programme Elective-V		
Sr. No.	**Course Code**	**Course Title**
1.	20PEEC802A	Advanced VLSI Design
2.	20PEEC802B	Artificial Intelligence
3.	20PEEC802C	Statistical Signal Processing
4.	20PEEC802D	Mobile Communication

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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	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 Systems	Y	Y	Y	Y	N
9	20OE802I	Wireless Networks	N	Y	Y	N	Y

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20EC801 BROADBAND COMMUNICATION 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 comprehend the components of fibre optic communication system
2. To understand the system design issues and the role of WDM components in advanced light wave systems
3. To describe optical network architectures
4. To explain the concepts of new services and applications to be supported in future satellite networks

Course Outcomes:

After completion of the course, students will be able to

CO1 Describe the effect of propagation characteristics of Optical communication system
CO2 Apply system design considerations for optical link
CO3 Describe optical access networks
CO4 Design WDM optical network
CO5 Identify and access sources for recent trends in Broadband Communication

Unit I: Fiber optic communications system (08)

Electromagnetic Spectrum and Optical spectral bands, Key elements of fiber optic communications system, Ray theory of propagation: Fiber types, Transmission characteristics of optical fibers, Intra modal Dispersion, Intermodal dispersion. Introduction to optical sources: Wavelength and Material Considerations, LEDs and semiconductor LASERs: principle of working and their Characteristics, Material Considerations, PIN, Avalanche photodiodes.

Unit II: Design considerations in optical links and Wavelength Division Multiplexing(WDM) (06)

Point to point Links: System design considerations, Link Power budget, Rise Time budget, Overview of WDM, WDM Components: Fiber Coupler, Optical Isolators and Circulators, Optical Fiber Applications.

Unit III: Optical Network Architectures (07)

Architectural choices of next generation transport networks, Designing transmission layer using-SDM, TDM, WDM, Unidirectional versus Bidirectional WDM systems, SONET Layering, Frame Structure, Physical network topologies, Access Networks- PON, Optical Interconnects, Data Centers ,Optical communication for Wireless Fronthauling.

Unit IV: WDM Network Design (07)

Cost Trade-Offs: A Detailed Ring Network, Light path Topology Design, Routing and Wavelength Assignment(RWA), Wavelength Conversion, Dimensioning Wavelength-Routing Networks, Online RWA in Rings, Long Haul Network case study, Metro Ring Network Case study.

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Unit V: Multiprotocol Label Switching (MPLS) Networks (07)
Introduction to MPLS, MPLS and Traffic Engineering, Integrated service Internet, RSVP, Differentiated service Internet, Voice over IP, Metro Ethernet Access networks.

Unit VI: Next Generation Internet (NGI) Over Satellite (07)
Overview of satellite communication, New Services and Applications, Traffic Modeling and Characterization, IPv6 Networks over Satellites, Future Development of Satellite Networking.

Text Books:

1. Gerd Keiser, **"Optical Fiber Communications",** *Tata McGraw Hill*, (5th Edition), (2013).
2. John M. Senior, **"Optical Fiber Communications: Principles and Practice",** *PHI*, (3rd Edition), (2008).
3. Anthony S. Acampora, "**An Introduction to Broadband Networks LANs, MANs, ATM, B-ISDN, and Optical Networks for Integrated Multimedia**", *Springer US* (1st Edition), (1994).
4. Rajiv Ramaswami, Kumar N. Sivarajan, and Galen H. Sasaki, "**Optical Networks: A Practical Perspective",** *Morgan Kaufmann Publishers Inc*, (3rdEdition), (2010).
5. C. Siva Ram Murthy and Mohan Guruswamy, **"WDM Optical Networks: Concepts, Design and Algorithms"**, *PHI*, (1stEdition), (2001).
6. Zhili Sun, **"Satellite Networking Principles and Protocols"**, *John Wiley & Son*, (2nd Edition), (2014).

Reference Books:

1. Djafar K. Mynbaev and Lowell L. Scheiner,**"Fiber Optic Communications Technology",** *Pearson Education*, (1st Edition), (2000).
2. Govind P. Agrawal, **"Fiber Optic Communication Systems",** *Wiley India*, (3rd Edition), (2002).
3. Dennis Roddy, **"Satellite Communications",***McGraw Hill*, (4th Edition), (2017).

Online Resources:

1. NPTEL Course "**Fiber Optic Communication Technology**" https://nptel.ac.in/courses/108/106/108106167/
2. NPTEL Course **"Satellite Communication Systems"** https://nptel.ac.in/courses/117/105/117105131/
3. NPTEL Course **"Broadband Networks: Concepts and Technology"** https://nptel.ac.in/courses/117/101/117101050/

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20PEEC 801A MICROWAVE AND RADAR ENGINEERING

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC601 Wave Theory and Antenna

Course Objectives:
1. To study the basics of waveguides and various microwave components
2. To analyze microwave components using scattering parameters
3. To study various microwave measurement techniques
4. To explain different types of Radars and its applications

Course Outcomes:
After completion of the course, students will be able to
CO1 Discuss the advantages and applications of microwaves
CO2 Analyze different modes of propagation in waveguides
CO3 Derive and analyze S parameters for different microwave components
CO4 Explain the operation of different microwave tubes
CO5 Calculate and analyze parameters at microwave frequencies
CO6 Discuss the principle of Radar and compare different types of Radars

Unit I: Microwave Transmission Lines (08)
Introduction of Microwaves and their applications, Rectangular waveguides, Solution of Wave equation in TE and TM modes, Power transmission and Power losses, Planar transmission lines.

Unit II: Waveguide Components (08)
Scattering matrix representation of networks, Rectangular cavity resonator, Waveguide Tees, Directional couplers, Faraday rotation principle, Circulators and isolators.

Unit III: Microwave Tubes (08)
Introduction to conventional vacuum tubes, High frequency limitations of conventional tubes, Klystron tubes, Magnetron, TWT and their applications.

Unit IV: Microwave Measurements (06)
Introduction to microwave measurements, Measurement methods of parameters such as Frequency, Power, Attenuation, Phase shift, VSWR, Impedance, Insertion loss, Q of a cavity resonator.

Unit V: Radar Fundamentals (06)
Radar block diagram and operation, Radar range equation, Prediction of range performance, Minimum detectable signal, Radar cross section of targets, Pulse repetition frequency and Range ambiguities, Radar Displays.

Unit VI: Types of Radar and Applications (06)
Types of Radars, Doppler effect, CW radar, basic principle and operation of FMCW radar, MTI and Pulse Doppler Radar.

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Text Books:

1. S.Y. Liao**, "Microwave Devices and Circuits",** *Prentice Hall India,* (2nd Edition), (2014).
2. M. Kulkarni**, "Microwave and Radar Engineering",** *Umesh Publications***,** (4th Edition), (2013)**.**
3. M. I. Skolnik, "**Introduction to Radar Systems", *McGraw Hill, (***3rd Edition), (2008).

Reference Books:

1. David M. Pozar, **"Microwave Engineering"**, *John Wiley and Sons,* (5th Edition), (2014).
2. NadowLevanon, **"Radar Principles"**, *John Wiley and Sons,* (5th Edition), (1989).

Online Resources:

1. NPTEL Course on **"Microwave Theory and Techniques"**
   https://onlinecourses.nptel.ac.in/noc19_ee57/preview
2. NPTEL Course on **"Basic Blocks of Microwave Engineering"**
   https://nptel.ac.in/courses/117105130/

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20PEEC801B REMOTE SENSING

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: PEEC 501 Digital Image Processing, 20EC403 Machine learning with Python

Course Objectives:
1. To understand basic concepts, principles and applications of remote sensing
2. To provide knowledge related to remote sensing data collection, reading and analysis
3. To perform image pre-processing, classification and clustering on remote sensing data
4. To learn multidisciplinary applications of remote sensing

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain geometric and radiometric principles, Digital Image Processing techniques for pre-processing of Remote Sensing image data
CO2 Illustrate atmospheric and energy interaction, scanning mechanism on earth surface
CO3 Interpret data products from different satellites and calculate image statistics
CO4 Apply machine learning algorithms for dimensionality reduction, clustering and classification on satellite images
CO5 Analyze performance of different machine learning algorithms on multispectral and hyperspectral images
CO6 Demonstrate multidisciplinary applications of remote sensing

Unit I: Introduction to Remote Sensing (08)
Energy sources and radiation principles, Energy interactions in the atmosphere, Characteristics and Physics of Remote Sensing systems, Electromagnetic spectrum, Effects of Atmosphere, Scattering and Absorption, Atmospheric window, Energy interaction with surface features: Spectral reflectance of Vegetation, Soil and Water, Atmospheric influence on spectral response patterns.

Unit II: Multispectral, Thermal, and Hyperspectral Sensing (08)
Platforms used for Remote Sensing data acquisition and characteristics, Different types of aircrafts, Manned and Unmanned spacecrafts, Sun-synchronous and geo-synchronous satellites, Types and characteristics of different platforms, Opto-mechanical and electro-optical sensors: across-track and along-track scanners, Multispectral scanners and Thermal scanners, Imaging spectroscopy.

Unit III: Data Representation and Preprocessing (09)
Resolution: spatial, spectral, radiometric and temporal resolution, Data products and their characteristics, Visual and digital interpretation, Image statistics, Basic principles of data processing: Radiometric correction, Geometric correction, Atmospheric errors and corrections, Image enhancement.

Unit IV: Data Analysis (09)
Dimensionality reduction techniques, Image classification: Supervised classification, Unsupervised classification, Classification accuracy assessment, Image segmentation.

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Unit V: Applications of Remote Sensing (08)

Hyperspectral image analysis, Multispectral image analysis, Time Series Analysis using machine learning techniques in different application areas as urban planning, agricultural, forestry and disaster management.

Text Books:

1. Lillesand T.M., and Kiefer, R.W.,"**Remote Sensing and Image interpretation**", *John Wiley & Sons*, (6th Edition), (2000).
2. John R. Jensen, **"Introductory Digital Image Processing: A Remote Sensing Perspective**", *Pearson*, (4th Edition), (2016).
3. George Joseph, **"Fundamentals of Remote Sensing",** *Universities Press*, (2nd Edition), (2005).

Reference Books:

1. John A. Richards, **"Remote Sensing Digital Image Analysis"**, *Springer–Verlag*, (5th Edition), (2013).
2. Charles Elachi and Jakob J. Van Zyl, **"Introduction to The Physics and Techniques of Remote Sensing"**, *Wiley Series in Remote Sensing and Image Processing*, (2nd Edition), (2006).
3. JianGuo Liu, Philippa J. Mason,**"Image Processing and GIS for Remote Sensing: Techniques and Applications"**, *John Wiley & Sons, Ltd.*, (2nd Edition), (2016).

Online Resources:

1. NPTEL Course**"Remote Sensing and Digital Image Processing of Satellite Data"** https://nptel.ac.in/courses/105/107/105107160/
2. NPTEL Course**"Remote Sensing Essentials"** https://nptel.ac.in/courses/105/107/105107201/
3. https://www.iirs.gov.in

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20PEEC801C INDUSTRIAL AUTOMATION

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite:

Course Objectives:
1. To introduce the basics of process control and automation systems
2. To explain the essential elementsas required for a process control system
3. To introduce the basics of P.L.C. programming and P.L.C. programming standard
4. To familiarize with SCADA and DCS

Course Outcomes:
After completion of the course, students will be able to :
CO1 Explain the basics of a Process Control System and Automation System
CO2 Design subsystems of a Process Control application
CO3 Develop P.L.C. ladder diagram for process control application
CO4 Explain communication in P.L.C. (Programmable Logic Control),SCADA(Supervisory Control and Data acquisition) and DCS (Distributed Control System)

Unit I: Process Control and Automation (08)
Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation, Architecture of Industrial Automation Systems, Advantages and Limitations of Automation.

Unit II: Transmitters and Signal Conditioning (08)
Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire and 3-Wire transmitters, Analog and Digital signal conditioning for R.T.D., Thermocouple, Differential Pressure Transmitter (D.P.T.) , Smart and Intelligent transmitters.

Unit III: Controllers and Actuators (09)
PID Controller, Cascade PID control, Microprocessor Based control, PAC(Programmable Automation Controller), Mechanical switches, Solid state switches, Electrical Actuators: Solenoids, Relays and Contactors, A.C. Motor, V.F.D., D.C. Motor, B.L.D.C. Motor, Stepper Motor, Servo Motor, Pneumatic and Hydraulic actuators.

Unit IV: Programmable Logic Controller (09)
Functions of P.L.C., Types of PLCs, Advantages, Architecture, Working of P.L.C., Selection of P.L.C., Networking of P.L.C.s, Ladder Programming basics, Ladder Programming examples, Interfacing Input and Output devices with P.L.C., P.LC. Programming standard IEC61131.

Unit V: Industrial Automation Technologies : Supervisory Control And Data Acquisition (S.C.A.D.A.) and Distributed Control System (D.C.S.), Industrial Communication (08)
Introduction to S.C.A.D.A. (Features, MTU-functions of MTU, RTU-Functions of RTU, Applications of S.C.A.D.A., Communication in S.C.A.D.A.: types, methods and Media used), Introduction to DCS (Architecture, Input and Output modules, Communication module,

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Specifications), Industrial Communication: Devicenet, Interbus , Device network : Foundation Fieldbus -H 1, HART, CAN, PROFIBUS-PA, Control network: ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP.

Text Books:

1. Curtis Johnson, **"Process Control Instrumentation Technology"**, Pearson Education, (8th Edition), (2013).
2. S. Sen, S. Mukhopadhyay, A. K. Deb, **"Industrial Instrumentation Control and Automation"**, Jaico Publishing House, (1st Edition), (2013).
3. Madhuchhanda Mitra, Samarjit Sengupta, **"Programmable Logic Controllers and Industrial Automation"**, Penram International Publishing India Pvt. Ltd., (2nd Edition), (2012).
4. Stuart A. Boyer, **"SCADA (Supervisory Control and Data Acquisition)"**, ISA Publication, (4th Edition), (2010).

Reference Books:

1. John W. Webb, Ronald A. Reis, **"Programmable Logic Controllers, Principles and Applications"**, Prentice Hall of India Pvt. Ltd., (5th Edition), (2016).
2. Kilian, **"Modern Control Technology: Components & Systems"**, Cengage India, (3rd Edition), (2021).
3. BelaG. Liptak, **"Process Software and Digital Networks"**, CRC Press, (3rd Edition), (2011).

Online Resources:

1. **NPTEL Course on Industrial Automation and Control**
   https://onlinecourses.nptel.ac.in/noc21_me67/preview

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20PEEC801D EMBEDDED DESIGN AND RTOS

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC503 Advanced Processors, 20ES02 Fundamentals of Programming Language I

Course Objectives:

1. To discuss embedded system design challenges
2. To explain Operating System (OS) requirement for embedded systems
3. To describe real time operating system concepts
4. To discuss features of Linux OS
5. To interface real world input and output devices

Course Outcomes:

After completion of the course, students will be able to

CO1 Identify and analyze design metrics for development of embedded systems
CO2 Compare and contrast different types of software development model for a given application
CO3 Explore the structures, task services, states and other basic operations of the real time operating systems
CO4 Apply real time system concepts for developing embedded systems
CO5 Explain Linux kernel configuration and bootloader

Unit I : Introduction to Embedded Systems (07)

Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. Embedded processor technology: IC technology, Design technology, Software development life cycle (SDLC) models like Waterfall, Spiral, V, Rapid Prototyping models and comparison.

Unit II: Structure of μCOS II (07)

Kernel Structure: Foreground and background systems, Pre-emptive and Non-Preemptive, Starting the OS, Tasks, Task States, Task Control Blocks (TCB), Ready list, Task Scheduling, Task Level, Multitasking , Context Switching, Idle Task, Statistics Task, Task Management: Creating/Deleting and Suspending/Resuming Task, Task Stacks and checking, Changing Task's Priority.

Unit III : Synchronization in μCOS II (07)

Critical Session, Shared resources, Inter task communication, Mutual exclusion, Semaphore Management: Creation/Deletion, Pending/Posting/Acceptance/Query, Mutual Exclusion Semaphores: Creation/Deletion, Pending/Posting/Acceptance/Query, Event Flag Management: Internals, Creation/ Deletion of Event Flag groups, Waiting/Setting/Clearing/Looking for/Querying an Event Flag Group.

Unit IV: Structure of μCOS II (07)

Static and Dynamic Priorities, Priority inversion, Synchronization mechanism, Interrupts: Latency, Response and Recovery, Clock Tick, Memory requirements. Schedulers, Locking and unlocking of scheduler, Interrupts, Clock Tick, Initialization, Time Management: Delaying/Resuming task,

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System Time.

Unit V: Communication in µCOS II (07)

Message Mailbox Management: Creating/Deleting a Mailbox, Waiting/ Sending /Getting without waiting a Message from Mailbox, Status of Mailbox, and Alternate uses of Mailbox, Message Queue Management: Creating/Deleting/Flushing a Message Queue, Waiting/Sending/Getting without waiting a Message from Queue, Status and Alternate use of Message Queue, Memory Management: Memory Control Block(MCB), Creating a partition, Obtaining /Returning/Waiting for a memory Block, Partition Status, Porting of µCOS-II: Development tools, Directories and Files, Configuration and testing of Port.

Unit VI: Linux Kernel Construction (07)

Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration, Role of a Bootloader, Bootloader Challenges, A Universal Bootloader: Das U-Boot, Porting U-Boot.

Text Books:

1. Jean J. Labrosse, **"MicroC OS II, The Real-Time Kernel",** *CMP Books*, (2nd Edition), (2011).
2. Christopher Hallinan, **"Embedded Linux Primer - A Practical, Real-World Approach",** *Prentice Hall Pvt.*, (2nd Edition), (2010).
3. Raj Kamal, **"Embedded Systems –Architecture, Programming and Design",** *McGraw Hill*, (2nd Edition), (2008).

Reference Books:

1. Dr. K. V. K. K. Prasad **"Embedded / real time System: Concepts, Design, & Programming - Black Book"**, *Dreamtech Press Publication*, (2nd Edition), (2003).
2. Frank Vahid and Tony Givargis, **"Embedded System Design – A Unified hardware/ Software introduction"**, *Wiley Publication*, (3rd Edition), (2006).

Online Resources:

1. NPTEL Course on "**Real Time Operating System"** https://onlinecourses.nptel.ac.in/noc20_cs16/
2. NPTEL Course on "**Real-Time Systems"** https://onlinecourses.nptel.ac.in/noc21_cs98/

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20PEEC802A ADVANCED VLSI DESIGN

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC502 VLSI Design

Course Objectives:

1. To discuss the coverage of timing analysis
2. To study the fundamentals of static timing analysis
3. To understand logic fault models and learn test generation for sequential and combinational logic circuits
4. To learn power distribution and power optimization techniques

Course Outcomes:

After completion of the course, students will be able to

CO1	Apply the timing constraints, including clocks and external delays for performance improvement
CO2	Apply Static Timing Analysis(STA) checks for timing closure
CO3	Analyze the faults in digital circuits
CO4	Analyze the design for testability methods for combinational and sequential circuits
CO5	Describe power distribution and power optimization techniques

Unit I: Introduction to Timing Analysis (08)

Performance axes, Design flow, Static versus dynamic methods, Intrinsic and extrinsic delays, Delay factors, Path delays, Combinational paths, Synchronous paths, Pipelining and analysis, Clock definitions: Skew, Frequency and phase, Clock distribution.

Unit II: Static Timing Analysis (08)

True paths, Transitions, Multi-cycle operations, Clock specification, Interface specification, Timing checks, Timing constraints, Design rule constraints, Wire-load model, Gate delay, Net delay, Timing reports, Back annotation, Delay Formats: Standard Delay Format (SDF).

Unit III: Basics of Testing (08)

Fault models, Combinational logic and fault simulation, Test generation for Combinational Circuits, Current sensing based testing, Classification of sequential ATPG methods, Fault collapsing and simulation.

Unit IV: Design for Testability (DFT) (08)

Scan design, Partial scan, Use of scan chains, Boundary scan, DFT for other test objectives, Memory Testing. Built-in self-test (BIST): Pattern Generators, Estimation of test length, Test points to improve testability, Analysis of aliasing in linear compression, BIST methodologies, BIST for delay fault testing.

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Unit V: Power Analysis and Clock Synthesis (10)

Introduction, Power Basic, Key Factors in Accurate Power Estimation, Power Estimation Early in the Design Cycle, Simulation Based Power Estimation, Best Practices for Power Estimation, Supply and ground bounce, Power distribution techniques, Power optimization, Clock Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Interconnect routing techniques.

Text Books:

1. J. Bhasker, Rakesh Chadha, **"Static Timing Analysis For Nano-meter Designs: A Practical Approach"**, *Springer*, (1st Edition), (2009).
2. Jan M. Rabaey, **"Digital Integrated Circuits Design Perspective"**, *Prentice Hall of India Pvt. Ltd.*, (2nd Edition), (2002).

Reference Books:

1. Srivastava Ashish, Sylvester Dennis, Blaau David, **"Statistical Analysis and Optimization for VLSI: Timing and Power"**, *Springer*, (1st Edition), (2005).
2. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, **"VLSI Test Principles and Architectures: Design for Testability"**, *Elsevier,* (1st Edition), (2006).
3 M. L. Bushnell and V. D. Agrawal, **"Essential of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits"**, *Springer*, (1st Edition), (2005).

Online Resources:

1. NPTEL Course **"Advanced VLSI Design"**
   https://nptel.ac.in/courses/117/101/117101004/
2. NPTEL Course **"VLSI Physical Design"**
   https://nptel.ac.in/courses/106/105/106105161/

MKSSS'S CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

20PEEC802B ARTIFICIAL INTELLIGENCE

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC403 Machine Learning with Python

Course Objectives:
1. To explain the basics of Artificial Intelligence
2. To introduce various types of algorithms useful in Artificial Intelligence
3. To explain the types of reasoning
4. To explain the code of ethics for Artificial Intelligence

Course Outcomes:
After completion of the course, students will be able to
1. Explain the components of intelligent agents and expert systems
2. Apply knowledge representation techniques and problem solving strategies to Artificial Intelligence applications
3. Explain and analyze the search and learning algorithm along with the reasoning
4. Describe the code of ethics for the Artificial Intelligence systems

Unit I: Basics of Artificial Intelligence (05)
Categories of Artificial Intelligence (AI), Applications of AI, Intelligent agents, Agents and environments, Good behavior, The nature of environments, Structure of agents. Applications of Artificial Intelligence, Game Playing, Expert Systems, Natural Language Processing, Image Understanding, Robotics, Pattern Recognition, Virtual Reality, Computer Vision, Intelligent Control

Unit II: Problem Solving (07)
Problem solving agents, Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic function, Local search algorithms and optimistic problems, Optimal decisions in games, MINIMAX algorithm, Alpha Beta Pruning, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP.

Unit III: Knowledge Representation (07)
Logic, Propositional logic, First order logic, Knowledge engineering in first order logic, inference in first order logic, Prepositional versus first order logic, Forward chaining, backward chaining, Resolution , Knowledge representation, Uncertainty and methods, Bayesian probability and Belief network.

Unit IV: Reasoning (06)
Types of Reasoning, Non-monotonic Inference Methods Non-monotonic Reasoning, Truth Maintenance Systems, Reasoning with Fuzzy Logic, Fuzzy Sets, Fuzzy Reasoning, Rule-based Reasoning, Diagnosis Reasoning, Case-based Reasoning Systems, Model-based Reasoning Systems

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Unit V: Learning (07)

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Statistical learning, Hidden Markov Models, Association Learning: Apriori Algorithm, Eclat Algorithm, Fuzzy Network, Fuzzy Systems, Info Fuzzy Networks, Fuzzy Neural Systems

Unit VI: Expert systems and Ethics for Artificial Intelligence (10)

Introduction to Expert System, Architecture and functionality, Examples of Expert system, Basic steps of pattern recognition system, Object Recognition- Template Matching theory, Prototype Matching Theory, Pattern Mining.

Ethics of AI : Privacy and Surveillance, Manipulation of Behavior, Opacity of AI Systems, Bias in Decision Systems, Human-Robot Interaction, Automation and Employment, Autonomous Systems, Machine Ethics, Artificial Moral Agents Privacy

Text Books:

1. Vinod Chandra S. S., Anand Hareendran S., "**Artificial Intelligence and Machine learning**", *PHI*, (1st Edition) (2014).
2. Stuart Russell, Peter Norvig, **"Artificial Intelligence", A Modern Approach '**, *Pearson Education/Prentice Hall of India*, (3rd Edition), (2010).
3. Elaine Rich, Kevin Knight and Shivshankar Nair, **"Artificial Intelligence"**, *Tata McGraw Hill*, (3rd Edition), (2009).
4. Paula Boddington**, "Towards a Code of Ethics for Artificial Intelligence"**, *Springer international Publishing***,** (1st Edition), (2017).

Reference Books:

1. Nils J. Nilsson, **"Artificial Intelligence: A new Synthesis"**, *Morgan Kaufmann Publishers*, (1st Edition), (1998).
2. George F. Luger, **"Artificial Intelligence: Structures and Strategies for Complex Problem Solving",** *Pearson Education***,** (6th Edition), (2008).

Online Resources:

1. NPTEL Course **"Artificial Intelligence"** http://nptel.ac.in/courses/106105077/
2. https://plato.stanford.edu/entries/ethics-ai/
3. https://intelligence.org/files/EthicsofAI.pdf
4. https://www.europarl.europa.eu/RegData/etudes/STUD/2020/634452/EPRS_STU(2020)634452_EN.pdf

MKSSS'S CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

20PEEC 802C STATISTICAL SIGNAL PROCESSING

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 explain concepts of statistical signal processing that have been used in many applications fields such as communications, speech signal processing, image processing
2. To describe Signal Modeling methods and its importance in signal processing
3. To explain Parametric and non-parametric spectral estimation methods
4. To introduce Linear prediction and optimum filters and its necessity for noise filtering
5. To explore necessity of adaptive filters and algorithms for real time noise filtering

Course Outcomes:
After completion of the course, students will be able to
CO1 Apply statistical models for analysis of signals using Stochastic processes
CO2 Design Optimum filters for prediction and filtering of real world signals
CO3 Analyze real world signals by estimating its power spectral densities using parametric and non-parametric spectral estimation methods
CO4 Apply Adaptive filtering algorithms for real world signals

Unit I: Signal Modeling (08)
Random processes, Introduction to signal modeling, Signal modeling using Least Square methods, Pade' method, Prony's method, Signal modeling using MA(q), AR(p) , ARMA(p,q) models.

Unit II: Linear Prediction of Signals (08)
Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters, Linear Minimum Mean-Square Error (LMMSE) Filtering.

Unit III: Wiener Filter (08)
Wiener Hoff Equation, Causal and Non Causal FIR filter, Linear Prediction using FIR Filter, Lattice representation of FIR filter, Causal IIR Wiener filter, Application of Wiener Filter as Noise Canceller.

Unit IV: Adaptive Filtering (10)
Principle and Applications, Steepest Descent Algorithm Convergence characteristics, LMS algorithm, Convergence, Excess mean square error, Leaky LMS algorithm, Application of Adaptive filters, Kalman filtering**:** State-space model and the optimal state estimation problem, Discrete Kalman filter, Extended Kalman filter.

Unit V: Spectral Analysis (08)
Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing, Periodogram: Parametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

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Text Books:

1. Charles W. Therrien, **"Discrete Random Signals and Statistical Signal Processing",** *Prentice Hall Signal Processing Series*, (1st Edition), (2004).
2. Monson H. Hayes, **"Statistical Digital Signal Processing and Modeling"**, *John Wiley and Sons, Inc, Singapore*, (1st Edition), (2002).

Reference Books:

1. Simon Haykin, **"Adaptive Filter Theory",** *Prentice Hall*, (5th Edition), (2013).
2. J. G. Proakis, **"Algorithms for Statistical Signal Processing",** *Pearson Education*, (1st Edition), (2002).

Online Resources:

1. NPTEL Course **"Statistical Signal Processing"**
   https://nptel.ac.in/courses/108/103/108103158/

MKSSS'S CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

20PEEC 802D MOBILE COMMUNICATION

Teaching Scheme
Lectures: 3 Hours / Week

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

Prerequisite: 20EC 402 Analog and Digital Communication

Course Objectives:
1. To explain the fundamentals of cellular system design and the techniques used to maximize the capacity of cellular network
2. To describe the basics of multi-path fading and various parameters used to characterize small scale fading
3. To explain various multiple access techniques
4. To explore the architecture and call processing of GSM and CDMA system

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain the basics and design challenges of cellular networks
CO2 Analyze signal propagation issues and their impact on the communication system performance
CO3 Compare and determine capacity of different multiple access techniques
CO4 Describe the architecture, operation and call processing of GSM system
CO5 Describe CDMA system and analyze it's design parameters

Unit I: Cellular Fundamentals (10)
Introduction to wireless Communication Systems, Evolution in cellular standards, Cellular concepts, Frequency reuse, Channel assignment, Handoff, Interference and System capacity, Trunking and Grade of service, Improving coverage and capacity.

Unit II: Mobile Radio Propagation (10)
Propagation mechanism, Free space path loss, Fading and Multipath, Small scale multipath propagation, Impulse response model of multipath channel, Parameters of mobile multipath channels, Types of small scale fading, Equalization techniques.

Unit III: Coding and Multiple Access Techniques for Wireless Communications (06)
Selection of Speech Coders for Mobile Communication, Linear Predictive Coders, Vocoders, GSM Codec, Multiple Access Techniques, Orthogonal Frequency Division Multiplexing(OFDM), OFDM applications.

Unit IV: Global System for Mobile Communications (08)
Evolution of Mobile standards, System Overview, The air interface, Logical and Physical channels, Synchronization, GMSK modulation, Call establishment, Handover.

Unit V: Code Division Multiple Access (08)
Basics of spread spectrum, Orthogonal codes, Physical and logical channels of IS-95, Handover mechanism, Factors affecting the performance of CDMA system, Comparison of WCDMA and CDMA 2000, Overview of LTE Standard, Architecture and Frame structure of LTE, Introduction to 5G standard, Comparison between 4G and 5G.

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Text Books:

1. Theodore S Rappaport**, "Wireless Communications Principles and Practice",** *Pearson Education,* (2nd Edition), (2010).
2. Andrea Goldsmith**, "Wireless Communications",** *Cambridge University Press***,** (1st Edition), (2005)**.**
3. William C.Y. Lee, **"Mobile Communications Engineering: Theory and applications"**, *McGraw-Hill Education*, (2nd Edition), (2017).

Reference Books:

1. Vijay K. Garg, Joseph E. Wilkes, **"Principles and Applications of GSM"**, *Pearson Education,* (6th Edition), (2009).
2. *Vijay K. Garg,* **"IS-95 CDMA and CDMA 2000 Cellular/PCS Systems Implementation"**, *Pearson Education,* (1st Edition), (2000).
3. R. Blake, "**Wireless Communication Technology",** *Thomson Delmar*, (1st Edition), (2015).

Online Resources:

1. NPTEL Course on **"Introduction to wireless and cellular communication"** https://onlinecourses.nptel.ac.in/noc20_ee61/

MKSSS CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

20EC 801L BROADBAND COMMUNICATION SYSTEMS LAB

Teaching Scheme
Practical: 2 Hours / Week

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

Course Objectives:

1. To interpret performance parameter of optical fiber
2. To interpret characteristics parameter for optical source and detector
3. To understand aspects of optical fiber communication link
4. To understand satellite communication link

Course Outcomes:

After completion of the course, students will be able to

CO1 Compute parameters of optical fiber: Numerical Aperture (NA), attenuation and bending losses
CO2 Illustrate characteristics parameters of optical source and detectors
CO3 Simulate power budget and rise time budget of optical link
CO4 Simulate Satellite scenario to measure BER and PER

List of Experiments:

1. Measure numerical aperture of optical fiber.
   Program to compare the acceptance angle for meridional ray and skew rays which change direction by 100 degrees at each reflection.
2. Program to Estimate the a) delay difference between the slowest and fastest modes at the fiber output b) the rms pulse broadening due to dispersion c) the maximum bitrate and bandwidth supported.
3. Program to determine the total carrier recombination lifetime, the power internally generated. Plot V-I characteristics of LED used in optical fiber communication.
4. Program to determine Quantum efficiency and responsivity of photodiodes . Compare performance of APD for different load resistors and biasing voltage.
5. Simulate Power budget and Rise time budget analysis of optical fiber system
6. Program to design wavelength channel plan for
   (a) 8 band, 32 channel dense WDM Interleave Waveband Filter band.
   (b) The overall bandwidth of the filter in each case.
7. End-to-End DVB-S2 Simulation with RF Impairments and Corrections.
8. Satellite link design/ Model, Visualize, and Analyze Satellite Scenario.

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20PEEC 801LA MICROWAVE AND RADAR ENGINEERING LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Objectives:

1. To learn reciprocal and non reciprocal passive microwave components.
2. To learn the characteristics of active devices like reflex klystron and Gunn diode.
4. To learn the nature of standing waves formed due to impedance mismatch.
5. To learn the working principle of Radar.

Course Outcomes:

After completion of the course, students will be able to

CO1 Measure and Analyze the characteristics of reciprocal and non-reciprocal passive microwave components.
CO2 Analyze the characteristics of various microwave sources like Reflex Klystron and Gunn Diode.
CO3 Analyze Standing waves for various terminations.
CO4 Simulation of Radar to measure range and speed of the target.

List of Experiments:

1. Measure and plot mode characteristics of the Reflex klystron.
2. Measurement of the free space wavelength of the microwave (for TE 10 mode) with the help of the X-band microwave test bench and verify with its theoretical calculation.
3. Measure VI characteristics of Gunn Diode and study of PIN modulator.
4. Measure and verify port characteristics of microwave tees (E, H, E-H or magic tee).
5. Measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
6. Measure and verify port characteristics of Isolator and Circulator. Calculate insertion loss and isolation in dB.
7. Measure wavelength of the microwave using a microwave test bench and verify with its theoretical calculations.
8. Plot a standing wave pattern and measure SWR for open, short and matched termination at microwave frequency using a slotted section with probe carriage.
9. To simulate the operation of Radar.

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20PEEC801LB REMOTE SENSING LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Objectives:

1. To introduce Geographic information system (GIS) software and operations on geo data using Quantum GIS (QGIS)
2. To provide knowledge about collecting and reading remote sensing data
3. To develop programming skills for satellite image analysis
4. To apply digital image processing and machine learning techniques on multispectral and hyperspectral images

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply QGIS software for geospatial data analysis
CO2 Choose and apply image pre-processing and enhancement techniques on satellite images
CO3 Collect data from different satellites and apply data analysis steps using Python
CO4 Develop algorithms for clustering and classification of multispectral and hyperspectral images

List of Experiments:

1. (a) Introduction to Quantum GIS (QGIS) software, (b) Read and display satellite images, Process raster data and create composites.
2. Implement image enhancement techniques for satellite images.
3. Implement pan-sharpening algorithm on satellite data.
4. Develop an algorithm to perform data analysis on satellite images (Sentinel/Landsat)- Read data, Visualize bands, Plot histogram, Calculate vegetation and soil indices.
5. Develop an algorithm to perform dimensionality reduction and clustering in hyperspectral images.
6. Develop an algorithm for supervised classification in multispectral/hyperspectral images.

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20PEEC801LC INDUSTRIAL AUTOMATION LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Objectives :

1. To demonstrate the measurement& control of a physical variable using an appropriate measurement and control circuit
2. To plot the response of Proportional (P), Proportional and Integral (PI) and PID Controllers
3. To introduce interfacing of I/O devices with PLC
4. To develop Ladder Program for Process Control Applications
5. To interface PLC with SCADA

Course Outcomes :

After completion of the course, students will be able to

CO1 Detect & control a physical variable using an appropriate measurement & control circuit
CO2 Plot the response of a Proportional, Proportional & Integral and PID Controllers
CO3 Interface I/O devices for a process control application with PLC
CO4 Develop PLC Ladder Programs for Process Control Applications
CO5 Interface PLC with RTU (Remote Terminal Unit) and SCADA

List of Experiments:

1. Temperature detection & control using RTD.
2. Temperature detection & control using Thermocouple.
3. Plotting step response of Proportional, Proportional & Integral and PID Controllers (Matlab based)
4. Interfacing of I/O devices (eg. Mechanical Switches, Relays) with PLC
5. Controlling the speed of Servo Motor using an analog voltage of 0-10V
6. Interfacing of PLC to Pneumatic Circuit
7. Developing PLC Ladder Programs for basic logical operations
8. Developing PLC program for a given Process Control Application
9. Interfacing PLC with RTU & SCADA at remote location.

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20PEEC801LD EMBEDDED DESIGN AND RTOS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
In Semester: 25 Marks
Practical: 25 Marks
Credits: 1

Course Objectives:
1. Interface real world input and output devices
2. Discuss use of µCOS-II RTOS functions in programming
3. Explain porting of Linux OS

Course Outcomes:
After completion of the course, students will be able to
CO1 Interface real world input and output devices
CO2 Apply RTOS concepts to external peripheral devices
CO3 Write C program using RTOS functions
CO4 Port Linux OS in embedded system

List of Experiments:
1. Port µCOS-II RTOS on ARM7.
2. Multitasking in µCOS-II RTOS using min 4 tasks on ARM 7
3. Semaphore as Signaling and Synchronizing on ARM 7.
4. Mailbox implementation for message passing on ARM 7.
5. Implement MUTEX on ARM 7.
6. Use OS service(s) to accept keyboard input and display/transmit.
7. Building tool chain for embedded Linux and porting Kernel on ARM 9 target board.
8. Write a program 'Hello world; using embedded Linux on ARM 9.

MKSSS'S CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

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/