METHODIST COLLEGE OF ENGINEERING & TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Accredited by NBA & NAAC with A+ Grade

Approved by AICTE, New-Dehli. Affiliated to Osmania University, Hyderabad.
Abids, HYDERABAD-500001, Telangana.

M21 - SCHEME OF INSTRUCTIONS and SYLLABI of III to VIII Semesters for B.E. Four Year Degree Programme in Electronics and Communication Engineering

(With Effect from the Academic Year 2022-23)
(As approved in Academic Council Meeting)

Empower Youth - Architects of Future World

B.E. III Semester

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs per Week	CIE	SEE	SEE Duration in ours	
Theory Courses										
1	5PC301EC	Electronic Devices	3	0	0	3	40	60		3
2	5PC302EC	Signals and Systems	3	0	0	3	40	60		3
3	5PC303EC	Network Theory	3	0	0	3	40	60		3
4	5PC304EC	Switching Theory and Logic Design	3	0	0	3	40	60		3
5	5ES303EC	Probability Theory and Stochastic Processes	3	0	0	3	40	60		3
6	5HS302HS	Managerial Economics and Financial Accountancy	3	0	0	3	40	60		3
7	5MC303HS	Indian Constitution	2	0	0	2	40	60		0
8	5ES304EC	Python Programming	2	0	0	2	40	60		2
Practical/Laboratory Course										
9	5PC351EC	Electronic Devices and Logic Design Lab	0	0	2	2	40	60		1
10	5PC352EC	Network Theory Lab	0	0	2	2	40	60		1
11	5ES353EC	Python Programming Lab	0	0	2	2	40	60		1
Total			**22**	**0**	**6**	**28**	**440**	**660**		**23**

III - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC301EC	Electronic Devices						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize :

1. The concepts of semiconductor devices like PN junction diode, Transistor, and special diodes.
2. The applications of diodes.
3. To familiarize the students with various two terminal and three terminal electronic devices working and use in the design of real time electronic products.
4. Design DC biasing techniques and evaluate A.C parameters for BJT in Amplifier Applications.
5. Explore V-I characteristics of FETs, MOSFETs and study IC fabrication techniques

COURSE OUTCOMES :

1. Demonstrate understanding of the characteristic behavior of various electronic devices such as Diodes, Transistors etc, and applying them for understanding various circuits.
2. Evaluate the performance parameters of various diode circuits (rectifiers, clippers and clampers). Identify the merits and demerits of various filters, formulate and design rectifier circuits with filters. Calculate ripple factor, efficiency and percentage regulation of rectifier circuits.
3. Discriminate the BJT configurations to recognize appropriate transistor configuration for any given application and design the biasing circuits with good stability.
4. Analyze and design various circuits for different applications in Engineering Field.

UNIT - I

Semiconductor Diode Characteristics: The p-n junction Diode, Energy band diagram, Current equations, V-I characteristics, Temperature dependence, Diode resistance-Static and Dynamic, Transition capacitance, Diffusion capacitance, Zener

diode, Avalanche breakdown, Zener breakdown mechanisms – Zener diode as voltage Regulator, Hall effect.

UNIT - II

Diode Applications: Diode as a circuit element, Clipping and clamping circuits, clamping circuit theorem. Half wave, Full wave and Bridge Rectifiers - their operation, performance characteristics- ripple factor calculations, and analysis; Filters (L, C, LC and CLC filters).

Special Purpose Semi-Conductor Devices: Elementary treatment of Silicon Controlled Rectifier (SCR), UJT, Tunnel diode. Schottky diode, LED, Photodiode, Solar cell.

UNIT – III

Bipolar Junction Transistor : Construction and Operation of Bipolar Junction Transistor, current components, Modes of transistor operation, BJT input and output characteristics of CB, CE, CC configuration, early effect

Biasing and Stabilization: Biasing techniques, Stabilization factors, Compensation techniques, Thermal run away, Thermal Stability

UNIT – IV

Small Signal Transistors equivalent circuits: Small signal low frequency h-parameter model of BJT, Approximate model, Analysis of BJT amplifiers using approximate model for CB, CE and CC configurations.

UNIT - V

Field Effect Transistor: Junction Field Effect Transistor: Principle of Operation - the Pinch-off Voltage, V-I Characteristics of JFET.

MOSFETs : Enhancement & Depletion mode MOSFETs, V-I characteristics, CMOS inverter. Small signal model analysis of FET

TEXT BOOKS :

1. Millman and Halkias , -"Electronic Devices and Circuits", 2nd Edition, McGraw Hill Publication, 2007.
2. Robert L. Boylestad, -"Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.
3. S.K. Gandhi, -"VLSI Fabrication Principles: Silicon and Gallium Arsenide", Wiley India Pvt. Ltd., New Delhi, 2nd Edition. 1994.

REFERENCE BOOKS :

1. Jacob Millman, Christos Halkias, Chetan Parikh, -"Integrated Electronics", McGraw Hill Publication, 2nd Edition, 2009.
2. David Bell, -"Fundamentals of Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
3. Christian Piguet, -"Low Power CMOS Circuits Technology, Logic Design and CAD Tools", 1st Indian Reprint, CRC Press, 2010.

Course Code	Course Title						Core/Elective
5PC302EC	Signals and Systems						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. Analyze basic concepts related to continuous time signals and systems, mathematical representation of periodic signals.
2. Familiarize with basic operations on signals and mathematical representation of aperiodic signals using Fourier and Laplace transform.
3. Analyze basic concepts related to discrete time signals and systems, mathematical representation of discrete time signals.
4. Describe the concept of Z- Transform and its properties and illustrate their applications to analyze systems.
5. Define convolution, correlation operations on continuous and discrete time signals.

COURSE OUTCOMES :

1. Define and differentiate types of signals and systems in continuous and discrete time.
2. Apply the properties of Fourier transform to continuous time signals.
3. Relate Laplace transforms to solve differential equations and to determine the response of the Continuous Time Linear Time Invariant Systems to known inputs.
4. Apply Z-transforms to discrete time signals to solve Difference equations.
5. Obtain Linear Convolution and Correlation of discrete time signals with graphical representation.

UNIT - I

Definitions and classifications: Classification of signals. Elementary continuous time signals, Basic operations on continuous-time signals. Classification of continuous-time systems: continuous time & discrete time systems, lumped-parameter & distributed –parameter systems, static & dynamic systems, causal &

non-causal systems, Time-invariant & time-variant systems, stable & unstable systems.

UNIT - II

Representation of Continuous-time signals: Analogy between vectors and signals, orthogonality and completeness.

Fourier series analysis of Continuous-time signals: Fourier series – Existence of Fourier series, Trigonometric and Exponential Fourier series, Computational formulae, Symmetry conditions, Complex fourier spectrum.

UNIT - III

Continuous-time Fourier Transform (FT): The direct and inverse FT, existence of FT, Properties of FT, FT of standard signals, properties of FT, The Frequency Spectrum.

Linear convolution of continuous time signals: Graphical interpretation, properties of convolution, Correlation between continuous-time signals: Auto and Cross correlation, graphical interpretation, properties of correlation.

Laplace Transform (LT) Analysis of signals and systems: The direct LT, Region of convergence, existence of LT, properties of LT. The inverse LT, Solution of differential equations, System transfer function.

UNIT - IV

Discrete-time signals and systems: Sampling, Classification of discrete-time signals, Basic operations on discrete time signals, Classification of discrete time systems, properties of systems.

Linear Convolution of discrete time signals: Graphical interpretation, Properties of discrete convolution.

Fourier analysis of discrete-time signals: Discrete-time Fourier transform (DTFT), properties of DTFT, Transfer function, Discrete Fourier transform properties of DFT.

UNIT - V

Z-Transform analysis of signals & systems: The direct Z-transform, Region of convergence, Z-plane and S-plane correspondence. Inverse Z-transform, Properties of Z-transforms. Solution to linear difference equations, linear constant coefficient systems, System transfer function.

TEXT BOOKS:

1. B. P. Lathi, "Linear Systems and Signals", 2nd Edition, Oxford University Press, 2009.
2. Alan V Oppenheim, A. S. Wlisky, "Signals and System", 2nd Edition, Prentice Hall.

REFERENCE BOOKS:

1. Douglas K. Linder, "Introduction to Signals and Systems", McGraw Hill, 1999.
2. P. Ramesh Babu, R Ananada Natarajan, "Signals and Systems", SCITECH, 3rd edition, 2009.
3. Rodger E. Ziemer, William H Trenter, D. Ronald Fannin, "Signals and Systems", Pearson , 4th Edition, 1998.

Course Code	Course Title						Core/Elective
5PC303EC	Network Theory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Concepts of Two Port networks, study of different two port parameter representations.
2. Concepts of the image impedance a different network, Design of attenuators.
3. Design concepts of equalizers.
4. Design concepts of different filters.
5. Design concepts of network synthesis.

COURSE OUTCOMES :

1. Able to Express given Electrical Circuit in terms of A, B, C, D and Z, Y Parameter Model and Solve the circuits and how they are used in real time applications.
2. Able to learn how to calculate properties of networks and design of attenuators.
3. Able to design of equalizers.
4. Able to design different types of filters using passive elements.
5. Able to synthesize the RL & RC networks in Foster and Cauer Forms.

UNIT - I

Two Port networks: Z, Y, h, g and ABCD parameters, equivalence of two ports networks, T-PI transforms, Reciprocity theorem, Interconnection of two port networks and Brune's test of inter connections.

UNIT-II

Symmetrical and Asymmetrical Networks: Characteristic impedance and propagation constant of symmetrical T and pi networks, Image and iterative impedances, Image transfer constant and iterative transfer constant of asymmetrical L, T and pi networks.

UNIT - III

Constant k- Filters - Low pass, high pass, band pass and band elimination filter design, m- derived low pass and high pass filter design, Composite filter design and notch filter.

UNIT - IV

Attenuators and Equalizers - Design of symmetrical T, pi, Bridge-T and Lattice attenuators, impedance matching networks, Inverse networks, Equalizers, Constant resistance equalizer, full series and full shunt equalizer.

UNIT - V

Network Synthesis : Hurwitz polynomials, positive real functions, Basic Philosophy of Synthesis, L-C Immittance functions, RC impedance functions and RL admittance functions. RL impedance functions and RC admittance functions. Cauer And Foster's forms of RL impedance and RC admittance. Properties of RC, RL Networks.

TEXT BOOKS :

1. Ryder J.D, "Network Lines Fields", Prentice Hall of India, 2nd edition, 1991.
2. P.K. Jain and Gurbir Kau, "Networks, Filters and Transmission Lines", Tata McGraw- Hill Publishing Company Limited, 1st edition, 1994.

REFERENCE BOOKS :

1. A. Sudhakar and Shyam mohan, "Circuits Networks: Analysis Synthesis", Tata McGraw Hill, 4th edition, 2010.
2 Van Valkenburg M.E, "Introduction to Modern Network Synthesis", Wiley Eastern, 1st edition, 1994.
3. S.P. Ghosh and A.K. Chakraborty, "Network Analysis and Synthesis", McGraw Hill, 1st edition, 2009.

Course Code	Course Title						Core/Elective
5PC304EC	Switching Theory and Logic Design						Core
Prerequisite	Contact hours per week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. To understand basic number systems, codes and logical gates.
2. To understand the concepts of Boolean algebra.
3. To understand the use of minimization logic to solve the Boolean logic expressions.
4. To understand the design of combinational and sequential circuits.
5. To understand the state reduction methods for Sequential circuits.
6. To understand the various types of memories.

COURSE OUTCOMES :

Students will be able to: -

1. To apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions using suitable gates namely NAND, NOR etc.
2. Make use of the concepts to solve the problems related to the logic circuits.
3. Design simple Combinational Circuits such as Adders, Subtractors, Code Convertors, Decoders, Multiplexers, and Magnitude Comparators etc.
4. Identification of gates – application. Understand and Design – concept of FSM, Mealy and Moore machines.
5. Design Sequential Circuits such as different types of Counters, Shift Registers, Serial Adders, and Sequence Generators. Compare various Programmable logic devices.

UNIT - I

Number System: Binary, decimal, octal, hexa decimal, weighted and un-weighted codes.

Boolean Algebra: Axiomatic definition of Boolean algebra, Binary operators, postulates of and theorems. Boolean addition, subtraction, 1's complement, 2's complement. Switching functions, Canonical forms and Standard forms, Simplification of switching functions using theorems.

Character coding schemes - ASCII. Arithmetic operations on binary octal,

hexadecimal and BCD numbers. Error Detection and Correction – Parity and Hamming code.

UNIT – II

Logic gates: Basic gates and universal gates.

Minimization of Switching Functions: simplification rules, Karnaugh map method, Prime implicants, don't care combinations, Minimal SOP and POS forms, Quine-McCluskey Tabular Method, Prime Implicant chart.

UNIT – III

Single output and multiple output combinational logic circuit design, AND-OR, OR-AND, and NAND/NOR realizations, Exclusive-OR and Equivalence functions, Binary adders/subtractors, carry look ahead adder, BCD adder, code converter, magnitude comparator, Encoder, Decoder, Multiplexer, Demultiplexer, MUX realization of switching functions, Parity bit generator, Code-converters, Concepts of threshold logic and threshold gates.

UNIT – IV

Sequential Circuits-1: Classification of sequential circuits (Synchronous, Asynchronous Pulse mode, and Level mode with examples). Basic flip-flops-Triggering and excitation tables. Conversion of flip-flops.

Sequential Circuits-2: The sequential circuit model, Asynchronous counters, Design of simple synchronous sequential circuits such as counters (Design of modulo-N counter, Ring counter, twisted ring counter) and Shift registers

UNIT - V

Programmable Logic Devices: Basic PLD's-ROM, PROM, PLA, and PLD Realization of Switching functions using PLDs.

Algorithmic State Machines: State machines and state diagrams. Design of weighing machine and binary multiplier.

TEXT BOOKS :

1. Morris Mano, -"Digital design" PHI, 2nd Edition.
2. Zvi Kohavi and Niraj K Jha -"Switching & Finite Automata theory"– Cambridge, 3rd Edition.

REFERENCE BOOKS :

1. Fletcher -"An Engineering Approach to Digital Design" – PHI. -2nd edition.
2. Roth, Kenny, -"Fundamentals of Logic Design", Cengage Learning, Seventh Edition.
3. John M. Yarbrough -"Digital Logic Applications and Design"– Thomson Publications, 2006.
4. CVS Rao, -"Switching Theory and Logic Design" Pearson Education, 2005.

Course Code	Course Title						Core/Elective
5ES303EC	Probability Theory and Stochastic Processes						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. To understand fundamentals of probability and random variables as applicable to Electronics Engineering.
2. To learn one Random variable characteristic function of different variables using their density functions.
3. To learn Two Random variable characteristic functions of different variables using their density functions.
4. To understand elementary concepts of the stochastic processes and their temporal characteristics.
5. To understand elementary concepts of the stochastic process and their spectral characteristics.

COURSE OUTCOMES :

Upon completing this course, the student will be able to

1. To understand different types of Random variables their density and distribution functions.
2. To learn one Random variable characteristics of different variables their density and distribution functions.
3. To extend bi-variate distributions and the operations on.
4. To understand elementary concepts of the stochastic process in to Temporal characteristics.
5. To understand elementary concepts of the stochastic process in to spectral characteristics.

UNIT - I :

Probability & Random Variable: Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events, Random Variable- Definition, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variable.

UNIT - II:

Distribution & Density Functions and Operations on One Random Variable : Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Rayleigh, Methods of defining Conditional Event, Conditional Density, Properties. Expected Value of a Random Variable, Function of a Random Variable g(x) and its distribution, Moments about the Origin, Central Moments, Variance and Skew, Chebyshev's Inequality (no proof), Characteristic Function, Moment Generating Function; Transformations of Random Variables.

UNIT - III :

Two Random Variables and operations : Joint Distribution and Density Functions and their properties, Joint Moments, Joint Characteristic Functions, Conditional Distributions (Point & Interval), Conditional Expected Values. Marginal distribution functions, Statistical independence, Sum of two random variables, Central Limit Theorem (no proof); Engineering application (theoretical discussion) – Mutual information, Channel Capacity and Channel Coding.

UNIT - IV

Stochastic Processes – Temporal Characteristics : Introduction to stationary (First and Second order; WSS; SSS), Statistical independence, Time averages and ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Auto correlation Function and its Properties, Cross-Correlation Function and its Properties, Covariance and its Properties. Linear System Response of Mean and Mean-squared Value.

UNIT - V

Stochastic Processes - Spectral Characteristics : Power Density Spectrum and its properties; Relationship between Power Density Spectrum and Autocorrelation Function; Relationship between Cross-Power Density Spectrum and Cross-Correlation Function; White and colored noise, response to linear systems and stochastic inputs, concept of Markov Processes.

TEXT BOOKS :

1. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing", Pearson Education, 3rd edition, 2014.
2. Athanasius Papoulis and S. Unni krishna Pillai, "Probability, Random Variables and Stochastic Processes", McGraw Hill, 4th edition, 2006.

REFERENCE BOOKS:

1. Peyton Z. Peebles, "Probability Random Variables & Random Signal Principles", Tata McGraw Hill, 4th edition, 2001.
2. k. Murugeshan and P.Guruswamy, "Probability statistics and Random processes", Anuradha Agencies, 3rd edition, 2003.
3. Bruce Hajck, "Random processes for Engineers", Cambridge unipress, 2nd edition, 2015.

Course Code	Course Title						Core/Elective
5HS302HS	Managerial Economics & Financial Accounting						HS
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES:

1. To understand responsibilities of a manager of a business undertaking.
2. To analyze various determinants influencing demand and price.
3. To understand the principles of accounting and prepare Journal, Ledger, Trial Balance & Final accounts.
4. To understand Financial statement Analysis.
5. To evaluate & analyze the long term investments.

COURSE OUTCOMES :

1. Determine the responsibilities & decision making in the Organization.
2. Understand the various factors influencing demand & market structure.
3. Understand the principles of Accounting & solve the problems.
4. Analyze the Financial performance.
5. Understand the capital structure & to take decision on selection of projects.

UNIT - I

Introduction to Managerial Economics, its Scope, Importance and relation to other sciences, its usefulness to Engineers-Basic concepts of Managerial Economics.

UNIT - II

Demand Analysis: Introduction to demand, determinants, law of demand, its assumptions, Elasticity of demand-price, income and cross elasticity, demand forecasting, Market, competitive structure, price & output determination under perfect competition and Monopoly.

UNIT - III

Basics of Accounting: Financial Accounting - Definition - Accounting Cycle-Journal - Ledger - Cash book - Trial Balance.

UNIT - IV

Financial statement Analysis: Preparation of Final accounts with simple adjustments (including problems). Ratio Analysis – Importance – Liquidity and profitability ratios.

UNIT-V

Capital management : Significance determinates and estimation of fixed and working capital requirements, sources of capital, Introduction to capital budgeting, Time Value of money - Methods: Non-Discounted cash flow methods (pay back, ARR), Discounted (NPV, PI, IRR) with problems.

TEXT BOOKS :

1. Mehta P.L., "Managerial Economics", Sultan Chand & Sons Publishers.
2. Luke M Froeb, "Managerial Economics - A Problem Solving Approach".
3. I.M.Panday, "Financial Management", Vikas Publishing House.
4. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House.

REFERENCE BOOKS :

1. R.L.Varshney, K.L.Maheshwari, Managerial Economics, Sultan Publishers.
2. D.M.Mithani, Managerial Economics, Himalaya Publishing House.
3. Mukherjee, Hanif, Financial Accounting, Tata McGraw Hill.
4. Ramachandran, Kakani, Financial Accounting for Management, Tata McGraw Hill.

Course Code	Course Title						Core/Elective
5MC303HS	Indian Constitution						MC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	0	-	0	40	60	0

COURSE OBJECTIVES :

1. To create awareness and relevance of the Indian Constitution, its directive principles.
2. To impart understanding of the role, powers and functions of administration at the Central, State and local levels.
3. To expose students to the relations between Central/Federal, State and Provincial units, divisions of executive, legislative and judiciary in them.
4. To impart knowledge about the statutory institutions and their role.

COURSE OUTCOMES:

1. Have a general knowledge and back ground of the Constitution of India and its importance.
2. Will distinguish and understand the working of the Central, state and provincial levels of administration.
3. Will be conscious about the fundamental duties, responsibilities and rights as an ideal citizen of India
4. Will be able to perceive and interpret the functioning and distribution of resources between centre and state.
5. Have an awareness and relate to the existing hierarchy of the social structure, election process and grievance redressal in a democracy.

UNIT-I

Introduction to Constitution- Meaning, reasons for having a constitution. Evolution of the Indian Constitution: History, 1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Preable- its importance and key words; Fundamental features of the Indian Constitution. Emergency powers.

UNIT - II

Style of Governance adopted, Structure of the Indian Union, Relationship between bodies in hierarchy.

Union Government: Executive-President, Prime Minister, Council of Minister-role, position and powers.

State Government: Executive: Governor, Chief Minister, and Council of Minister - role, position and powers.

Local Government: Panchayat Raj Institutions, Rural and Urban local bodies-composition, role, position and powers.

UNIT - III

Rights and Duties: Fundamental Rights- importance and salient features,

Directive principles of State Policy-meaning and purpose, classification, importance and implementation

Fundamental duties of a good citizen.

UNIT-IV

Relation between Federal and Provincial units:

Union-State relations: Administrative, legislative and Financial, Inter-State council, NITI Ayog, Finance Commission of India.

Judiciary: Meaning and Functions, Conditions of independence of judiciary, Composition and powers of Supreme court, judicial activism and judicial restraint.

UNIT - V

Constitutional bodies: Finance Commission, UPSC, Election Commission, the CAG, National Commissions for SCs and STs, etc.

Statutory Institutions: Securities & Exchange Board of India, National Human Rights Commission, National Commission for Women, National Commission for Minorities, National Green Tribunal, National Commission for Protection of Child Rights etc.

TEXT BOOKS :

1. Durga Das Basu, "Introduction to the Constitution of India", 25th Edition, English- Hardcover – 1 January 2021, Dr. Durga das Basu (Author), ASIN:B091Q92R7R Publisher:Lexis Nexis, New Delhi, 2021.
2. PM Bhakshi, "The Constitution of India", 1 January 2017, English, Paperback, Publisher Universal Law Publishing - An imprint of Lexis Nexis.

REFERENCE BOOKS:

1. Subhash Kashyap, "National Book Trust Our Parliament", English Medium, ISBN 19788123701479, Publication National Book Trust-New Delhi.
2. Peu Ghosh, "Indian Government and Politics Paperback", (Author) Publisher: Prentice Hall India Learning Private Limited (1 January 2012), English, Paperback, ISBN-10: 8120346491; ISBN-13 : 978-8120346499.
3. Dr. B.L. Fadia, Dr. Kuldeep Fadia, "Indian Government and Politics", Authors: ISBN: 978-93 84885-62-5, Sahithya Bhavan Publications, Agra.

Course Code	Course Title						Core/Elective
5ES304EC	Python Programming						Mandatory
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Basic Mathematics	2	0	-	0	40	60	2

COURSE OBJECTIVES :

1. To learn how to use lists, tuples, and dictionaries in Python programs.
2. To learn how to write loops and decision statements in Python.
3. To learn how to read and write files in Python.
4. To learn how to use exception handling in Python applications for error handling.

COURSE OUTCOMES :

1. Explain basic principles of Python programming language.
2. Create, run, and manipulate Python Programs using core data structures like Lists, Tuple, Set and Dictionaries.
3. Understand and summarize different File handling operations.
4. Handle exceptions in programming.

UNIT - I

Basics of Python: Algorithms, building blocks of algorithms (statements, state, control flow), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms. Python Basics, Features of Python, Python Applications, Installing and running Python with Different IDEs, Comments in Python, Memory Management in Python, Garbage Collection in Python, Python I/O : Printing to the Screen, Reading Keyboard Input.

UNIT - II

Python Operators: Arithmetic, Relational and Comparison Operators, Python Assignment Operators, Logical Operators and Bitwise Operators, Membership Operators, Identity Operators, Operator Precedence and Associativity, Evaluating Expressions. Control Statements: A Word on Indentation, the if Statement, The if … else Statement, The if … elif … else Statement, The while Loop, the for Loop, Infinite

Loops, Nested Loops, Loop manipulation using pass, continue, break and else Statement.

UNIT - III

Variables and Data Types in Python : How Python Sees Variables, Constants, Identifiers and Reserved words in Python, Naming Conventions in Python. Declaring and using Numeric data types: int, float, complex and Boolean, Sequences: Using String data type, Lists and Tuples, Methods and Useful Built-in Functions, Dictionaries and Set Types.

UNIT - IV

Python Programming using functions, modules, and packages: Organizing python codes using functions, Formal and Actual Arguments, Positional Arguments, Keyword Arguments, Default Arguments, Variable Length Arguments, Pass by Object Reference, Local and Global Variables, Scope and Lifetime of variables, Nested Functions, Recursive Functions, Powerful Lambda function.

UNIT - V

Python File Input-Output : Opening and closing file, Various types of file modes, reading and writing to files. Python Exception Handling: Avoiding code break using exception handling, Various keywords to handle exception, try .. exception else … finally, Raising Exceptions, Assertions, Python Custom Exceptions. Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

TEXT BOOKS :

1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers, "Learning with Python: How to Think Like a Computer Scientist", 3rd Edition.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Shroff O’Reilly Publishers.

REFERENCE BOOKS :

1. Hans Fangohr, "Introduction to Python for Computational Science and Engineering (A beginner's guide)", Edition, top, Publisher.
2. Timothy A. Budd, "Exploring Python", Mc Graw Hill Education.
3. John V Guttag, - "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press.

Course Code	Course Title						Core/Elective
5PC351EC	Electronic Devices and Logic Design Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. The V-I characteristics of diodes and determination of static and dynamic resistances of semiconductor diode.
2. To design the rectifiers and performance of parameters.
3. To understand the characteristics of transistor in various configurations

COURSE OUTCOMES :

1. To demonstrate the characteristic behavior of PN junction diode and Zener diode.
2. To design various non-linear wave shaping circuits using diodes for given specifications.
3. Analyze the behavior of non-linear wave shaping circuits using diodes.
4. Examine the characteristics of BJT and FET in various configurations.
5. Evaluate and compare the significant parameters obtained from the characteristics of BJT and FET.

List of Experiments:

PART-A

1. V-I Characteristics of Silicon and Germanium diodes and measurement of static and dynamic resistances.
2. Zener diode characteristics and its application as voltage regulator.
3. Clipping and Clamping Circuits.
4. Design, realization and performance evaluation of half wave rectifiers without filters and with filters (capacitor filter and p - section filter).
5. Plotting the characteristics of BJT in Common Base configuration and Common Emitter configuration.
6. V-I Characteristics of JFET in CS configuration.
7. Frequency response of Common Source FET amplifier.
8. V-I characteristics of UJT.

PART - B

1. Verification of truth tables of Logic gates and realization of Binary to Gray and Gray to Binary code converters.
2. Realization of Half adder/ and full adder/using universal logic gates.
3. Realization of Full adder/using MUX and Decoder.
4. Design 2's complement Adder/subtractor using IC 74283 and verify experimentally.
5. Verification of truth tables of Flip Flops and Flip flop conversions form one form to the other.

Note :

1. Wherever possible, Analysis and design of circuits shall be carried out using simulation tools.
2. A minimum of 10 experiments should be performed.

Objective

- To get acquainted with the Analog/Digital Training System.
- To get acquainted with different standard integrated circuits (ICs).
- To study the basic logic gates: AND, OR, INVERT, NAND, NOR, and XOR.
- To understand formulation of Boolean function and truth table of logic circuits.

Components

Analog/Digital Training System - IC Type 7400 Quadruple 2-input NAND gates
- IC Type 7402 Quadruple 2-input NOR gates
- IC Type 7404 Hex Inverters
- IC Type 7408 Quadruple 2-input AND gates
- IC Type 7432 Quadruple 2-input OR gates
- IC Type 7486 Quadruple 2-input XOR gate

Experiment No.	Title of the Experiment	Objective of the Experiment
1	To study and verify the truth table of logic gates	Identify various ICs and their specification a. OR gate b. AND gate c. NAND gate d. NOR gate
2	Realization of a Boolean function	To simplify the given expression and to realize it using Basic gates and Universal gate
3	Design and implementation using NAND gate	To realize why NAND gate is known as the universal gate by implementation of: a. NOT using NAND b. AND using NAND c. OR using NAND d. XOR using NAND
4	Adders and Subtractors	To realize a. Half Adder and Full Adder b. Half Subtractor and Full Subtractor by using Basic gates and NAND gates
5	Binary to grey generator	To learn the importance of weighted and non weighted code To learn to generate gray code.
6	Multiplexer and Demultiplexer	a. To design and set up a 4:1 Multiplexer (MUX) using only NAND gates. b. To design and set up a 1:4 Demultiplexer(DE-MUX) using only NAND gates.

7	Realization of a Boolean function using Logisim	To learn the use of Logisim software to design digital electronics circuits.
8	FlipFlop	a. Truth Table verification of 1) RS Flip Flop 2) T type Flip Flop. 3) D type Flip Flop. 4) JK Flip Flop. b. Conversion of one type of Flip flop to another

TEXT BOOKS :

1. R P Jain, - Modern Digital Electronics.
2. William Gothmann H, - Digital Electronics: An Introduction To Theory And Practice.
3. John Morris, - Digital Electronics.
4. Anand Kumar, - Fundamentals of Digital Circuits.

Course Code	Course Title						Core/Elective
5PC352EC	Network Theory Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	40	60	1

COURSE OBJECTIVES:

1. To learn the usage of basic electronic components, equipments and meters, used in electronic laboratories.
2. To learn practical electric AC & DC circuits.
3. To learn about PCB making
4. To learn various filters.

COURSE OUTCOMES:

1. Use the basic electronic components and design circuits.
2. Verify various parameters of the circuits by applying theorems.
3. Understand the making of PCB.
4. Design various filters.

List of Experiments :

1. Study of all types of discrete Active & passive devices, display devices, integrated components, electro-mechanical components (switches, sockets, connectors etc.,) electromagnetic components (relays). Study and use of different meters (volt/ammeter, AVO/Multi meter) for the measurement of electrical parameters. Measurement of RLC components using LCR Meter.
2. Study of CRO and its applications.
3. Verification of Superposition and Tellegan's theorem.
4. Verification of of Thevenin's and Maximum Power Transfer Theorem.
5. Measurement of two-port network parameters.
6. Measurement of Image impedance and Characteristics impedance.
7. Design of T-section constant K Low Pass Filter.
8. Design of m-derive High Pass Filter.
9. Verification of Reciprocity theorem.
10. Verification of Norton's theorem.
11. Soldering and De-soldering.
12. PCB Making.

Note : A minimum of 10 experiments should be performed. The students may use any commercial / open-source SPICE programs available such as MULTISIM, PSPICE, TINA, and LABVIEW for simulation.

Course Code	Course Title						Core/Elective
5ES353EC	Python Programming Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To learn how to design and program using lists, Sets, tuples, and dictionaries.
2. To learn how to use indexing and slicing to access data in Python programs.
3. To learn structure and components of Python and to read and write files.
4. To learn how to design object oriented programs with Python classes and Exception handling techniques.
5. To learn how to do report preparation to access data.

COURSE OUTCOMES :

1. Develop solutions to simple computational problems using Python programs.
2. Solve problems using Control statements.
3. Develop Python programs by defining functions and parameters.
4. Use Python data structures for problem solving.
5. Apply file handling and report preparation to access data.
6. Develop Python programs for exception handling.

List of Programs :

1. Installing and running python programs with different environments.
2. Write a program to demonstrate python Input /Output functions and data types.
3. Write a program to use python Operators.
4. Write a program to apply control structures.
5. Write a program to implement List, Tuple, Set, dictionary Data structures in python.
6. Write a program to apply String handling functions.
7. Write a program to demonstrate Functions and parameters passing techniques.

8. Write a program to apply recursion and Lambda functions.
9. Write a program to demonstrate python modules and packages.
10. Write a program to apply python File handling.
11. Write a program to demonstrate python Exception Handling.
12. A case study on Creation of Dynamic OTP generator for Financial Transactions.

TEXT BOOKS :

1. Kenneth A. Lambert, “The Fundamentals of Python: First Programs”, 2nd Edition, 2017, Cengage Learning.
2. John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of India.

REFERENCE BOOKS:

1. Mark Summerfield, Programming in Python 3: A Complete introduction to the Python Language, Addison-Wesley Professional, 2009.
2. Allen B. Downey, "Think Python: How to think like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/ O’Reilly Publishers, 2016.

B.E. (ECE) - IV SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Total Hours	CIE	SEE	
Theory									
1	5PC405EC	Analog Electronic Circuits	3	0	0	3	40	60	3
2	5PC406EC	Automatic Control Systems	3	1	0	3	40	60	4
3	5PC407EC	Computer Organization and Architecture	3	0	0	3	40	60	3
4	5PC408EC	Electro Magnetic Theory and Transmission Lines	3	0	0	3	40	60	3
5	5PC409EC	IC Applications	3	0	0	3	40	60	3
6	5MC402HS	Essence of Indian Traditional Knowledge	2	0	0	2	40	60	0
7	5HS403HS	Human Values and Professional Ethics	3	0	0	3	40	60	3
Laboratories									
8	5PC453EC	AEC Laboratory	0	0	2	2	40	60	1
9	5PC454EC	IC Applications Laboratory	0	0	2	2	40	60	1
Total Credits									**21**

IV - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC405EC	Analog Electronic Circuits						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ED, NT	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. The Understand the applications of BJT & FET as a switch and as an amplifier.
2. Analysis of BJT & FET in various configurations using small signal equivalent models and their frequency response.
3. Familiarize with concept and effect of negative feedback.
4. Study of positive feedback and Design different types of oscillators.
5. Design Power Amplifiers and calculate their efficiencies.

COURSE OUTCOMES :

1. Recall and relate the knowledge of BJT and FET behavior in the design of various biasing and amplifier circuits.
2. Apply low and high frequency models of transistor in the analysis of single stage and multistage amplifiers.
3. Design and analyze amplifier and oscillator circuits.
4. Compare and Contrast different types of biasing, Multistage, Feedback and Power amplifiers.
5. Interpret a given analog circuit and evaluate its performance parameters by applying acquired knowledge.

UNIT-I

Transistor at high frequencies : Hybrid π CE transistor model, Hybrid p Conductance's and Capacitances, CE short circuit current gain, Current gain with resistive load, Miller's Theorem.

BJT Amplifiers - Frequency Response: Frequency response of BJT Amplifier, Analysis at Low and High frequencies, Effect of coupling and bypass Capacitors - Single Stage CE Transistor Amplifier Response, Gain-Bandwidth Product, Emitter follower at higher frequencies.

UNIT - II

Multi Stage Amplifiers-Analysis of Cascaded RC Coupled BJT amplifiers, Cascode Amplifier, Darlington Pair, Different Coupling Schemes used in Amplifiers - RC Coupled Amplifier, Transformer Coupled Amplifier, Direct Coupled Amplifier.

UNIT - III

Feed Back Amplifiers: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances. Method of analysis of feedback amplifiers, Analysis of Voltage series, voltage shunt, current series and current shunt feedback amplifiers.

UNIT - IV

Oscillators: Positive feedback and conditions for sinusoidal oscillations, RC oscillator, LC oscillator, Crystal oscillator, Amplitude and frequency stability of oscillator.

Voltage Regulators: Transistor series and shunt voltage regulators.

UNIT - V

Large Signal Amplifies: Large Signal Amplifiers: BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, Class A resistive coupled and transformer coupled amplifiers, Class-B Push-pull and complementary symmetry amplifiers, Class AB operation.

TEXT BOOKS :

1. Millman and Halkias, -"Electronic Devices and Circuits", 2nd Edition, McGraw Hill Publication, 2007.
2. Robert L. Boylestad, -"Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.

REFERENCE BOOKS :

1. Jacob Millman, Christos Halkias, Chetan Parikh, -"Integrated Electronics", 2nd Edition, McGraw Hill Publication, 2009.
2. David Bell, -"Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
3. Christian Piguet, -"Low Power CMOS Circuits Technology, Logic Design and CAD Tools" 1st Indian Reprint, CRC Press, 2010.
4. S.K. Gandhi, - "VLSI Fabrication Principles: Silicon and Gallium Arsenide", Wiley India Pvt. Ltd., New Delhi, 2nd Edition. 1994.

Course Code	Course Title						Core/Elective
5PC406EC	Automatic Control Systems						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	0	40	60	4

COURSE OBJECTIVES :

1. To Analyze the stability and performance of dynamic systems in both time and frequency domain.
2. To design feedback controllers, such as PID, lead and lag compensators, to meet desired system performance specifications.
3. To provide knowledge of state variable models and fundamental notions of state model design.
4. To understand the classical methods of control engineering and physical system modeling by linear differential equations.
5. To understand state space representation of control systems.

COURSE OUTCOMES :

1. Convert a given control system into equivalent block diagram and transfer function.
2. Analyze system stability using time domain techniques.
3. Analyze system stability using frequency domain techniques.
4. Design a digital control system in the discrete time domain.
5. Analyze a control system in the state space representation.

UNIT - I

Control System Fundamentals and Components: Classification of control systems including Open and Closed loop systems, Transfer function representation, Mathematical modeling of Mechanical systems and their conversion into electrical systems, Block diagram representation, Block diagram algebra and reduction and Signal flow graphs and Mason's gain formula.

UNIT - II

Time Response: Transfer function and types of input. Transient response of second order system for step input. Time domain specifications Characteristic Equation of Feedback control systems Types of systems, static error coefficients, error series.

Stability: Concept of Stability, Routh-Hurwitz criterion for stability, Root locus technique and its construction.

UNIT - III

Frequency Response Plots: Bode plots, frequency domain specifications Gain and Phase margin. Principle of argument Nyquist plot and Nyquist criterion for stability

Compensation Techniques: Cascade and feedback compensation. Phase lag, lead and lag-lead compensators PID controller.

UNIT - IV

State Space Representation: Concept of state and state variables. State models of linear time invariant systems, State transition matrix, Solution of state equations. Controllability and Observability

UNIT - V

Discrete Control Systems : Digital control, advantages and disadvantages, Digital control system architecture. The discrete transfer function sampled data system Transfer function of sample data systems. Analysis of Discrete data systems

TEXT BOOKS :

1. Nagrath, I.J, and Gopal. M, "Control System Engineering", 5th Edition, New Age Publishers, 2009.
2. Nagoor Kani. "Control systems", Second Edition, RBA Publications,

REFERENCE BOOKS :

1. Ogata, K., “Modern Control Engineering”, 5th Edition, PHI.
2. Ramesh Babu, “Digital Signal Processing”, 2nd Edition.
3. K. Deergha Rao, Swamy MNS, “Digital Signal Processing, Theory and Applications”, 1st Edition, Springer Publications, 2018.

Course Code	Course Title						Core/Elective
5PC407EC	Computer Organization and Architecture						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. Implement the Fixed point and Floating point addition, Subtraction, multiplication and Division.
2. Describe the basic structure and operation of a Digital computer.
3. Discuss the different ways of communicating with I/O devices and standard I/O interfaces.
4. Analyze the hierarchical memory system including cache memories and virtual memory.
5. Understand issues affecting modern processors.

COURSE OUTCOMES :

1. Apply digital engineering fundamentals to acquire knowledge of arithmetic algorithms for different processors.
2. Interpret the concept of Basic processor system and analyze the performance of Micro programmed Control unit organization.
3. Implementing the techniques of pipelining and parallelism to analyze the performance of a Processor.
4. Apply the conceptual knowledge of system development with appropriate I/O Interface.
5. Interpret various techniques for efficient memory utilization to develop a system application.

UNIT - I :

DATA REPRESENTATION AND COMPUTER ARITHMETIC :

Introduction to Computer Organization and architecture, evolution and computer generations; Fixed point representation of numbers, digital arithmetic algorithms for Addition, Subtraction, ripple carry adder, carry look-ahead adder, Multiplication using Booth's algorithm and Division using restoring and non restoring algorithms. Floating point representation with IEEE standards and its arithmetic operations.

UNIT - II

BASIC PROCESSOR ORGANIZATION AND DESIGN :

Instruction codes, stored program organization, computer registers and common bus system, computer instructions, timing and control, instruction cycle: Fetch and Decode, Register reference instructions; Memory reference instructions. Input, output and Interrupt: configuration, instructions, Program interrupt, Interrupt cycle, Micro programmed Control organization, address sequencing, micro instruction format and micro program sequencer.

UNIT - III

CENTRAL PROCESSING UNIT:

General register organization, stack organization, instruction formats, addressing modes, Data transfer and manipulation, Program control. CISC and RISC: features and comparison. Pipeline and vector Processing, Parallel Processing, Pipelining, Instruction Pipeline, Basics of vector processing and Array Processors.

UNIT - IV

INPUT - OUTPUT ORGANIZATION :

I/O Bus and interface modules, I/O versus Memory Bus, Asynchronous data transfer: Strobe control, Handshaking, Asynchronous serial transfer. Modes of Transfer: Programmed I/O, Interrupt driven I/O, Priority interrupt; Daisy chaining, Parallel Priority interrupt. Direct memory Access, DMA controller and transfer. Input output Processor, CPU-IOP communication.

UNIT - V

MEMORY ORGANIZATION:

Memory hierarchy, Mapping of memory with CPU, Primary memory, Concept of memory interleaving, Associative memory, Cache memory organization and performance measures, cache mapping functions, Virtual memory organization, paging mechanism, address mapping using pages, Memory management hardware

TEXT BOOKS :

1. Morris Mano, M., "Computer System Architecture," 3/e, Pearson Education, 2005.
2. Hamacher, Vranesic, Zaky, "Computer Organization," 5/e, McGraw Hill, 2007.

REFERENCE BOOKS :

1. William Stallings, "Computer Organization and Architecture: Designing for performance," 7/e, Pearson Education, 2006.
2. Govindarajulu, B., “Computer Architecture and Organization” , 2/e, TMH, 2010.
3. John Hennessy and David Patterson, "Computer Architecture: A Quantitative Approach", 5th Edition, Elsevier.

Course Code	Course Title						Core/Elective
5PC408EC	Electro Magnetic Theory and Transmission Lines						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. Analyze fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications to describe the relationship between Electromagnetic Theory and circuit theory.
2. Formulate the basic laws of static electricity, magnetism and extend them to time varying fields to define the Maxwell's equations in differential and integral form.
3. Derive the wave equations for conducting and di-electric mediums to analyze the wave propagation characteristics of Uniform Plane Waves (UPW) in normal and oblique incidences.
4. Analyze fundamental concepts of Transmission lines and to formulate the basic relationship between distortion less transmission lines & applications.
5. To understand the concepts of RF Lines and their characteristics, Smith Chart, and its applications, acquires knowledge to configure circuit elements, QWTs and HWTs and to apply the same for practical problems.

COURSE OUTCOMES :

1. Understand the different coordinate systems, vector calculus, coulombs law and gauss law for finding electric fields due to different charges and to formulate the capacitance for different capacitors.
2. Learn basic magneto-statics concepts and laws such as Biot –Savart's law and Amperes law, their application in finding magnetic field intensity, inductance, and magnetic boundary conditions.
3. Distinguish between the static and time-varying fields, establish thecorresponding sets of Maxwell's Equations and Boundary Conditions, and use them for solving engineering problems.

4. Determine the Transmission Line parameters for different lines, characterize the distortions and estimate the characteristics for different lines.
5. Analyze the RF Line features and configure them as SC, OC Lines, λ/2, λ/4 and λ/8 Lines and design the same for effective impedance transformation.
6. Study the Smith Chart profile and stub matching features, and gain ability to practically use the same for solving practical problems.

UNIT - I

Electrostatics: Review of coordinate systems. Coulomb's Law, Electric field due to various Charge distributions and Electric flux density. Gauss's Law and its applications. Work, Potential and Energy, The dipole. Current and Current density, Laplace and Poisson's equations. Calculation of capacitance for simple configurations.

UNIT - II

Magnetostatics: Steady magnetic - Biot-Savart's law, Ampere's law. Stoke's theorem, Magnetic flux and magnetic flux density. Scalar and vector magnetic potentials. Electric and Magnetic fields boundary conditions. Maxwell's equations for static and time varying fields.

UNIT - III

Electromagnetic Waves :

Uniform plane waves in free space and in conducting medium, Polarization. Instantaneous, average and complex Power, Poynting theorem, Surface Impedance.

Reflection and Refraction: Normal and Oblique incidence on dielectric and conducting medium.

UNIT - IV

Transmission Lines 1:

Overview of T and p networks. Two wire Transmission lines, Primary and secondary constants. Transmission Line equations. Infinite line and characteristic impedance-Open and short circuit lines and their significance. Distortion less transmission line, Concept of loading of a transmission line, Campbell's formula.

UNIT - V

Transmission Lines 2 :

Impedance of a transmission line, RF and UHF lines, transmission lines as circuit elements. Properties of $\lambda/2$, $\lambda/4$ and $\lambda/8$ Lines. Reflection coefficient and VSWR. Matching: Stub matching. Smith chart and its applications.

TEXT BOOKS :

1. Matthew N.O. Sadiku, "Principles of Electro-magnetics", Oxford University Press, 6th edition 2016.
2. William H. Hayt Jr. and John A. Buck, -"Engineering Electromagnetics", Tata McGraw Hill, 7th edition, 2006.

REFERENCE BOOKS :

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Pearson, 2nd edition, 2015.
2. K.D. Prasad, "Antennas and Wave Propagation", Khanna Publications.
3. Nannapaneni Narayana Rao, "Elements of Engineering Electromagnetics", Pearson, 6th edition, 2004.

Course Code	Course Title						Core/Elective
5PC409EC	IC Applications						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. To learn the concept of Op-Amp and it's characteristics.
2. To impart the linear and non-linear applications of operational amplifier.
3. To impart the theory and applications of 555 IC Timer, PLL & IC Regulator.
4. To learn the characteristics of different logic families.
5. Discuss the operation of the most commonly used D/A and A/D converters.
6. To analyze combinational and sequential circuits with ICs.

COURSE OUTCOMES :

Student will be able to:

1. Understand the basic construction, characteristics and parameters of Op-Amp.
2. Analyze the linear and non-linear applications of Op-Amp.
3. Understand the concepts of IC555 timer, IC723 regulator and PLL.
4. Classify and describe the characteristics of different logic families.
5. Design and analyze ADC & DAC converters.
6. Design the Combinational and Sequential circuits with ICs.

UNIT - I

Differential Amplifiers: Classification, DC and AC analysis of single, dual input Balanced and unbalanced Output Configurations of Differential amplifiers using BJTs, Level Translator.

Introduction to ICs: Integrated circuits classification, Integrated circuit package & types, pin identification and temperature ranges.

Operational Amplifier (IC741): Op-Amp block diagram, ideal Op-Amp Characteristics, Op-Amp parameters: Input offset voltage; Output offset voltage, input offset and bias currents, Slew rate, CMRR and PSRR.

UNIT - II

Op-Amp Applications : Inverting and Non-inverting amplifiers with ideal and non-ideal Op-amps, Voltage Follower, Difference Amplifier, Summing Amplifier, ideal and practical Integrator and differentiator, Voltage to Current and Current to Voltage converters, Log and antilog amplifiers, Comparator, Schmitt Trigger with and without reference voltage, Triangular waveform generator.

Active Filters : Introduction – First order, Second order Active filters - LP, HP, BP, BR and All pass filter.

UNIT - III

555 Timer: Functional diagram. Modes of operation: Monostable, Astable multivibrators, applications of 555 Timer.

Voltage Regulators : Basic of voltage Regulators, Linear regulators using op-amp, IC Regulators 78XX and 723.

PLL : Operation, lock range, Capture range, PLL applications: Frequency multiplier and frequency translator.

UNIT - IV

Logic families: Digital IC characteristics. TTL logic family, TTL series and TTL output configurations: open collector, Totem pole, Tri state logic. MOS logic family, CMOS logic family and its series characteristics, CMOS transmission gate, CMOS open drain and high impedance outputs. Comparison of TTL and CMOS logic families

Data Converters : Introduction, Digital to Analog Converters: Weighted Resistor DAC & Inverted R-2R Ladder DAC. Analog to digital Converters: Parallel Comparator ADC, Successive Approximation ADC and Dual Slope ADC. DAC and ADC specifications.

UNIT - V

Combinational Circuits: Design using TTL-74XX or CMOS 40XX series: Decoders, drivers for LED, Encoder, priority encoder, Multiplexer and their applications, Demultiplexer, Digital comparator, Parallel and serial binary adder, Subtractor circuits using 2's complement. Carry look-ahead adder, BCD adder.

Sequential Circuits: Design using TTL-74XX or CMOS 40XX series: Synchronous and Asynchronous counters, Cascading of BCD counters, applications of counters, Shift register and applications.

TEXT BOOKS:

1. David A Bell, -"Operational Amplifiers and Linear ICs", 3/e, Oxford Publications, 2011.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits," 4/e, PHI, 2010.

REFERENCE BOOKS:

1. D.Roy Chowdhury, Shail B. Jain, "Linear Integrated Circuits", 4/e, New / Age International (P) Ltd., 2008.
2. Ronald J. Tocci, Neal S. Widmer & Gregory L.Moss, "Digital Systems: Principles and Applications", 10/e, PHI, 2011.
3. Jain R.P, "Modern Digital Electornics", 4/e, TMH, 2011.

Course Code	Course Title						Core/Elective
5MC402HS	Essence of Indian Traditional Knowledge						MC
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	0	-	0	40	60	0

COURSE OBJECTIVES :

1. To reinforce the students understanding with the pan-Indian heritage in terms of culture, traditions and knowledge.
2. To impart understanding of the importance of the roots of the traditional knowledge and types.
3. To impart basic knowledge on the evolution of the multiple languages that highlight India's diversity.
4. To know Indian Languages, Philosophies, Religion, Literature, Fine arts and Technology.
5. To explore the Ancient Science, Scientists, in Medieval and Modern India; the education system.

COURSE OUTCOMES :

1. Understand the concepts of Indian culture and Traditions and their importance.
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras, interpret the concepts and the importance to protect Intellectual property of the nation.

UNIT - I

- Dawn of human civilization and evolution of various cultures.
- Introduction to Culture: Civilization, Culture and heritage.
- General characteristics of culture, importance of culture in human literature.
- Indian Culture, Ancient India, Medieval India, Modern India.

UNIT - II

Indian Languages, Culture and Literature:

- Indian Languages and Literature-I:
- The evolution and role of Sanskrit, significance of scriptures to current society.
- Indian philosophies, other Sanskrit literature, literature of south India.
- Indian Languages and Literature - II :
- Northern Indian languages & literature.

UNIT - III

- Religion and Philosophy.
- Religion and Philosophy in ancient India.
- Religion and Philosophy in medieval India.
- Religious reform movements in modern India (selected movements only).

UNIT - IV

Fine Arts in India (Art, Technology& Engineering):

- Indian Painting, Indian handicrafts.
- Music: Divisions of Indian classic music, moderm Indian music.
- Dance and Drama-Indian Architecture (ancient, medieval and modern) Science and Technology in India.
- development of science in ancient, medieval and modern India. Their relation in terms of modern scientific perspective.
- Protection of traditional knowledge, significance, value to economy.
- role of government in protection of indigenous knowledge and technology; protection of traditional knowledge bill, 2016.

UNIT - V

- Education System in India.
- Education in ancient, medieval and modern India.
- Aims of education, subjects, languages.
- Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

TEXT BOOKS :

1. Kapil Kapoor and Avadhesh Kumar Singh, "Indian Knowledge Systems" (2 Vols-Set), ISBN 10: 8124603367 / ISBN 13: 9788124603369, Published by D K Print world, Publication Date: 2007.
2. Samskrita Bharati, "Science in Samskrit, Samskrita Bharati", Published, New Delhi, India, 2007; ISBN 10: 8187276339 / ISBN 13: 9788187276333.
3. Basanta Kumar Mohanta and Vipin K. Singh, "Traditional Knowledge System and Technology in India", Book, Originally published: 2012 Publication Date: 2012; ISBN 10: 8177023101ISBN 13: 9788177023107.

REFERENCE BOOKS :

1. 1.7-Position paper, "National Focus Group on Arts, Music, Dance and Theatre NCERT", March 2006, ISBN 81-7450-494-X, NCERT, New Delhi, 2010.
2. Nitin Singhania, "Indian Art and Culture", 4th Edition, ISBN: 9354601804 • 9789354601804, © 2022 | Published: December 20, 2021.
3. S. Narain, "Education and Examination Systems in Ancient India", written/ authored/edited, published 2017, English-Hardcover, ISBN 9789351282518 publisher: Kalpaz Publications.
4. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, New Delhi, 1989.
5. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, New Delhi, 2005.

Course Code	Course Title						Core/Elective
5HS403HS	Human Values and Professional Ethics						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Adaptive	3	0	-	0	40	60	3

COURSE OBJECTIVES :

1. To create an awareness on Human Values and Engineering Ethics.
2. To move from discrimination to commitment.
3. To understand social responsibility of an engineer.
4. To appreciate ethical dilemma while discharging duties in professional life.
5. To encourage students to discover what they consider valuable in life.

COURSE OUTCOMES :

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the role of a human being in ensuring harmony in society and nature.
4. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

UNIT - I

Introduction to Value Education: Value Education, Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education. Self-exploration as a means of Value Education. Happiness and Prosperity as parts of Value Education.

UNIT - II

Harmony in the Human Being: Human Being is more than just the Body. Harmony of the Self ('I') with the Body. Understanding Myself as Co-existence of the Self and the Body. Understanding Needs of the Self and the needs of the Body. Understanding the activities in the Self and the activities in the Body.

UNIT - III

Harmony in the Family and Society and Harmony in the Nature

Family as a basic unit of Human Interaction and Values in Relationships. The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour. Harmony in Nature : The Four Orders in Nature. The Holistic Perception of Harmony in Existence.

UNIT - IV

Social Ethics : The Basics for Ethical Human Conduct. Defects in Ethical Human Conduct. Holistic Alternative and Universal Order. Universal Human Order and Ethical Conduct. Human Rights violation and Social Disparities.

UNIT - V

Professional Ethics : Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario. Vision for Holistic Technologies, Production System and Management Models.

TEXT BOOKS :

1. R. R. Gaur, R Sangal, G P Bagaria, -A Foundation Course in Human Values and Professional Ethics, 2009.
2. Prof. K. V. Subba Raju, -Success Secrets for Engineering Students, Smart Student Publications, 3rd Edition, 2013, Ivan IIIich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA.

REFERENCE BOOKS :

1. E. F. Schumancher, 1973, "Small is Beautiful: a study of economics as if people mattered". Blond & Briggs, Britain.
2. A Nagraj, 1998, "Jeevan Vidya ek Parichay", Divya Path Sansthan, Amarkantak. Sussan George, 1976, How the Other Half Dies, Penguin Press, Reprinted 1986.
3. Smriti Shristava, "Human Values and Professional Ethics", Katson Publications, 2007
4. Bertrand Russell, "Human Society in Ethics & Politics".
5. Corliss Lamont, "Philosophy of Humanism".

Course Code	Course Title						Core/Elective
5PC453EC	AEC Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	0	-	0	40	60	1

COURSE OBJECTIVES :

1. To design and simulate various BJT and FET Voltage and Power amplifiers.
2. To design and simulate various BJT Feedback amplifiers.
3. Analyse Oscillator circuits.
4. Analyse Series and Shunt Voltage Regulators.
5. Design and simulate tuned voltage amplifier.

COURSE OUTCOMES :

1. Apply the concepts of amplifiers in the design of Public Addressing System.
2. To be able to Generate Sinusoidal wave forms of given specifications.
3. Design stable system using feedback concepts.
4. Design of Tuned amplifier.
5. Design Series and Shunt Voltage Regulators.

List of Experiments

1. Two Stage RC Coupled CE BJT amplifier.
2. Two Stage RC Coupled CS FET amplifier.
3. Voltage Series Feedback Amplifier.
4. Voltage Shunt Feedback Amplifier.
5. Current series feedback Amplifier.
6. RC Phase Shift Oscillator.
7. Hartly & Colpitt Oscillators.
8. Design of Class A and Class B Power amplifiers.
9. Constant-k low pass & high pass filters.
10. Series and Shunt Voltage Regulators.
11. RF Tuned Amplifier.

SPICE :

12. Two Stage RC Coupled CS FET amplifiers.
13. Voltage Series Feedback Amplifier.
14. Current Shunt Feedback Amplifier.

Note: A minimum of 10 experiments should be performed. It is mandatory to simulate any three experiments using SPICE.

Course Code	Course Title						Core/Elective
5PC454EC	IC Applications Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To learn the configurations and parameters of the 741 Op-Amp.
2. To explain the circuits of linear and nonlinear applications of Op-Amp.
3. Design and analyze the active filters circuit using Op-amp.
4. To know the concepts of IC555 timer & IC723.
5. To know the various characteristics of TTL and CMOS gates.
6. To learn combinational and Sequential circuits using digital ICS.

COURSE OUTCOMES :

1. Analyze the configurations, parameters of Op-Amp (IC741).
2. Demonstrate the circuits of Op-Amp for various applications.
3. Implement Active filters using Op-amps.
4. Analyze and design the circuits using IC555 timer, IC723 and data converters.
5. Analyze the characteristics of TTL and CMOS gates.
6. Analyze and design various combinational & sequential circuits using digital ICs.

List of Experiments

Part - A : Linear IC

1. Measurement of Op-Amp parameters.
2. Voltage Follower, Inverting and Non-Inverting Amplifiers using Op-Amp.
3. Arithmetic Circuits using Op-Amp.
4. Active filters : LP, HP and BP using Op-Amp.
5. Triangle and Square wave Generators. Schmitt Trigger using Op-Amp.
6. Monostable and Astable multivibrator using Op-Amp.

7. Astable, Monostable multi vibrators using IC555Timer.
8. IC voltage regulator.
9. Voltage controlled oscillator – NE 565.

Part - B : Digital IC

1. Measurement of various characteristic parameters of TTL and CMOS gates.
2. Flip Flop conversions and latches using gates and ICs.
3. Designing Synchronous, Asynchronous up/ down counters.
4. Shift Registers and Ring counters using IC Flip-Flop & Standards IC counters.
5. Interfacing counters with 7-segment LED /LCD display units.
6. Mux – Demux applications.
7. Code Converters and Parity Generator & Checker
8. Binary adder and subtractor, BCD adders using ICs.

Note: At least ten experiments should be conducted in the sem, of which three should be from PART - B.

V & VI - Semester Detailed Syllabus

B.E V- SEM ECE

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Total Hours	CIE	SEE	
1	5PC510EC	Microcontrollers	3	0	0	3	40	60	3
2	5PC511EC	Digital Signal Processing	3	0	0	3	40	60	3
3	5PC512EC	Analog Communication	3	0	0	3	40	60	3
4	5PE51XEC	Professional Elective - I	3	0	0	3	40	60	3
5	XOE5XXXX	Open Elective – I	3	0	0	3	40	60	3
6	5HS352HS	Effective Technical Communication	2	0	0	2	40	60	2
7	5PC551EC	Microcontrollers Lab	0	0	2	2	40	60	1
8	5PC552EC	Signals and Systems Lab	0	0	2	2	40	60	1
9	5PW571EC	Mini Project	0	0	2	2	40	60	1
		Total Credits							**20**

5PE51XEC	Professional Elective-I
1	Electronics Measurement and Instrumentation
2	Scripting Languages
3	Real Time Operating Systems
4	Neural Networks

XOE5XXXX	Open Elective - I	Offered by
1	Disaster Mitigation	CIVIL
2	Oops using JAVA	CSE
3	Artificial Intelligence	AI&DS
4	Renewable Energy Systems	EEE
5	Basics of Electronic Communication	ECE
6	Start up & Entrepreneurship	MECH

V - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC510EC	Microcontrollers						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Computer Organization and Architecture	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand architecture & programming of 8051 microcontroller.
2. To design Interfacing & Programming of I/O ports, timers and UART using 8051.
3. To design Interfacing of real time devices like ADC, DAC and stepper motor with 8051.
4. To understand architecture of ARM microcontrollers.
5. To design Interfacing of real time devices like RTC and WDT.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Explain the architecture of 8051
2. Write Assembly programming using 8051microcontroller.
3. Interface different peripherals to 8051microcontroller.
4. Explain the architecture of ARM controller.
5. Interface different peripherals to ARM controller.

UNIT - I

8051 Microcontroller : Internal architecture and pin configuration, 8051 addressing modes, instruction set, Bit addressable features. I/O Port structures, assembly language programming using data transfer, arithmetic, logical and branch instructions.

UNIT - II

8051 Timers and Interrupts : 8051 Timers/Counters, Serial data communication and its programming, 8051 interrupts, Interrupt vector table, interrupt programming.

UNIT - III

8051 Interfacing: Interfacing of 8051 with LCD, ADC, DAC, external memory, Stepper Motor interfacing

UNIT - IV

ARM Embedded Systems : The RISC design philosophy, The ARM design philosophy, ARM Processor fundamentals, registers, current program status register, pipeline exceptions, interrupts and vector table, core extensions, architecture revisions.

UNIT - V

LPC 21xx microcontroller : Internal memory, GPIOs, Timers, ADC, UART and other serial Interfaces, PWM, RTC, WDT.

TEXT BOOKS :

1. Mazidi M.A, Mazidi J.G & Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007
2. Sloss Andrew N, symes dominic, wright Chris "ARM System Developers Guide: Designing and optimizing", Morgan kaufman.
3. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd edition

REFERENCE BOOKS:

1. Ayala K.J, "The 8051 Micro Controller Architecture, programming and Application," Penram International, 2007.
2. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Pearson 2012.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM SYSTEM Developer's Guide Designing and Optimizing System Software" Elsevier2015.

Course Code	Course Title						Core/Elective
5PC511EC	Digital Signal Processing						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Signals and Systems	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To describe the necessity and of digital signal processing.
2. To discuss various design methods of FIR & IIR filters.
3. To describe the concepts of multirate signal processing and identify important features of TMS320C67XX DSP processors.

COURSE OUTCOMES :

1. Apply the knowledge of FFT Algorithms for computation of DFT.
2. Design of FIR filters using various methods.
3. Design of IIR filters using various methods.
4. Apply decimation and interpolation concepts for the design of sampling rate converters.

UNIT - I

Discrete Fourier Transform and Fast Fourier Transform : Discrete Fourier Transform (DFT), Computation of DFT, Linear and Circular Convolution, FFT algorithms: Radix- 2 case, Decimation in Time and Decimation in Frequency algorithms, in place computation, bit Reversal.

UNIT - II

Finite Impulse - Response Filters (FIR) : Linear phase filters, Windowing techniques for design of Linear phase FIR filters, Rectangular, Triangular, Bartlett, Hamming, Hanning , Kaiser Windows, Realization of filters, Finite word length effects.

UNIT - III

Infinite Impulse - Response Filters (IIR) : Introduction to filters, comparison between practical and theoretical filters, Butterworth and Chebyshev approximation, IIR digital filter design Techniques, Impulse Invariant technique, Bilinear transformation

technique, Digital Butter worth & Chebyshev filter implementation, Digital filters structures, Comparison between FIR and IIR.

UNIT - IV

Multirate Digital Signal Processing : Introduction, Decimation by factor D and interpolation by a factor I, Sampling Rate conversion by a Rational factor I/D.

Implementation of Sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling conversion by an arbitrary factor, Application of Multirate Signal Processing.

UNIT - V

Introduction to DSP Processors : Difference between DSP and other microprocessors architectures, Importance of DSP Processors- General purpose DSP processors, TMS320C67XX processor, architecture, registers, pipelining, addressing modes and introduction to instruction set.

TEXT BOOKS :

1. Nagoor Kani,, Digital Signal Processing,, McGraw-Hill Education, 2nd Edition, 2012
2. Alan V. Oppenheim & Ronald W. Schafer, Digital Signal Processing, PHI, 2nd edition, 2014.
3. B.Venkataramani & M. Bhaskar, ?Digital Signal Processor Architecture, Programming and Application, TMH, 2e 2013.

REFERENCE BOOKS:

1. John G. Proakis & Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application", PHI, 4th edition, 2012.
2. Alan V. Oppenheim & Ronald W. Schafer, "Digital Signal Processing", PHI, 2nd edition, 2014.

Course Code	Course Title						Core/Elective
5PC512EC	Analog Communication						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Signals & Systems	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To analyze the analog communication system requirements.
2. To understand the generation of various analog modulation techniques.
3. To analyze the noise performance of analog modulation techniques.
4. To understand AM and FM receivers.
5. To understand the pulse modulation techniques.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand analog communication system.
2. Compare and analyze analog modulation techniques.
3. Calculate noise performance of analog modulation techniques.
4. Design AM and FM receivers.
5. Differentiate between pulse modulation & continuous modulation techniques.

UNIT - I

Amplitude Modulation: Need for modulation, Amplitude Modulation (AM), Double Side Band Suppressed Carrier (DSB - SC) modulation, Hilbert transform, properties of Hilbert transform, Single side band (SSB) modulation and Vestigial-sideband (VSB) modulation, Modulation and demodulation of all the modulation schemes, COSTAS Receiver.

UNIT - II

Angle modulation: Frequency Modulation (FM) and Phase modulation (PM), Concept of instantaneous phase and frequency. Types of FM modulation: Narrow band FM and wide band FM, FM spectrum in terms of Bessel functions, Direct and

Indirect (Armstrong's) methods of FM Generation Balanced discriminator, Foster–Seeley Discriminator, Zero crossing detector and Ratio detector for FM demodulation Amplitude Limiter in FM.

UNIT - III

Transmitters and Receivers : Classification of transmitters. High level and low level AM transmitters, FM transmitters, Principle of operation of Tuned radio frequency (TRF) and super heterodyne receivers Selection of RF amplifier, Choice of Intermediate frequency Image frequency and its rejection ratio Receiver characteristics, Sensitivity, Selectivity, Fidelity, Double spotting, Automatic Gain Control.

UNIT - IV

Analog pulse modulation : Sampling of continuous time signals. Sampling of low pass and band pass signals Types of sampling, Pulse Amplitude Modulation (PAM) generation and demodulation. Pulse time modulation schemes: PWM and PPM generation and detection, Time Division Multiplexing.

UNIT - V

Noise : Atmospheric noise, Shot noise and thermal noise. Noise temperature, Noise in two- Port network: noise figure, equivalent noise temperature and noise bandwidth. Noise figure and equivalent noise temperature of cascade stages. Narrow band noise representation S/N ratio and Figure of merit calculations in AM, DSB-SC, SSB and FM systems, Pre-Emphasis and De - Emphasis.

TEXT BOOKS :

1. Simon Haykin, “Communication Systems,” 2/e, Wiley India, 2011.
2. B.P. Lathi, Zhi Ding, “Modern Digital and Analog Communication Systems”, 4/e

REFERENCE BOOKS:

1. “P. Ramakrishna Rao, “Analog Communication,” 1/e, TMH, 2011.
2. T G Thomas and S Chandra Shekar, Communication theory, 2/e, McGraw-Hill Education
3. 3. R.P.Singh, S.D.Sapre, Communication Systems, 2/e McGraw-Hill Education, 2008.
4. H. Taub, D.L. Schilling, "Principles of communication systems", Tata McGraw Hill, 2001.

PROFESSIONAL ELECTIVE - I (5PE51XEC)

Course Code	Course Title						Core/Elective
5PE511EC	Electronic Measurements and Instrumentation						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
NT, EDC	3	0	-	0	40	60	3

COURSE OBJECTIVES

This course aims to familiarize

1. Performance characteristics and various errors present in measuring instruments.
2. Describe the various transducers and their working principles.
3. Understand construction, working principle of display devices, printers, oscilloscopes.
4. Comprehend different types of signal generators, their construction and operation.
5. To address the underlying concepts and methods behind digital instruments.

COURSE OUTCOMES :

At the end of the course the student should be able to:

1. Understand the performance characteristics and various errors of an instrument.
2. Apply the complete knowledge of transducers to measure the physical quantities in the field of science, engineering and technology.
3. Understand construction and working principle of transducers, display devices, printers, Oscilloscopes, signal generators and digital instruments.
4. Illustrate different types of signal generators.
5. Understand the operation of different digital instruments.

UNIT - I

Qualities of Measurements : Introduction, Performance Characteristics, Static Characteristics, Error in Measurements, Types of Static Error, Sources of Error.

UNIT - II

Transducers : Introduction, Electrical Transducer, Selecting a Transducer, Resistive Transducers, Strain Gauges, Inductive Transducer, LVDT, Capacitive Transducer (Pressure), Load Cell (Pressure Cell), Piezo-Electrical Transducer, Photo Electric Transducer, Photo-Voltaic Cell, Temperature Transducers.

UNIT - III

Display Devices, Printers and Oscilloscope : Introduction, Display Devices, LED, LCD, Other Display Devices,Printers, Classification of Printers, Dot-Matrix Printers, Character at a Time Dot-Matrix Impact Printer, Non-Impact Dot-Matrix (NIDM) Printers.

Introduction to Basic Principle, CRT Features, Block Diagram of Oscilloscope, Simple CRO, Dual Beam CRO, Sync Selector for Continuous Sweep CRO, Dual Trace Oscilloscope, (VHF) Sampling Oscilloscope, Storage Oscilloscope (for VLF Signal), DSO.

UNIT - IV

Signal Generators : Introduction, Fixed Frequency AF Oscillator, Variable Frequency AF Oscillator, Basic Standard Signal Generator (Sine Wave), Modern Laboratory Signal Generator, AF Sine and Square Wave Generator, Function Generator, Square and Pulse Generator (Laboratory Type), Random Noise Generator, Sweep Generator, Wobbluscope, Video Pattern Generator.

UNIT - V

Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Decade Counter, Electronic Counter, Digital Measurement of Frequency (Mains), Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter.

TEXT BOOKS :

1. H. S. Kalsi, "Electronic Instrumentation", McGraw Hill Education (India) Private Limited, 3rd Edition 2016.
2. Anand, "Electronics Instruments and Instrumentation Technology", PHI.

REFERENCE BOOKS :

1. David A. Bell, "Electronic Instrumentation and Measurements", 3e, Oxford Univ. Press, 2013.
2. A.D. Helbincs. W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, PHI, 2003.
3. B.M. Oliver, "Electronic Measurements and Instrumentation", J.M. Cage TMH Reprint 2009.
4. K. Lai Kishore, "Electronic Measurements and Instrumentation", Pearson Education 2010.
5. Albert D. Helstrick and William D. Cooper, "Modern Electronics Instrumentation & Measurement Techniques", Pearson Education.
6. Joshph J. Carr, "Elements of Electronics Instrumentation and Measurement", 3rd Edition, Pearson Education.
7. Doebelin, E.O., "Measurement systems", McGraw Hill, Fourth edition, Singapore, 1990.

Course Code	Course Title						Core/Elective
5PE512EC	Scripting Languages						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Programming Language skills	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand the UNIX and Shell environments.
2. To study the Linux kernel and commands.
3. To understand the ability of PERL scripting language.
4. To study the Python scripting language.

COURSE OUTCOMES :

At the end of the course the student should be able to:

1. Able to use UNIX and Linux based systems to perform various tasks.
2. Able to use shell scripting to run programs of any scripting language.
3. Able to compile large programming sets in the Perl and Python environment.
4. Able to effectively apply knowledge of Perl and Python to new situations and learn from the experience.
5. Able to Use Python scripting language for Web application development.

UNIT - I

Linux : Introduction to Linux, File System of the Linux, General usage of Linux kernel & basic commands, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts, Overview of scripting languages.

UNIT - II

Shell : The Shell as a Process, Creating a Command File, VI Editor, UNIX Power Tools, Redirection and Pipelines, Variables, Conditional Constructs, Looping Constructs, Shell Functions, Parameters, Pattern Matching. Exporting, Signals and Traps, Built-In Commands, Bourne-Again Shell, Error Debugging, Advanced Shell Scripting Commands.

UNIT - III

Java Script : Overview, Object Orientation and JavaScript, Syntactic Characteristics, Primitives, Operators, Expressions, Input and Output, Control Statements, Objects Creation and modification, Arrays, Functions, Constructors, Pattern Matching. Manipulating DOM, HTML DOM Events, Basics of AJAX with example.

UNIT - IV

Ruby : Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, Cookies, Choice of Web servers, SOAP and web services. Rubik – Simple Tk Application, widgets, Binding events, Canvas, Scrolling.

Extending Ruby : Ruby Objects in C, Jukebox extension, Memory allocation, Ruby Type System, Embedding Ruby to Other Languages, Embedding a Ruby Interpreter.

UNIT - V

Python : Introduction to Python language, Python-Syntax, Statements, Functions, Built-in- functions and Methods, Modules in python, Exception Handling, Integrated Web Applications in Python – Building Small, Efficient Python Web Systems, Web Application Framework.

TEXT BOOKS :

1. David Barron, "The World of Scripting Languages", Wiley Publications.
2. Larry Wall, Tom Christiansen, John Orwant, "Programming PERL", 3rd Ed, Oreilly publications.

REFERENCE BOOKS :

1. Steve Holden and David Beazley, "Python Web Programming", New Riders Publications.
2. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly.

Course Code	Course Title						Core/Elective
5PE513EC	Real Time Operating Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Operating Systems	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To illustrate the functions of operating systems.
2. To explain various real time systems and study the scheduling algorithms.
3. To comprehend the concepts of process synchronization.
4. To describe elementary concepts of Vx Works.
5. To introduce the fundamental concepts of UNIX operating system.

COURSE OUTCOMES :

At the end of the course the student should be able to:

1. Classify various types of kernels and operating systems
2. Analyse various scheduling algorithms related to RTOS.
3. Summarize the Inter process communication tools.
4. Understand the elementary concepts of VxWorks.
5. Enumerate the fundamental concepts of UNIX operating system.

UNIT - I

Operating System Introduction: Structures of Operating System (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of OS and Hardware architecture, Evolution of operating systems- Batch, multi programming, Multitasking, Multiuser, parallel, distributed and real-time OS.

UNIT – II

Hard versus Soft Real-Time System: Jobs and Processors, Release time, Deadlines, and timing constraints, Hard and soft timing constraints, Hard real time systems, Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread scheduling, Multiprocessor scheduling concept, Real Time scheduling concept.

UNIT - III

Concurrency: Principles of Concurrency, Mutual Exclusion H/W Support, Software approaches, Semaphores and Mutex, Message passing, Monitors, Classical problems of Synchronization. Readers - Writers problem, Producer Consumer problem, Dining Philosopher problem. Deadlock. Principles of deadlock, Deadlock prevention, Deadlock Avoidance, Deadlock detection, An Integrated Deadlock Strategies.

UNIT - IV

Elementary Concepts of VxWorks: Multitasking, Task State Transition, Task Control – Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Deletion Safety. Comparison of RTOS – VxWorks, μC/OS-II, RT Linux and Xenomai for Embedded RTOS Applications. Case Studies in VxWorks.

UNIT - V

UNIX Kernel : File System (open, create, close, lseek, read, write), Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution (fork, vfork, exit, wait, exec). Basic level Programming with System calls, Shell programming and filters, UNIX Signals, POSIX Standards.

TEXT BOOKS :

1. Andrew S. Tanenbaum, “Modern Operating Systems,” 4/e, Pearson Edition, 2014.
2. Jane W.S. Liu, “Real Time Systems,” 1/e, Pearson Education, Asia, 2002.
3. Jean J Labrose, "Embedded Systems Building Blocks Complete and Ready-to-use Modules in C", 2/e, CRC Press 1999.

REFERENCE BOOKS :

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yesset, Philippe Gerum, “Building Embedded Linux Systems”, 2/e, O’ Reilly Media, 2008.
2. Wind River Systems, “VxWorks Programmers Guide 5.5”, Wind River Systems Inc.2002.
3. P. Raghavan, Amol Lad, Sriram Neelakandan “Embedded Linux System Design and Development”, 2005 CRC Press.

Course Code	Course Title						Core/Elective
5PE514EC	Neural Networks						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
PTSP	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To provide an introduction to neural networks and their classification, enabling students to understand the fundamental concepts and principles.
2. To develop a strong foundation to the mathematical models of artificial neural networks, including the McCulloch-Pitts and perceptron neuron models.
3. To explore the activation and synaptic dynamics of neural networks, and understand different activation models such as additive, shunting, and stochastic models.
4. To familiarize students with the basic learning laws of neural networks, enabling them to understand the principles behind learning and adaptation in neural networks.
5. To provide an overview of pattern recognition tasks and their applications, including pattern association, pattern storage, and neural network memory systems.
6. To introduce feed-forward and feedback neural networks, such as the backpropagation neural network and the Hopfield network, and their respective features, limitations, and applications.

COURSE OUTCOMES :

After completing this course, the student twill be able to

1. Understand the fundamental concepts and classification of neural networks, and apply this knowledge to solve real-world problems related to pattern recognition and memory systems.
2. Analyze and interpret the mathematical models of artificial neural networks, including the McCulloch-Pitts and perception neuron models, and apply them to various learning scenarios.
3. Evaluate and compare different activation models in neural networks, such as additive, shunting, and stochastic models, and select the appropriate model for specific applications.

4. Apply the basic learning laws of neural networks, such as Hebbian and delta rules, to train and adapt neural networks for pattern recognition and recall tasks.
5. Design and implement neural network memory systems, including auto, hetero, and bidirectional associative memory, for storing and retrieving patterns.
6. Develop an understanding of feed-forward and feedback neural networks, including back propagation and Hopfield networks, and apply them to solve complex problems in classification, approximation, and optimization.

UNIT - I

Introduction to Neural Networks, Classification, Mathematical Model of Artificial Neural Network, McCulloch-Pitts Neuron Model, Perceptron Neuron Model, ADALINE Neuron model.

UNIT - II

Activation and Synaptic Dynamics of Neural Networks, Additive, Shunting, and Stochastic Activation Models, Basic Learning Laws, Recall in Neural Networks.

UNIT - III

Pattern Recognition Tasks, Pattern Association, Pattern Storage (LTM & STM), Neural Network Memory: Auto, Hetero and Bidirectional Associative Memory.

UNIT - IV

Feed Forward Neural Networks, Single Layer & Multi-Layer Neural Networks, Perception Neural Networks and Solution of XoR Problem, Back Propagation Neural Networks: Features, Limitations, and Extensions.

UNIT - V

Feedback Neural Networks, Hopfield Network: Capacity and Energy Analysis, Applications.

Radial Basis Function Networks : Training Algorithm, Applications.

TEXT BOOKS :

1. B.Yeganaranarana, "Artificial Neural Networks", Prentice Hall, New Delhi, 2007.
2. J.A.Freeman and D. M.Skapura, "Neural Networks Algorithms, Applications and Programming Techniques", Addison Wesley, NewYork, 1999.

REFERENCE BOOKS :

1. Simon Haykin, "Neural Networks (A Comprehensive Foundation)", McMillan College Publishing Company,NewYork, 1994.
2. S.N.Sivanandam & M.Paul Raj, "Introduction to Artificial Neural Networks", Vikas Publishing House Pvt Limited, 2009.
3. Richard O. Duda, Peter E Heart, David G. Stork, "Pattern Classification", John Wiley & Sons 2002.

OPEN ELECTIVE-I (XOE5XXXX)

Course Code	Course Title						Core/Elective
2OE501CE	Disaster Mitigation						Open Elective -I
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. Define disaster and explain the different types of disasters.
2. Describe the disaster management cycle and the role of NDMA in disaster management.
3. Analyze the legal aspects of disaster management.
4. Develop disaster mitigation plans.
5. Participate in disaster response and recovery activities.

COURSE OUTCOMES :

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

1. Demonstrate the concepts of disaster management.
2. Identify different types of disasters.
3. Explain the disaster management cycle.
4. Illustrate the role of NDMA in disaster management.
5. Explain the development of disaster mitigation plan.

UNIT - I

Introduction to Disaster Management: Definition of disaster, Types of disasters, History of disaster management in India, National Disaster Management Authority (NDMA) and its role in disaster management, Disaster management cycle. Case studies of disasters in India and the world.

UNIT - II

Disaster Mitigation: Mitigation measures for different types of disasters, Use of technology in disaster mitigation, Disaster risk assessment, Disaster preparedness, Exercises and simulations on disaster mitigation.

UNIT - III :

Disaster Response: Search and rescue operations, Medical relief, Food and shelter, Restoration of essential services, Rehabilitation and reconstruction.

UNIT - IV

Disaster Law and Policy: Disaster management acts of India, Disaster management policies of India, Legal aspects of disaster management.

UNIT - V

Disaster Communication and Public Awareness: Importance of communication in disaster management, Methods of disaster communication, Public awareness programs, Case studies of disaster communication and public awareness in India and the world.

TEXT BOOKS :

1. R.Subramanian, "Disaster Management", Vikas Publishing House, 2018.
2. M. M. Sulphey, "Disaster Management", PHI Learning, 2016.

REFERENCE BOOKS :

1. S. C. Sharma, "Disaster Management: Concepts, Approaches and Techniques", Khanna Book Publishing House, 2017.
2. G. K. Ghosh, "Disaster Management : Theory and Practice", APH Publishing Corporation, 2018.

Course Code	Course Title						Core/Elective
3OE501CS	OOPS Using Java						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to make the student to

1. The Java programming language: its syntax, idioms, patterns and styles.
2. Object oriented concepts in Java and apply for solving the problems.
3. How exception handling and multithreading makes Java robust.
4. Explore java Standard API library such as io, util, applet, awt.
5. Building of applications using Applets and Swings..

COURSE OUTCOMES :

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

1. Understand the concept of OOP and analyze relationships among classes, objects.
2. Develop programs using concepts like inheritance, packages, interfaces, Java I/O streams and strings.
3. Utilize exception handling and Multithreading concepts to develop Java programs.
4. Interpret the Java Collection API, Java utility classes, concept of files and serialization.
5. Design GUI applications using concepts like AWT controls and Swings and client server programs using networking concepts.

UNIT - I

Object Oriented Programming: Principles, Benefits of Object Oriented Programming. Introduction to Java: Java buzzwords, bytecode. Java Programming Fundamentals: Applet and Application program using simple java program, data types, variables, arrays, operators, expressions, control statements, type conversion and casting, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, introducing access

control, static, final, nested and inner classes, exploring string class, using command-linear arguments.

Inheritance: Inheritance concept, types of inheritance, Member access rules, use of super and final.

Polymorphism - dynamic binding, method overriding, abstract classes and methods.

UNIT - II

Interfaces: Defining an interface, implementing interfaces, extending interface.

Packages: Defining, Creating and Accessing a Package, importing packages.

Exception handling: Benefits of exception handling, classification, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, rethrowing exceptions, built in exceptions, creating own exception sub classes.

Multithreading: Java Thread Model, The Main Thread, creating a Thread, creating multiple threads, using is Alive() and join(), thread priorities, synchronization, inter thread communication, deadlock.

UNIT - III

Collections: Overview of Java Collection frame work, commonly used Collection classes – Array List, Linked List, Hash Set, Tree Set, Collection Interfaces – Collection, List, Set. Accessing Collection via iterator, working with Map. Legacy classes and interfaces – Vector, Hashtable, Stack, Dictionary, Enumeration interface.

Other Utility classes: String Tokenizer, Date, Calendar, Gregorian Calendar, Scanner Java.

Input/Output: exploring java.io, Java I/O classes and interfaces, File, Stream classes, byte stream, character stream, serialization.

UNIT - IV

GUI Programming with java: The AWT class hierarchy, MVC architecture.

Applet Revisited: Basics, architecture and skeleton, simple applet program.

Event Handling: Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces. Handling mouse and keyboard events, Adapter classes.

Database Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture, CURD operation Using JDBC, Connecting to non-conventional Databases.

UNIT - V

Exploring Swing: JLabel, ImageIcon, JTextField, the Swing buttons, JTabbedpane, JScrollPane, JList, JComboBox.

Servlet: Life cycle, using tomcat, simple servlet, servlet API, javax.servlet package, reading servlet parameters, javax.servlet.http package, handling HTTP requests and responses

TEXTBOOKS :

1. Java: The Complete Reference, X Edition, Herbert Schildt, McgrawHill.
2. Java Fundamentals: A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. Java for Programming, P.J.Dietel X Edition, PearsonEducation

REFERENCE BOOKS :

1. The Java Programming Language, Ken Arnold, David Holmes, James Gosling, Prakash Goteti, III Edition, Pearson 2008
2. An Introduction to OOP, T. Budd, IIIEdition, Pearson Education.
3. Introduction to Java Programming, Y. Daniel Liang, X Edition, Pearson Education.

Course Code	Course Title						Core/Elective
1OE501AD	Artificial Intelligence						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
ATD	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to make the student to

1. To introduce the AI techniques to solve problems and search strategies to find optimal solution paths from start to goal state.
2. To introduces different knowledge representation methods in AI Programs.
3. To introduce different design techniques for Game Playing Programs.
4. To introduce the AI Agents their design, planning and learning techniques.
5. To introduce the natural language processing and expert systems.

COURSE OUTCOMES:

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

1. Understand fundamental AI concepts and identify a range of symbolic and non symbolic AI techniques.
2. Demonstrate an understanding of various searching algorithms such as adversarial search and game-playing commonly used in artificial intelligence software.
3. Use different knowledge representation techniques used in AI Applications.
4. Demonstrate an understanding of agent based AI architectures, Planning and logic based agents.
5. Exploring Expert systems options.

UNIT - I

Introduction : Artificial Intelligence and its applications, Artificial Intelligence Techniques Problem solving techniques: State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, AO* search, Constraint satisfaction problem, Agenda Driven Search, Mean-end analysis, Min- Max Search, Alpha-Beta Pruning, Iterative Deepening.

UNIT - II

Knowledge representation: Mapping between facts and representations, Approaches to knowledge representation, procedural vs declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Weak and Strong filler structures.

UNIT - III

Non Monotonic and Statistical Reasoning: on monotonic Logic, Default Logic, Circumscription, Bayes Theorem, Bayesian Network, Dempster Shafer Theory, Fuzzy sets, Fuzzy Logic, Defuzzification.

UNIT - IV

Planning and Learning Agents : Intelligent Agents, Nature and structure of Agents, Learning Agents, Introduction to different Forms of Learning, The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

UNIT - V

Introduction to Learning and Expert system: Expert systems, Expert system examples, Expert System Architectures, Rule base Expert systems, Non Monotonic Expert Systems, Decision tree base Expert Systems.

TEXTBOOKS :

1. AI: A Modern Approach Stuart J. Russel, Peter Norvig Pearson Education Latest Edition, 2012
2. Artificial Intelligence Elaine Rich, Knight McGraw Hill Third Edition 2010.
3. Artificial Intelligence, Saroj Kaushik Cengage Learning, First Edition 2011.

REFERENCE BOOKS :

1. Artificial Intelligence, Partick Henry Winston Addison Wesley Latest Edition 2012.
2. Artificial Intelligence George Luger Pearson Education Latest Edition 2010.

Course Code	Course Title	Core/Elective					
4OE501EE	Renewable Energy Systems (Open Elective - I)	Elective					
		L	T	P/D	Credits	CIE	SEE
		3	0	0	3	40	60

COURSE OBJECTIVES:

1. To understand the concepts and Importance of renewable energy sources such as solar, wind, biomass, geo and tidal power.
2. To make the students understand the advantages and disadvantages of different renewable energy sources.

COURSE OUTCOMES :

At the end of the course students will be able to

1. Explain the advantages, disadvantages and applications of different non-conventional sources.
2. Acquire the knowledge of various components, principle of operation and present scenario of different conventional and non- conventional sources.

UNIT - I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells- Applications of Fuel Cells.

UNIT- II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy, V-I and P-V curves.

UNIT - III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS - Classification of WECS - Site selection considerations - Advantages and disadvantages of WECS - Wind energy collectors - Applications of Wind energy.

UNIT - IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy.

UNIT - V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

TEXTBOOKS :

1. Rai G.D, "Non-Conventional Sources of Energy", Khandala Publishers, New Delhi, 2011.
2. David M Buchla and Thomas E Kissell, "Renewable Energy Systems", 1st Edition by, Pearson India.

REFERENCE BOOKS :

1. M.M.El-Wakil, "Power Plant Technology", McGraw Hill, 1984.
2. John Twidell, Tony Weir, "Renewable Energy Resources", 3rd Edition, Taylor and Francis.

Course Code	Course Title						Core/Elective
5OE501EC	Basics of Electronic Communication						Open Elective -I
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mathematics, Basic Electronics	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To provide an introduction to fundamental concepts in the understanding of communications systems.
2. To describe the network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
3. To discuss the evolution of wireless systems and current wireless technologies.

Course Outcomes :

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

1. Understand the working of analog and digital communication systems.
2. Explain the OSI network model and the working of data transmission.
3. describe the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.
4. Differentiate between analog and digital modulation techniques.
5. Understand the optical fibre communication link, structure, propagation and transmission properties.

UNIT - I

Introduction to Communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.

Signal Transmission Concepts: Baseband transmission and Broadband transmission, **Communication Parameters:** Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT - II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes - ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT - III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/ IPv6), Transport Layer – TCP, UDP.

UNIT - IV

Telecommunication Systems: Telephones, Telephone system, Optical Communications : Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT - V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

TEXT BOOKS :

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3rd edition, McGraw Hill, 2008.
2. George Kennedy, Bernard Davis, "Electronic Communication systems", 4th edition, McGraw Hill, 1999.

REFERENCE BOOKS :

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th edition, TMH, 2012.
2. Rappaport T.S., "Wireless communications", 2nd edition, Pearson Education, 2010.
3. Wayne Tomasi, "Advanced Electronic Communications Systems", 6th edition, Pearson Education.

Course Code	Course Title						Core/Elective
6OE501ME	Start - up and Entrepreneurship						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

Students should be able to understand

- To motivate students to take up entrepreneurship in future.
- To learn nuances of starting an enterprise & project management.
- To understand project formulation and choice Technology in Enterprise.
- To understand Intellectual properties, patents, Start-ups.

COURSE OUTCOMES :

After the completion of course students will be able to

1. Understand Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Understand the concept of Intellectual Property Rights and Patents
5. Comprehend the aspects of Start-Ups.

UNIT - 1

Entrepreneurship: Definition, functions of Entrepreneurship, Characteristics and qualities of entrepreneurs, Entrepreneur vs. intrapreneur, need of innovation, Economic growth. Small Scale Industry in India, Linkage among small, medium and heavy industries.

UNIT – II

Indian Industrial Environment: Competence, Opportunities and Challenges, Emergence of First generation entrepreneurs, women entrepreneurs. Conception and evaluation of ideas and their sources. Types of enterprises. - Collaborative interaction for Technology development. Corporate Social Responsibility

UNIT – III

Project formulation: Introduction, Elements of Business Plan and its salient features, Analysis of market demand, Financial and profitability analysis and Technical analysis.

UNIT -IV

Intellectual Property Rights: Meaning, Nature, Classification and protection of Intellectual Property, the main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

UNIT - V

Aspects of Start-Up: What is Start-Up, Start-up Policy, start-up strategy, Progress of startups in India, Principles of future organizations, start-up sectors and action plan for start-ups by Govt. of India.

TEXT BOOKS :

1. Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House,
2. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster", Publication, 1994.

REFERENCE BOOKS :

1. G.S. Sudha, “Organizational Behaviour”, 1996.
2. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005.
3. G.B. Reddy, "Intellectual Property Rights and the Law", 5th Ed. 2005 Gogia Law Agency.
4. Ajit Parulekar and Sarita D’Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India Ltd, 2006.

HS 502HS & HS602HS	**Effective Technical Communication** (Common to ECE, ME, CE & EEE –V SEM & CSE & AI & DS – VI SEM)						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
	2	-	-	-	40	60	2

COURSE OBJECTIVES :

The following are the Objectives of the Course :

1. To Understand the process, features and barriers of Communication.
2. To learn the aspects of communication and Presentation.
3. To comprehend the types of official and business correspondence.
4. To analyze the techniques of Report Writing
5. Aspects of data transfer and presentation.

COURSE OUTCOMES :

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

1. Handle Technical Communication effectively by over coming barriers of communication.
2. Use different types of Professional correspondence to communicate effectively.
3. Use different types of Business and Inter Office Correspondence.
4. Acquire adequate skills to draft reports efficiently.
5. Enhance their skills of information transfer.

UNIT - I

Introduction to Communication.

Definition, process and Channels of Communication.
ABC of Technical communication.
Barriers to communication.
Differences between general and Technical writing.

UNIT - II

Aspects of Communication.
Importance of listening and types of Listening.
Types of Technical communication (Oral and Written).

Features of technical communication (Precision, relevance, format, style & Use of visual aids).

Persuasive Techniques.

UNIT - III

Technical Writing-I

Emails

IOM

Business Letters - enquiry and response; compliant and Adjustment; placement of order; Cover letters/Job Application & Resume Writing.

Business Proposals.

UNIT - IV

Technical Writing –II

Types of technical Reports (Informative, analytical, periodic, special, formal and Informal).

Formal Elements of a Report.

Feasibility, Project, Progress and Evaluation reports.

UNIT - V

Information Transfer and Presentations

Non-verbal to verbal

Verbal to Non – Verbal

Important aspects of Oral and Visual Presentations.

SUGGESTED READING:

1. Raman, Meenakshi & Sharma, Sangeeta.(2015). "Technical Communication: Principles and Practice", 3rd ed., New Delhi. OUP.
2. Rizvi, Ashraf, M (2017). "Effective Technical Communication", 2nd ed., New Delhi, Tata McGraw Hill Education.
3. Sharma, R. C & Mohan , Krishna.(2017). "Business Correspondence and Report Writing: A Practical approach to business & technical communication", 4th ed., New Delhi, Tata McGraw Hill Education.
4. Tyagi, Kavita & Misra, Padma.(2011). "Advanced Technical Communication". New Delhi, PHI Learning.
5. Jungk, Dale.(2004). "Applied Writing for Technicians", Newyork, McGraw Hill Higher Education.

Course Code	Course Title						Core/Elective
5PC551EC	Microcontrollers Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Computer Organization and Architecture	0	-	-	2	40	60	1

COURSE OBJECTIVES :

This course aims to familiarize

1. To develop and execute the assembly programming concepts of 8051.
2. To Design and develop 8051 based programs for various interface modules.
3. To develop and execute the embedded C programming concepts of ARM.
4. To Design and develop ARM based programs for various interface modules.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. To write assembly language programs using 8051 controller.
2. To develop interfacing applications using 8051 controller.
3. To develop embedded C programming concepts of ARM.
4. To develop ARM based programs for various interface modules.

List of Experiments

PART-A

[Experiments for 8051 Microcontroller kit]

1. Familiarity and use of 8051 microcontroller trainers, and execution of programs.
2. Instruction set for simple programs (using 4 to 5 lines of instruction code).
3. Timer and counter operations and programmingusing8051.
4. Serial communications using UART.
5. Programming using interrupts.
6. Interfacing 8051 with DAC to generate waveforms.
7. Interfacing traffic signal control using 8051.
8. Program to control stepper motor using 8051.

9. ADC interfacing with 8051.
10. Serial RTC interfacing with 8051.
11. LCD interfacing with 8051.

PART-B

Interfacing Programs using embedded C on ARM Microcontroller Kit

1. Program to interface 8-bit LED and switch interface
2. Program to implement Buzzer interface on IDE environment
3. Program to display message in a 2 line x 16 characters LCD display and verify the result in debug terminal Stepper motor interface.
4. ADC & Temperature sensor LM35 interface
5. Transmission from kit and reception from PC using serial port.

NOTE : 1. At least ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and 5 from Part B is compulsory.
3. In Part-B, perform the experiments using assembler simulator like Keil software.

TEXT BOOKS :

1. Mazidi M.A, Mazidi J.G & Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C," 2/e, Pearson Education, 2007
2. Joseph yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd edition.

Course Code	Course Title						Core/Elective
5PC552EC	Signals and Systems Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Signals & Systems	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To develop C & MATLAB programs for operation of sequences.
2. To implement the algorithms of DFT, IDFT, FFT and IFFT on discrete time signals.
3. To design and obtain the frequency response of various digital filters.

COURSE OUTCOMES :

1. Develop MATLAB files for the verification of system response.
2. Design and analyze the digital filters using MATLAB.
3. Verify the functionality of FFT algorithms.
4. Experiment with multirate techniques using MATLAB & CCS.
5. Design and implement the digital filters on DSP processor.

PART-A

List of Signal Processing Experiments

Perform the following programs using MATLAB Simulator.

1. Introduction to MATLAB and signal generation.
2. Perform Linear Convolution.
3. Perform Circular Convolutions.
4. Perform DFT and FFT algorithm.
5. Perform FIR filters design using different window functions.
6. Perform IIR filters design: Butterworth and Chebyshev, LPF, HPF, BPF & BSF filter.
7. Perform Interpolation and Decimation.
8. Implementation of multi-rate systems.

PART-B

List of DSP Processor Experiments

Implement the following experiments using DSK (TMS320C67XX)

1. Introduction to DSP processors and Study of procedure to work in real-time.
2. Implement Solution of difference equations.
3. Implement Impulse Response.
4. Implement Linear Convolution.
5. Implement Circular Convolution.
6. Implement Fast Fourier Transform Algorithms.
7. Design of FIR (LP/HP) USING windows: (a) Rectangular (b) Triangular (c) Hamming windows.
8. Design of IIR (HP/LP) filters.

NOTE :

1. Atleast ten experiments to be conducted in the semester.
2. Minimum of 5 from Part A and Part B is compulsory.

TEXT BOOKS :

1. A. Nagoor Kani, "Digital Signal Processing", McGraw-Hill Education , 2nd Edition, 2012
2. John Leis, "Digital Signal Processing - A MATLAB - Based Tutorial Approach", Overseas Press, 1st Edition, 2008.

Course Code	Course Title						Core/Elective
5PW571EC	Mini Project						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EDC, Microcontroller, H/W Skills	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
2. To provide training in soft skills and also train them in presenting seminars and technical report writing.
3. To design, implement and test the prototype/algorithm in order to solve the conceived problem.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Get practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments
3. Prepare reports and deliver effective presentation.
4. Demonstrate effective written and oral communication skills.
5. Innovate in various engineering disciplines and nurture their entrepreneurial ideas.

Guidelines for Mini Project

1. The mini-project is a team activity having maximum of 3 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

B.E VI - SEM ECE

S. No.	Course Category	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Total Hours	CIE	SEE	
Theory									
1	5PC613EC	Digital Communication	3	0	0	3	40	60	3
2	5PC614EC	VLSI Design	3	0	0	3	40	60	3
3	5PC615EC	Antenna and Wave Propagation	3	0	0	3	40	60	3
4	5PE62XEC	Professional Elective – II	3	0	0	3	40	60	3
5	5PE63XEC	Professional Elective – III	3	0	0	3	40	60	3
6	XOE6XXXX	Open Elective - II	3	0	0	3	40	60	3
Laboratories									
7	5PC651EC	Analog & Digital Communication Laboratory	0	0	2	2	40	60	1
8	5PC652EC	VLSI Design Lab	0	0	2	2	40	60	1
9	5HS653HS	Soft Skills Laboratory	0	0	2	2	40	60	1
10	5PW672EC	Technical seminar	0	0	2	2	50	-	1
11	5PW774EC	Summer Internship (during summer break)	-	-	-	-	-	-	*
Total Credits									**22**

***Note: Summer Internship** to be conducted during summer break and evaluation will be in VII Sem.

5PE62XEC	**Professional Elective - II**
1	Embedded System Design
2	Data analytics using R-Programming
3	Digital Image processing
4	CPLD/FPGA Architectures

5PE63XEC	**Professional Elective-III**
1	Internet of Things
2	Cyber Security
3	Multirate Signal Processing
4	Fundamentals of Electronics Packaging

XOE6XXXX	**Open Elective - II**	**Offered by**
1	Green Building Technologies	CIVIL
2	Software Engineering	CSE
3	Deep Learning	AI&DS
4	Electric Vehicle Technology	EEE
5	Fundamentals of IOT	ECE
6	3D Printing Technologies	MECH

VI - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC613EC	Digital Communication						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PTSP, AC	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Familiarize the students with elements of digital communication system and waveform coding techniques like PCM, DPCM, DM and ADM.
2. Introduce the concepts of information theory and source coding.
3. Familiarize the students with channel coding techniques such as LBC, BCC and convolution codes.
4. Introduce the concepts of baseband digital data transmission and analyze the error performance of different digital carrier modulation schemes like ASK, FSK, PSK etc.
5. Familiarize the students with the concepts of spread spectrum communication with emphasis on DSSS and FHSS.

COURSE OUTCOMES :

1. Classify the different types of digital modulation techniques PCM, DPCM, DM and ADM and compare their performance by SNR.
2. Illustrate the classification of channels and Source coding methods.
3. Distinguish different types of Error control codes along with their encoding/ decoding algorithms.
4. Examine the Performance of different Digital Carrier Modulation schemes of Coherent and Non-coherent type based on Probability of error.
5. Generation of PN sequence using Spread Spectrum and characterize the Acquisition Schemes for Receivers to track the signals.

UNIT - I

Elements of Digital Communication System: Comparison of Digital and Analog Communication Systems,

Pulse Digital Modulation Schemes: Quantization and Encoding techniques, PCM. Companding in PCM systems - u law and a law, Applications of PCM. Modulation and demodulation of DPCM, DM and ADM. Comparison of PCM, DPCM, DM and ADM. SNRQ of PCM and DM.

UNIT - II

Information Theory and Source Coding: Uncertainty, Information and entropy. Source-coding, Shannon – Fano and Huffman coding Discrete memory less channel – Probability relations in a channel, mutual information, Channel capacity - Binary Symmetric Channel, Binary Erasure Channel, , cascaded channels, information rate. Shannon-Hartley Theorem.

UNIT - III

Channel Coding: Types of transmission errors, need for error control coding, Linear Block Codes (LBC): description of LBC, generation, Syndrome and error detection, Minimum distance of Linear block code, error correction and error detection capabilities, Standard array and syndrome decoding, Hamming codes.

Binary cyclic codes (BCC): Description of cyclic codes, encoding, decoding and error correction using shift registers.

Convolution codes: description, encoding – code tree, state diagram.

UNIT - IV

Base band digital data transmission – Block diagram, Inter Symbol Interference, Nyquist criterion for Zero ISI, Eye pattern

Digital Carrier Modulation Schemes - Description and generation of ASK, FSK, PSK optimum receiver – matched filter, correlation receiver. Gaussian error probability -Coherent detection of Binary ASK, FSK, PSK DPSK Comparison of digital carrier modulation schemes M-ary signaling schemes – Introduction, QPSK.

UNIT - V

Spread Spectrum Communication: Advantages of Spread Spectrum, generation and characteristics of PN sequences. Direct sequence spread spectrum and Frequency hopping spread spectrum systems and their applications. Acquisition and Tracking of DSSS and FHSS signals.

TEXT BOOKS :

1. Simon Haykin, “Communication systems” 4/e, Wiley India 2011
2. Sam Shanmugam K, “Digital and Analog Communication systems”, Wiley 1979.
3. B. P. Lathi, “Modern digital and analog communication systems” 3/e, Oxford University Press. 1998

REFERENCE BOOKS:

1. Leon W. Couch II., "Digital and Analog Communication Systems", 6th Edition, Pearson Education inc., New Delhi,2001.
2. R.E. Zimer & R. L. Peterson: "Introduction to Digital Communication", PHI, 2001.

Course Code	Course Title						Core/Elective
5PC614EC	VLSI Design						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
L	T	D	P				
STLD, ED	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To describe verilog hdl and develop digital circuits using various modeling styles.
2. To explain electrical properties of MOS devices to analyze the behaviour of inverters designed with various loads.
3. To give exposure to the design rules to be followed to draw the layout of any logic circuit and provide concept to design different types of combinational and sequential circuits.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Familiarize with the constructs and conventions of the verilog HDL programming in gate level and data flow modeling.
2. Generalize combinational and sequential logic circuits in behavioural modeling and concepts of switch level modelling.
3. Analyze modes of operation of MOS transistor and its basic electrical properties.
4. Draw stick diagrams and layouts for any MOS transistors.
5. Analyse the operation of various arithmetic and sequential logic circuits using CMOS transistors.

UNIT - 1

Introduction to HDLs: Basic Concepts of Verilog, Data types, system tasks and compiler directives. Gate Level Modeling: Gate types and Gate Delays, Dataflow Modeling: Continuous assignments and Delays. Design of stimulus blocks. Design of Arithmetic Circuits using Gate level, Data flow modeling for Adders, Subtractors, 4- bit Binary Adder and 1-digit BCD adder.

UNIT - II

Modeling of Sequential Logic Modules: Latches, Flip Flops, Counters and Shift registers applications Tasks, Functions, Procedural Continuous Assignments, Design of Mealy and Moore FSM models for sequence detector using Verilog. Switch Level Modelling of basic gates.

UNIT - III

Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS Fabrication Process. Basic Electrical Properties: Basic Electrical Properties of MOS: Ids- Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design.

UNIT - IV

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates. Basic circuit concepts. Design basic gates using Pass Transistor Logic, Transmission Gates and Multiplexers.

UNIT - V

Sub-system Design : Shifters, carry skip adder, carry select adder, Memory Elements: 6T SRAM cell, 1T DRAM cell. Sequential Logic Design: Behaviour of Bi-stable elements, CMOS D latch and Edge triggered Flip flops.

TEXT BOOKS :

1. Samir Palnitkar, “Verilog HDL A Guide to Digital Design and Synthesis,” 2nd Edition, Pearson Education, 2006.
2. Kamran Eshraghian Dougles and A. Pucknell, Essentials of VLSI circuits and systems", PHI, 2005 Edition
3. Weste and Eshraghian Principles of CMOS VLSI Design ‘, Pearson Education, 2ndedition,1999.

REFERENCE BOOKS:

1. John. P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley, 2003
2. John M. Rabaey, "Digital Integrated Circuits", PHI, EEE, 1997.

Course Code	Course Title						Core/Elective
5PC615EC	Antenna and Wave Propagation						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EMTL	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To familiarize the students with the basic principles of antennas and introduce the antenna terminology.
2. To introduce different types of wire antennas and make proficient in analytical skills for understanding practical antennas.
3. To familiarize with the design of different types of antennas for various frequency ranges and latest developments in the practical antennas.
4. To introduce need for antenna arrays and the concepts of measurements of antennas.
5. To introduce the various modes of Radio Wave propagation used.

COURSE OUTCOMES :

1. To illustrate the basic principles of antennas and learn the antenna terminology.
2. To design different types of wire antennas and make proficient in analytical skills for understanding practical antennas.
3. To design different types of antennas for various frequency ranges and get updated with latest developments in the practical antennas.
4. To apply the principles of antennas, to design antenna arrays and measure various parameters of antennas.
5. To Identify and understand the suitable modes of Radio Wave propagation used in current practice.

UNIT - I

Antenna Fundamentals: Introduction, Radiation Mechanism, Retarded potential, Isotropic Radiator, Radiation pattern, Radian and Steradian, Radiation Intensity, Gain, Directivity, Antenna Efficiency, Effective Aperture, Effective Length, Reciprocity Theorem, Friis transmission equation, Front–to-back ratio, Antenna Beamwidth, Beam Efficiency, Beam Area, Antenna Impedance, Polarization, Antenna temperature, Antenna Field Regions.

UNIT – II

Thin Linear wire Antennas: Radiation from Infinitesimal Dipole, Radiation Resistance of Short Dipole, Halfwave Dipole and Monopole, Loop Antennas, Helical Antennas.

UNIT – III

Antenna Arrays: Array of point sources, two element arrays with equal and unequal amplitudes, different phases, linear n- element array with uniform distribution, Principle of Pattern Multiplication, Binomial array, V- Antenna, Rhombic Antenna, Yagi - Uda Antenna, Log- periodic Antenna.

UNIT – IV

VHF and UHF Antennas: Babinets principle, Slot Antennas, Horn antenna, Parabolic Reflector and Cassegrain Antennas, Lens Antennas, Microstrip Antennas, Smart Antennas

Antennas for Special Applications: Vehicle mounted antennas, VSAT and DBS TV antennas, RFID antenna, Plasma antenna, Terahertz antenna.

UNIT – V

Radio Wave Propagation: Modes of propagation - Ground wave propagation, Sky Wave Propagation and Space Wave Propagation, Structure of Atmosphere, Characteristics of Different Ionized Regions, Sky wave propagation, Ray Path, Virtual Height, MUF, Skip Distance, LOS.

TEXT BOOKS :

1. K. D. Prasad, Antennas and wave Propagation, Tech India Publication, New Delhi, 4e, 2019-20
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems," 2/e, PHI, 2001.

REFERENCE BOOKS :

1. J. D. Kraus, R. J. Marhefka; Ahmad S. Khan, Antennas and wave Propagation, McGraw-Hill, 4th Edition, 2010.
2. Constantine A. Balanis, Antenna Theory: Analysis and Design, Wiley, 3rd edition, 2005.
3. R. E. Collins, Antennas and Radio Propagation, Singapore: McGraw Hill, 1985.
4. R Harish and M. Sachidananda, Antennas and Wave Propagation, Oxford University Press, 2011.

PROFESSIONAL ELECTIVE-II (5PE62XEC)

Course Code	Course Title						Core/Elective
5PE621EC	Embedded System Design						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Micro controllers	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Detailed overview of important concepts of Embedded system.
2. Analyze PIC microcontroller, its features and programming.
3. Describe ARM Microcontroller architectural details and instruction set.
4. Understand ARM Memory management.
5. Learn the techniques to develop an embedded system and case studies.

COURSE OUTCOMES :

1. After completing this course, the student will be able to:
2. Understand the fundamentals of the embedded system design.
3. Enumerate the instruction set of ARM Processor by studying the architecture of ARM core.
4. Acquire knowledge on the serial, parallel and network communication protocols.
5. Learn the embedded system design life cycle and co-design issues.
6. List the various embedded software development tools used in the design of embedded system for various applications.

UNIT - I

Introduction to Embedded Systems: Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture. Application areas of Embedded Systems and Categories of Embedded Systems. Embedded System Design and Co-Design issues and Design Cycle Process.

UNIT - II

PIC 18: Family Overview, Architecture, Instruction Set, Addressing modes. Timers, interrupts of PIC 18, Capture/Compare and PWM modules of PIC 18.

UNIT - III

ARM Architecture: ARM Processor Families. Instruction Set: Data Processing

Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT - IV

ARM Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.

ARM Memory Management: Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

UNIT - V

Embedded Software Development Tools, Host and Target Machines, Linkers/ Locators for Embedded Software, Getting Embedded Software into the Target System. Debugging Techniques.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee).

TEXT BOOKS :

1. Raj Kamal, "Embedded Systems - Architecture, Programming and Design", 2nd Edition, TMH, 2008.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guides – Designing & Optimizing System Software," Elsevier, 2008.

REFERENCE BOOKS :

1. Mazidi, MCKinlay and Danny Causey, "PIC Microcontrollers and Embedded Systems", Pearson Education, 2007.
2. David.E. Simon, "An Embedded Software Primer", 1st Edition, Pearson Education, 1999.
3. Jonathan W. Valvano, "Embedded Microcomputer Systems", Real Time Interfacing, Thomas Learning, 1999.

Course Code	Course Title						Core/Elective
5PE622EC	Data Analytics using R-Programming						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering. Mathematics	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To learn basics of R Programming environment: R language, R- studio and R packages.
2. To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting.
3. To learn Decision tree induction, association rule mining and text mining.

COURSE OUTCOMES :

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

1. Use various data structures and packages in R for data visualization and summarization.
2. Use linear, non-linear regression models, and classification techniques for data analysis.
3. Use clustering methods including K-means and CURE algorithm.

UNIT - I

Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT - II

Statistical Modelling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT - III

Predictive Modelling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression.

UNIT - IV

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists,

Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT - V

Classification : performance measures, Logistic regression implementation in R, K-Nearest neighbours (KNN), K-Nearest neighbour's implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

TEXT BOOKS :

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.

REFERENCE BOOKS :

1. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
2. Rafael A Irizarry, Introduction to Data Science, Lean Publishing, 2016.

Course Code	Course Title						Core/Elective
5PE623EC	Digital Image Processing						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
S&S, DSP	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To provide an introduction to the basic concepts and methodologies for Digital Image processing.
2. To familiar with spatial and transform domain techniques used in Image Enhancement, Restoration and Segmentation of Images.
3. To gain knowledge about various Image transforms used in Image processing and Image compression problems.
4. To understand various methods employed for edge, line and isolated points detection in an image.

COURSE OUTCOMES :

After completing this course, the student twill be able to

1. Develop a foundation that can be used as the basis for higher study and research in the Image processing area.
2. Design various filters for processing and deblurring of images without destroying fine details like edges and lines.
3. Apply image processing techniques for processing and analysis of remotely sensed, Microscope, Radar and Medical images.
4. Understand the need for Digital Image processing techniques for Machine vision.
5. Applications and concept of image compression.

UNIT – I

Digital Image Fundamentals: Image sensing, acquisition, Image formation model, sampling and Quantization, Basic relationships between pixels; neighbours of a pixel, adjacency, connectivity, regions and boundaries. Image formation, brightness, adaptation and discrimination. Categorization of images according to their source of EM radiation.

UNIT – II

Image Transforms : 2D Fourier transform, Properties of 2D Fourier transform, Walsh, Hadamard, Slant, Haar, Discrete cosine transform and Hotelling transform.

UNIT – III

Image Enhancement: Spatial domain techniques: Contrast stretching, histogram equalization andhistogram specification method, Neighborhood averaging and adaptive Median filter. Frequency domain methods: Ideal Low pass, Butterworth and Gaussian Lowpass filters. Ideal Highpass, Butterworth and Gaussian Highpass filters. Homomorphic filtering.

UNIT – IV

Image Restoration: Mathematical expression for degraded image, estimation of degradation functions: image observation, experimentation and by modeling, Inverse filter, Wiener filter, Geometric transformation, periodic noise reduction method.

UNIT – V

Image segmentation and Compression: Detection of discontinuities, point line And Edge detection methods: Gradient operation, Laplacian, Prewitt, Sobel, Laplacian of a Gaussian and Canny edge detectors. Image compression: Functional block diagram of a general image compression system various types of redundancies, Huffman coding, Arithmetic coding.

TEXT BOOKS :

1. Rafeal C. Gonzalez, Richars E. Woods, Digital Image Processing ?, Pearsons Education, 2009, 3rd Edition.
2. Anil K Jain, Fundamentals of Digital Image Processing, Prentice-Hall of India Private Limited, New Delhi, 1995.
3. Milan Sonka, Vaclav Havel and Roger Boyle, Digital Image Processing and Computer vision, Cengage Learning India Pvt. Limited, 2008.

REFERENCE BOOKS:

1. S.Jayaraman, S. Esakkirajan,T. Veerakumar,-Digital Image Processing-TataMcGrawHill2014.
2. A K. Jain, -Fundamentals of Digital Image Processing- Pearson 2004.
3. Vipul Singh, -'Digital Image Processing with MATLAB and Lab view', Elsevier 2013.

Course Code	Course Title						Core/Elective
5PE624EC	CPLD/FPGA Architectures						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
STLD, VLSI	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. Understand the ASIC design flow and Programming Technologies.
2. Study different Architecture of FPGAS.
3. Understand the FPGA physical Design Flow of FPGA.
4. Learn the placement and routing algorithms.
5. Enlist the verification and testing methods of digital circuits.

COURSE OUTCOMES :

1. After completing this course, the student will be able to.
2. Design of ASICs using implementation tools for simulation and synthesis.
3. Describe the architecture of FPGAs.
4. Discuss physical design using FPGAs and CAD tools.
5. Describe placement & routing algorithms.
6. Analyze verification and testing of Digital circuits.

UNIT - I

Introduction to ASICs : Types of ASIC's, ASIC design flow, Economies of ASICs, Programmable ASICs: CPLD and FPGA. Commercially available CPLDs and FPGAs: XILINX, ALTERA, ACTEL. FPGA Design cycle, Implementation tools: Simulation and synthesis, Programming technologies. Applications of FPGAs.

UNIT - II

FPGA logic cell for XILINX, ALTERA and ACTEL ACT, Technology trends, Programmable I/O blocks, FPGA interconnect: Routing resources, Elmore's constant, RC delay and parasitic capacitance, FPGA design flow, Dedicated Specialized components of FPGAs.

UNIT-III

FPGA physical design, CAD tools, Power dissipation, FPGA Partitioning, Partitioning methods.

Floor planning: Goals and objectives, I/O, Power and clock planning, Low-level design entry.

UNIT - IV

Placement: Goals and objectives, Placement algorithms: Min-cut based placement, Iterative Improvement and simulated annealing.

Routing, introduction, Global routing: Goals and objectives, Global routing methods, Back-annotation. **Detailed Routing:** Goals and objectives, Channel density, Segmented channel routing, Maze routing, Clock and power routing, Circuit extraction and DRC.

UNIT - V

Verification and Testing: Verification: Logic simulation, Design validation, Timing verification. Testing concepts: Failures, Mechanism and faults, Fault coverage.

Testing concepts: failures, mechanisms and faults, fault coverage, ATPG methods, and programmability failures.

TEXT BOOKS :

1. Pak and Chan, Samiha Mourad, "Digital Design using Field Programmable Gate Arrays", Pearson Education, 1/e, 2009.
2. Michael John Sebastian Smith, "Application Specific Integrated Circuits", Pearson Education Asia, 3/e, 2001.

REFERENCE BOOKS :

1. S. Trimberger, Edr, "Field Programmable Gate Array Technology", Kluwer Academic Publications, 1994.
2. John V. Oldfield, Richard C Dore, "Field Programmable Gate Arrays", Wiley Publications.
3. Clive Maxfield, "The Design Warrior's Guide to FPGAs?, Elsevier, 2004.

PROFESSIONAL ELECTIVE-III (5PE63XEC)

Course Code	Course Title						Core/Elective
5PE631EC	Internet of Things						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
Controllers, Communication protocols, web services	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To discuss about the fundamentals of IoT and its applications and requisite infrastructure.
2. To describe Internet principles and communication technologies relevant to IoT.
3. To illustrate hardware and software aspects of designing an IoT system.
4. To describe concepts of cloud computing and data analytics.
5. To demonstrate business models and manufacturing strategies of IoT products.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT.
3. Design simple IoT systems with requisite hardware and Python programming software.
4. Understand the relevance of cloud computing and data analytics to IoT.
5. Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT-I

Introduction to Internet of Things: Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and logistics, Smart Agriculture and Industry, Smart Industry and smart Health.

UNIT - II

Internet Principles and Communication Technology: Internet Communications: An Overview –IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS.

UNIT - III

Prototyping and Programming: Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

Introduction to Python: Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT - IV

Cloud Computing and Data analytics: Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow.

UNIT - V

IoT Case Studies: Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation, Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

TEXT BOOKS :

1. Internet of Things - Converging Technologies for smart environments and integrated ecosystems, River Publishers.
2. Adrian McEwen (Author), Hakim Cassimally, “Designing the Internet of Things”, Wiley India Publishers.

REFERENCE BOOKS :

1. Kenneth A Lambert and B.L. Juneja, “Fundamentals of Python”, Cengage Learning.
2. Vijay Madisetti, Arshdeep Bahga, “Internet of Things (A Hands-on-Approach),” VPT Publisher, 1st Ed., 2014.

Course Code	Course Title						Core/Elective
5PE632EC	Cyber Security						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
Programming skills, web services	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To understand various types of cyber-attacks and cyber-crimes.
2. To learn threats and risks within context of the cyber security.
3. To have an overview of the cyber laws & concepts of cyber forensics.
4. To study the defensive techniques against these attacks.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Analyze and evaluate the cyber security needs of an organization.
2. Understand Cyber Security Regulations and Roles of International Law.
3. Design and develop security architecture for an organization.
4. Understand fundamental concepts of data privacy attacks.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics.

UNIT - III

Cybercrime : Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT - IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

Cybercrime : Examples and Mini - Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS :

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles,
3. Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCE BOOKS :

1. James Graham, Richard Howard and Ryan Otson, -Cyber Security Essentials, CRC Press.
2. Chwan-Hwa(john) Wu,J. David Irwin, -Introduction to Cyber Security, CRC Press T&F Group.

Course Code	Course Title						Core/Elective
5PE633EC	Multirate Signal Processing						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
S&S, DSP	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To review the fundamentals of multirate systems.
2. To describe the techniques for multirate filter banks.
3. To explain the quadrature-mirror filter banks.
4. To demonstrate the concept of adaptive digital filters.
5. To illustrate the concept and application of wavelets.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Solve problems in sampling rate conversion and filter banks.
2. Build digital filter bank systems.
3. Implement quadrature-mirror filter banks for multirate signal processing.
4. Analyze the various adaptive processing algorithms.
5. Implement wavelets in signal processing applications.

UNIT - I

Review of fundamentals of Multirate systems: Decimation by an integer factor D, Interpolation by an integer factor L, Time- and frequency-domain representation and analysis of decimated and interpolated signals, Efficient structures for decimation and interpolation filters, Sampling rate conversion by a rational factor I/D, Inter connection of building blocks, polyphase representation, Multi stage implementation of sampling-rate conversion, Applications of Multirate systems.

UNIT - II

Multirate Filter banks: Digital filter banks, Uniform DFT filter banks, Polyphase implementation of Uniform filter banks.

Nyquist filters : Lth -band filters, half band filters, Half-band High pass filter, Window Design of Half-Band Filter, Interpolation and decimation with Low Pass Half-Band

Filters, Design of Linear phase Lth- band FIR filters, Relation between Lth-Band filters and power complementary filters.

UNIT - III

Quadrature- Mirror Filter banks: The filter bank structure, Analysis of Two channel QMF bank, Errors in the QMF bank, Alias free filter banks, Alias-free realization, Alias-free FIR QMF bank, Alias-free IIR QMF bank, perfect reconstruction(PR) two-channel FIR filter bank, Alias-free L-channel filter bank and Multilevel filter banks-filter with equal and unequal pass band widths.

UNIT - IV

Adaptive Algorithms to adjust coefficients of digital filters: Least Mean Square (LMS), Recursive Least Square (RLS) and Kalman Filter Algorithms.

UNIT - V

Wavelets and its applications: Introduction to wavelet Theory, wavelet transform, Definition and properties, Continuous Wavelet Transform and Discrete Wavelet Transform, Application of Wavelets in signal processing.

TEXT BOOKS:

1. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications",3rd Edn. Prentice Hall India,1999.
2. P.P. Vidyanathan, "Multi-rate Systems and Filter Banks," Pearson Education, 2008.
3. Bruce W Suter, "Multi-rate and Wavelet Signal Processing." Volume 8, Academic Press, 1998.

REFERENCE BOOKS :

1. B. Widrow & S Stearns, "Adaptive Signal Processing", PHI, 1985.
2. K. P. Soman, K. I. Ramachandran, N. G. Resmi, "Insight into wavelets from theory to practice", PHI.

Course Code	Course Title						Core/Elective
5PE634EC	Fundamentals of Electronics Packaging						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
Electrical and Electronics; Mechanical, Chemical, Instrumentation, Chemistry, Physics, Materials Engineering	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. The course will sensitize the participants to the fundamentals of electronics systems packaging.
2. The course is multidisciplinary in nature.
3. Today products in electronics industry need to be packaged to current state-of-art if it has to be in the leading edge market. Hence systems packaging is essential.

COURSE OUTCOMES :

1. Discuss the various packaging types.
2. Design of packages which can withstand higher temperature, vibrations and shock.
3. Design of PCBs which minimize the EMI and operate at higher frequency.
4. Analyze the concepts of testing methods.
5. Discuss the various packaging types.

UNIT - I

Overview of Electronic Systems Packaging: Functions of Electronic Packaging, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends and Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

UNIT - II

Electrical Issues in Packaging: Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines,

Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitics.

UNIT - III

Chip Level Packaging : IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test.

Single chip packaging: functions, types, materials processes, properties, characteristics, trends.

Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded.

UNIT - IV

PCB, Surface Mount Technology and Thermal Considerations: Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Structural analysis, Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements.

UNIT - V

Testing: Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue –failures – thermo mechanically induced –electrically induced – chemically induced.

Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.

TEXT BOOK :

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001.
2. Blackwell (Ed), The electronic packaging handbook, CRC Press, 2000.

REFERENCE BOOK:

1. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.
2. Bosshart, Printed Circuit Boards Design and Technology, TataMcGraw Hill, 1988.
3. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.
4. R.S.Khandpur, Printed Circuit Board, Tata McGraw Hill, 2005.
5. Recent literature in Electronic Packaging.
6. Michael L. Bushnell & Vishwani D. Agrawal," Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits", Kluwer Academic Publishers.2000.
7. M. Abramovici, M. A. Breuer, and A.D. Friedman, "Digital System Testing and Testable Design", Computer Science Press, 1990.

OPEN ELECTIVE-II (XOE6XXXX)

Course Code	Course Title						Core/Elective
2OE602CE	Green Building Technologies						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to impart knowledge of

1. To impart knowledge of the principles behind the green building technologies
2. To know the importance of sustainable use of natural resources and energy.
3. To understand the principles of effective energy and resources management in buildings
4. To bring awareness of the basic criteria in the green building rating systems
5. To understand the methodologies to reduce, recycle and reuse towards sustainability.

COURSE OUTCOMES :

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

CO 1. Define a green building, along with its features, benefits and rating systems.

CO 2. Describe the criteria used for site selection and water efficiency methods.

CO 3. Explain the energy efficiency terms and methods used in green building practices.

CO 4. Select materials for sustainable built environment & adopt waste management methods.

CO 5. Describe the methods used to maintain indoor environmental quality.

UNIT - I

Introduction to Green Buildings : Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems - GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT - II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT - III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT - IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks,(c) use of materials with recycled content such as blended cements, pozzolona cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off- site organic waste management

UNIT - V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics.

Codes related to green buildings : NBC, ECBC, ASHRAE, UPC etc.

TEXT BOOKS :

1. Michael Bauer, Peter Mösle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

REFERENCE BOOKS :

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao 'Alternative building materials and technologies'.

Course Code	Course Title						Core/Elective
3OE602CS	Software Engineering						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to impart knowledge of

1. Describe and compare various software development methods and understand the context in which each approach might be applicable
2. To impart knowledge on various phases, methodologies and practices of software development
3. To apply the project management and analysis principles to software project development.
4. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metric
5. To apply the design & testing principles to software project development.

COURSE OUTCOMES :

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

1. Acquired working knowledge of alternative approaches and techniques for each phase of SDLC.
2. Judge an appropriate process model(s) for software project attributes and analyze requirements for project development.
3. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting
4. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associated with the development of a significant software system
5. Apply the software engineering principles in real time project development.

UNIT - I

Introduction to Software : What is software? Types of software, Characteristics of software Attributes of good software.

Software Engineering: What is software engineering, Software engineering costs? What are the key challenges facing software engineering, Systems engineering & software Engineering, SDLC.

Software Development Process Models: prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

UNIT - II

Software Engineering Principles : SE Principles, Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment.

Software Requirement Analysis and Specification: System and software requirements, Types of software requirements, Elicitation and analysis of requirements, Requirement validation, Requirements specification, Feasibility.

UNIT - III

Building the Analysis Model : Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling.

Design Engineering: Design Process and Quality, Design Concepts, the Design Model.

Performing User Interface Design : The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT - IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Coding: Programming languages and development tools, Selecting languages and tools Good programming practices, Coding Standards

UNIT - V

Software Testing and Quality Assurance: Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing, Integration Testing, Interface testing, System testing, Alpha and beta testing, Regression testing Design of test cases, Quality management activities: Product and process quality Standards, ISO900, Capability Maturity Model (CMM), Risk management.

Debugging: Debugging Techniques, The Art of Debugging.

Current trends in Software Engineering Software Engineering for projects and products.

TEXTBOOKS:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, VII Edition, McGraw Hill, 2009.
2. Ian Sommerville, Software Engineering, VII edition, Addison-Wesley.
3. RajibMall, -Fundamentals of Software Engineering.

REFERENCE BOOKS:

1. Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996
2. Pankaj Jalote, An Integrated Approach to Software Engineering, III Edition, Narosa Publishing House, 2000.

Course Code	Course Title						Core/Elective
1OE602AD	Deep Learning						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to impart knowledge of

1. Develop and Train Deep Neural Networks.
2. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition.
3. Build and train RNNs, work with NLP and Word Embeddings.
4. The internal structure of LSTM and GRU and the differences between them.

COURSE OUTCOMES :

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

1. Feature Extraction from Image and Video Data.
2. Implement Image Segmentation and Instance Segmentation in Images.
3. Implement image recognition and image classification using a pretrained network (Transfer Learning).
4. Traffic Information analysis using Twitter Data.
5. Autoencoder for Classification & Feature Extraction.

UNIT - I

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT - II

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT - III

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Back propagation Through the Convolutional Layer. Filters and Feature Maps. Back propagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, Alex Net, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R- CNN, Mask-RCNN, YOLO

UNIT - IV

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Back propagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to- Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT - V

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational.

TEXT BOOKS :

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc. 2017.
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.

REFERENCE BOOKS :

1. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017.
2. Pro Deep Learning with Tensor Flow, Santanu Pattanayak, Apress, 2017.

Course Code	Course Title						Core/Elective
4OE602EE	Electric Vehicle Technology						Elective
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

The objective of this course is to impart knowledge of

1. Know the history of electric hybrid electric vehicles (EV & HEV) and emphasize the need and importance of EV-HEV for sustainable future.
2. Introduce the fundamental concepts and principles of electric and hybrid electric vehicles drive train topologies.
3. Develop a thorough understanding of the key elements of EV/HEV: Electric Machines for Propulsion Applications and Energy Sources.

COURSE OUTCOMES :

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

1. To identify and describe the history and evolvement of electric & hybrid electric vehicles to emphasize on the need and importance of EV/HEV for sustainable future.
2. To identify and describe the principles of various EV/HEVs drive train topologies along with their power flow control and fuel efficiency estimation.
3. To design and select electric propulsion system components for EV/HEV drives suitability for the desirable performance and control.
4. To compare and evaluate various energy sources and energy storage components for EV and HEV applications.

UNIT - I

Introduction : History of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, Power/Energy supplies requirements for EV/ HEV applications, vehicle power source characterization, and transmission characteristics. Vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion.

UNIT - II

Drive-Train Topologies: Series, Parallel, Series -Parallel and Complex configurations of HEV, basics of hybrid traction system, various hybrid drive-train topologies, power flow control in drive-train topologies, fuel efficiency analysis.

UNIT - III

Electrical Machines and Power Converters for Hybrid and Electric Vehicles: Electric system components for EV/HEV, suitability of DC and AC machines for EV/HEV applications, AC and DC Motor drives. Permanent magnet and switch reluctance machines, configuration and control of drives. Power Converters- Converters for EV and HEV applications.

UNIT - IV

Energy Sources for EV/HEV : Requirements of energy supplies and storage in EV/HEV, Review of batteries, fuel cells, flywheels and ultra-capacitors as energy sources for EV/HEV, characteristics and comparison of energy sources for EV/HEV, hybridization of different energy sources.

UNIT - V

Electric Vehicles Charging Station : Type of Charging station, Selection and Sizing of charging station, Components of charging Station and Single line diagram of charging station. Contactless inductive charging- Stationary Inductive charging, resonant and compensation circuit topologies.

TEXT BOOKS :

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiely, USA, 2012.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals, 2nd Edition, CRC Press, 2011.

REFERENCES BOOKS :

1. Chris Mi, M. Abdul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspective, Wiely, 2011
2. Simora Onori, Hybrid Electric Vehicles Energy Management Strategies, Springer.

Course Code	Course Title						Core/Elective
5OE602EC	Fundamentals of IOT						Open Elective -II
Prerequisite	Contact Hours per Week						
Controllers, Communication protocols, web services	L	T	D	P	CIE	SIE	Credits
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To introducee the fundamentals, applications and requisite infrastructure of IoT.
2. To describe Internet principles and communication technologies relevant to IoT.
3. To discuss hardware and software aspects of designing an IoT system.
4. To explain the concepts of cloud computing and data analytics.
5. To illustrate the business models and manufacturing strategies of IoT products.

COURSE OUTCOMES :

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT.
3. Construct simple IoT systems with requisite hardware and python programming.
4. Understand the relevance of cloud computing and data analytics to IoT.
5. Apply the business model of IoT from developing a prototype to launching a product.

UNIT - I

Introduction to Internet of Things: Introduction to Internet of Things: Physical Design of IoT : Things in IoT, IoT protocols, Logical Design of IoT : IoT functional Blocks, Communication Models, APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and logistics, Smart Agriculture and Industry, Smart Industry and smart Health.

UNIT - II

Internet Principles and communication technology : Internet Communications: An Overview - IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses TCP and UDP Ports, Application Layer Protocols - HTTP, HTTPS.

UNIT - III

Prototyping and Programming : Cost Vs Ease of Production, Prototypes and Production, Open-Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms - Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling.

Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT, IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT - IV

Cloud computing and Data analytics: Introduction to Cloud storage models -SAAS, PAAS, IAAS. Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT - Apache Hadoop- Map reduce job execution workflow.

UNIT - V

IoT Case Studies: Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation, Business model for IoT product manufacturing, IoT Startups, Mass manufacturing, Ethical issues in IoT.

TEXT BOOKS:

1. Internet of Things - Converging Technologies for smart environments and integrated ecosystems, River Publishers.
2. Adrian McEwen (Author), Hakim Cassimally, “Designing the Internet of Things”, Wiley India Publishers.

REFERENCE BOOKS :

1. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cenage Learning.
2. Internet of Things (A Hands-on-Approach), Vijay Madisetti , Arshdeep Bahga, VPT Publisher, 1st Ed., 2014.

Course Code	Course Title						Core/Elective
6OE602ME	3D Printing Technologies						Open Elective-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
NIL	3	-	-	-	40	60	3

COURSE OBJECTIVES :

1. To understand the fundamental concepts of 3D Printing, its advantages & limitations.
2. To know the various types of STL file errors and other data formats used in additive manufacturing Technology.
3. To know the working principle, advantages, disadvantages & applications of liquid, solid and powder based 3D Printing technologies.
4. To know the diversified applications of 3D Printing technologies and explore them in different industrial sectors.

COURSE OUTCOMES :

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

1. Describe the fundamentals of 3D printing, classify and explain advantages and disadvantages of 3D Printing technologies.
2. Select thesuitable CAD data formats and software used in 3D Printing technology.
3. Describe the operating principles, capabilities and limitations of liquid, solid & powder based 3D Printing Technologies.
4. Compare different 3D printing technologies based on their process capabilities and applications.
5. Apply the capabilities and knowledge of 3D printing in different industrial sectors.

UNIT-I

Prototyping Fundamentals: Historical Development, Fundamentals of 3D Printing, Advantages and Limitations of 3D Printing, commonly used terms, 3D Printing Process Chain, 3D Modelling, Data conversion and transmission, Checking & Preparing, Building, Post processing, Classification of 3D Printing processes,

Fundamental Automated Processes, Distinction between 3D Printing and Conventional Machining Processes.

Data Formats & Software : Data formats; conversion and transmission, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs, Newly Proposed Formats. Software's Features: Magics, Mimics, Solid View, Cura, ITK Snap.

UNIT-II

Liquid based Systems : Stereo Lithography Apparatus (SLA): Models and Specifications, Process, working principle, photopolymers, photo polymerization, Layering Technology, laser and laser scanning, Applications, Advantages and Disadvantages. Poly jet: Models and

Specifications, Process, working principle, Applications, Advantages and Disadvantages. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-III

Solid-based Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Fused Deposition Modelling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Multi Jet Modelling (MJM): Models and specifications, Process, Working principle, Applications, Advantages and Disadvantages.

UNIT-IV

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages. Three **Dimensional Printing (3DP):** Models and Specifications, Process, working principle, Applications, Advantages and Disadvantages. **Laser Engineered Net Shaping (LENS):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT-V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Construction field, Arts and Architecture, Pattern for investment and vacuum casting, Medical Models

and **Bioengineering Applications:** Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production Medical Devices, Forensic Science and Anthropology and Web Based Rapid Prototyping Systems.

TEXT BOOKS :

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2. 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" Springer, Second Edition.

REFERENCE BOOKS :

1. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies:
2. Frank W. Liou, "Rapid Prototyping & Engineering Applications"- CRC Press, Taylor & Francis Group.
3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons.

Course Code	Course Title						Core/Elective
5PC651EC	Analog /Digital Communication Lab						Core
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
AC, DC	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. Demonstrate AM, FM, Mixer, PAM, PWM and PPM techniques.
2. Understand multiplexing techniques.
3. Understand and simulate digital modulation (i.e., ASK, FSK, BPSK, QPSK) generation and detection.
4. Model analog, pulse modulation, PCM, Delta and Digital modulation techniques using CAD tools
5. Obtain data formats.

COURSE OUTCOMES :

1. Understand and simulate modulation and demodulation of AM and FM.
2. Construct pre-emphasis and de-emphasis at the transmitter and receiver respectively.
3. Understand and simulate the PAM, PWM & PPM circuits
4. Understand baseband transmission (i.e., PCM, DPCM, DM, and ADM) generation and detection.
5. Understand error detection and correction.

PART-A

Analog Communication Experiments list:

1. AM generation and detection
2. FM generation and detection
3. Pre emphasis and De-emphasis circuits
4. Multiplexing Techniques (FDM and TDM)
5. Mixer Characteristics
6. Sampling , PAM, PWM, and PPM generation and detection
7. Generation and Detection of Analog and Pulse modulation techniques by using MATLAB/Simulink/Labview

PART-B

Digital Communication Experiments list:

1. PCM generation and detection
2. Data formats / channel encoding and decoding.
3. Linear and Adaptive Delta Modulation and Demodulation
4. Modem characteristics.
5. ASK generation and Detection.
6. FSK and Minimum Shift Keying generation and Detection.
7. Phase shift keying methods (BPSK, QPSK) generation and Detection.
8. Generation and Detection of PCM, Delta modulation and Digital modulation Schemes (ASK. FSK, BPSK, QPSK) by using MATLAB/Simulink/Lab-view.

Note: At least ten experiments should be conducted in the semester, of which five should be from PART - B.

Course Code	Course Title						Core/Elective
5PC652EC	VLSI Design Lab						Core
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
STLD, VLSI	-	-	-	2	40	60	1

COURSE OBJECTIVES :

1. To develop Verilog HDL code for digital circuits using gate level, data flow and behavioural, Modelling and Verify the design block using stimulus.
2. To study the VLSI CAD tools.
3. To implement transistor level circuits.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to:

1. Write the Verilog HDL programs in Gate level and Data flow Modelling.
2. Implement combinational and sequential circuits using Verilog.
3. Analyse digital circuits using VLSI CAD tools like DSCH, Microwind.
4. Design CMOS circuits like basic gates, adders at the transistor level.
5. Implement the layout of simple CMOS circuits like inverter and basic gates.

List of Experiments

PART-A

1. Write structural Verilog HDL model for
   a. 4-bit ripple carry adder.
   b. 4-bit binary Adder cum Subtractor
   c. 1-digit BCD adder
2. Write a Verilog HDL program in behavioural model for
   a. 8:1 multiplexer b. 8:3 encoder c. 3:8 decoder
3. Write a Verilog HDL program in Hierarchical structural model for
   a. 16:1 multiplexer realization using 4:1 multiplexer
   b. 3:8 decoder realization through 2:4 decoder

4. Write a Verilog HDL program in behavioural model for
   a. SR-FF, b. D-FF, c. JK-FF and d. T-FF
5. Write a Verilog HDL program in behavioural model for
   a. 8 bit asynchronous up-down counter
   b. 8 bit synchronous up-down counter
6. Write a Verilog HDL program for 4-bit sequence detector through Mealy state machines
7. Write a Verilog HDL program for 3-bit sequence detector through Moore state machines

PART-B

Transistor Level implementation of CMOS circuits using VLSI CAD tool

1. Basic Logic Gates:
   a. Inverter,
   b. NAND and
   c. NOR
2. Half Adder and Full Adder
3. Half Subtractor and Full Subtractor
4. Implement the Layout of CMOS Inverter.
5. Implement the Layout of CMOS NAND.
6. Implement the Layout of CMOS NOR
7. Implement the Layout of CMOS Half Adder and Full Adder.
8. Implement the Layout of CMOS Half Subtractor and Full Subtractor

Note:

1. A total of 10 experiments must be completed in the semester.
2. Minimum of 5 experiments from Part-A and 5 from Part-B is compulsory.

Course Code	Course Title						Core/Elective
HS 553HS & HS653HS	Soft Skills Lab (Common to CSE & AI & DS – V SEM & ECE, ME, CE & EEE – VI SEM)						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-	-	2	40	60	1

COURSE OBJECTIVES :

The following are the Objectives of the Course :

1. To enable the students to listen to different speakers in different contexts for various purposes and learn target language expressions.
2. To enable the students to develop confidence and interactive skills to speak professionally in different situations.
3. To enable students to learn and develop various reading skills and strategies.
4. To enable the students to develop written expression of thought and provide opportunities to explore ideas by utilizing various techniques.
5. To equip the students to develop needed confidence and interactive skills to speak professionally and acquire skills to face any Interview.

COURSE OUTCOMES :

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

CO 1. Listen to a variety of speakers and texts and will be able to comprehend and perform the required tasks.

CO 2. Interact in a group professionally and communicate confidently in terms of both the spoken and written communication.

CO 3. Develop the skills and strategies of reading and writing.

CO 4. Face any Interview confidently by managing time, making decisions by speaking appropriately according to the context.

CO 5. Demonstrate right attitude and right skills to cope with team and communicate professionally.

LIST OF EXPERIMENTS

I. Listening Skills

- Listening to different situations by Native Speakers.
- Listening to Conversations.
- Listening to Motivational Speeches.

II. Speaking Skills

- Describing a person or a place or a thing using relevant adjectives.
- Picture Perception
- Oral Presentations.
- Etiquette in different situations.

III. Reading Skills

- Reading different Texts
- Reading Comprehension Passages.
- Skimming and Scanning
- Paraphrasing.

IV. Writing Skills

- Writing Slogans related to the image.
- Communicating on Social Media.

V. Interview Skills

- Skills required to attend an Interview
- Soft Skills to be demonstrated in a Job Interview.
- Debates and Group discussions.

SUGGESTED READINGS :

1. Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education. Inc. New Delhi.
2. Antony Jay and Ros Jay. Effective Presentation. How to be a Top Class Presenter. Universities Press.(India) Limited.1999.
3. Robert M Sherfield and etal. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education,2009.
4. M.Ashraf Rizvi Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited. New Delhi.

<table>
<tr><th>Course Code</th><th colspan="5">Course Title</th><th>Core/Elective</th></tr>
<tr><td>5PW672EC</td><td colspan="5">Technical Seminar</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours per Week</td><td>CIE</td><td>SIE</td><td>Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>P</td><td rowspan="2">50</td><td rowspan="2">-</td><td rowspan="2">1</td></tr>
<tr><td>Professional skills, communication skills</td><td>-</td><td>-</td><td>-</td><td>2</td></tr>
</table>

Seminar based on core contents related to parent discipline/department/branch of Engineering.

Course Code	Course Title						Core/Elective
5PW774EC	Summer Internship						Core
Prerequisite	Contact Hours per Week				CIE	SIE	Credits
	L	T	D	P			
professional skills, soft skills, communication skills	-	-	-	-	40	60	1

COURSE OBJECTIVES :

1. To enhance practical and professional skills.
2. To provide training in soft skills and also train them in presenting seminars and technical report writing.
3. To expose the students to industry practices and team work.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to:

1. Acquire practical experience of software design and development, and coding practices within Industrial / R&D Environments.
2. understand working practices within Industrial/R&D Environments
3. Prepare reports and deliver effective presentation.
4. demonstrate effective written and oral communication skills
5. Innovate in various engineering disciplines and nurture their entrepreneurial ideas.

Summer Internship is introduced as part of the curriculum for encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 4 to 6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship.

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of internal marks are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (xx Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will coordinate the overall activity of Industry Attachment Program.

Note : Students have to undergo summer internship of 4 to 6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

B.E. - ECE - VII Semester

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Total Hours	CIE	SEE	
Theory									
1	5PC716EC	Data Communication and Computer Networks	3	0	0	3	40	60	3
2	5PC717EC	Microwave Theory and Techniques	3	0	0	3	40	60	3
3	5PE74XEC	Professional Elective – IV	3	0	0	3	40	60	3
4	5OE7XXXX	Open Elective – III	3	0	0	3	40	60	3
5	5OE7XXXX	Open Elective – IV	3	0	0	3	40	60	3
Laboratories									
6	5PC751EC	Microwave Engineering Laboratory	0	0	2	2	40	60	1
7	5PC752EC	Embedded Systems and I0T Applications Laboratory	0	0	2	2	40	60	1
8	5PW773EC	Project Work - Phase I	0	0	4	4	40	60	2
9	5PW774EC	Summer Internship Evaluation	0	0	-	-	40	60	1
Total Credits									**20**

5PE74XEC	**Professional Elective-IV**
5PE741EC	Digital Design Verification using System Verilog
5PE742EC	Mobile and Cellular Communication
5PE743EC	Biomedical Signal Processing
5PE744EC	Soft Computing Techniques

5OE7XXXX	Open Elective - III	Offered by
2OE703CE	Essential of Road Safety Engineering	CIVIL
3OE703CS	Human Computer Interaction	CSE
1OE703AD	Machine Learning	AI&DS
4OE703EE	Programmable Logic Controllers	EEE
5OE703EC	Medical Electronics	ECE
6OE703ME	Introduction to Robotics	MECH

5OE7XXXX	Open Elective - IV	Offered by
2OE804CE	Remote Sensing and GIS	CIVIL
3OE804CS	Data Science	CSE
1OE804AD	Big Data Analytics	AI&DS
4OE804EE	Sensors and Transducers	EEE
5OE704EC	Industrial Electronics	ECE
6OE804ME	Industrial Engineering & Management	MECH

VII - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC716EC	Data Communication and Computer Networks						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Digital Communication	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To discuss the data communications concepts using the Open Systems Interconnect (OSI) and TCP/IP models for layered architecture.
2. To describe the necessity of data link layer protocols for error, flow control and analyze various multiple access protocols.
3. To Illustrate the principles of network protocols, internetworking and discuss various routing protocols
4. To describe the elements of the transport layer and evaluate the TCP, UDP and ATM protocols.
5. To Analyze the Internet applications and Network security.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Classify and compare different types of computer networks, network topologies, switching principles and OSI, TCP/IP models.
2. Analyze the need and design issues of Data Link layer and distinguish between various multiple access protocols.
3. Compare different routing algorithms of Network layer and discuss the role of network layer in internetworking and the IP addresses.
4. Interpret the elements of the transport layer and evaluate the TCP, UDP and ATM protocols.
5. Illustrate the features of Application layer and various issues of network security and authentication protocols.

UNIT - I

Data communication: Data Communication Models: ISO-OSI, TCP/IP, Protocol Architecture and Standardization. Network Types: Local Area Network, Wide Area Network, Metropolitan Area Network. Network Topologies: Bus, Star, Ring, Hybrid. Line configurations.

Packet and Circuit switching: Principles and concepts, Virtual circuit and Datagram subnets, X.25 Protocol.

UNIT – II

Data Link Layer: Need for Data Link Control, Design issues, Framing, Error Detection and Correction, Flow control Protocols: Stop and Wait, Sliding Window, Automatic Repeat Request (ARR) Protocols, HDLC.

MAC Sub Layer: Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access, Wireless LAN. IEEE 802.3, 802.4, 802.11, 802.15 standards, Bridges, and Routers.

UNIT – III

Network Layer: Network layer Services, Routing algorithms: Shortest Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast, Distance Vector Routing.

Congestion Control Algorithms: Token Bucket, Leaky-Bucket.

Internet Working: The Network Layer in Internet, IPv4 and IPv6, Comparison of IPv4 and IPv6, IP Addressing.

UNIT – IV

Transport Layer: Transport Services, Elements of Transport Layer, Connection management, TCP and UDP protocols, ATM Networks.

UNIT – V

Application Layer: Domain Name System, SNMP, Electronic Mail, World Wide Web.

Network Security: Cryptography, Symmetric Key and Public Key algorithms, Digital Signatures, Authentication protocols.

TEXT BOOKS:

1. Andrew S Tanenbaum, "Computer Networks," 5/e, Pearson Education, 2011.
2. Behrouz A. Forouzan, "Data Communication and Networking,"3/e, TMH, 2008.

REFERENCE BOOKS:

1. William Stallings, "Data and Computer Communications", 8/e, PHI, 2004.
2. Prakash C. Gupta, "Data Communications and Computer Networks", 2/e, PHI learning, 2013.

Course Code	Course Title						Core/Elective
5PC717EC	Microwave Theory and Techniques						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
EMTL,	L	T	D	P			
AWP	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand the concepts of Microwave signal propagation
2. To study the propagation of Guided waves in different modes between parallel planes.
3. To study the parameters of various components used in Microwave design.
4. To understand and analyze the principle of operation of different microwave tubes
5. To understand and analyze the principle of operation of different microwave solid state devices.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Analyze the propagation of Guided waves in different modes between parallel planes.
2. Evaluate different parameters like impedance, attenuation and quality factor for Rectangular & Circular Waveguides and Cavity Resonators.
3. Determine Scattering parameters of different microwave components and analyze their properties.
4. Integrate the concept of bunching and velocity modulation to summarize the operation of microwave tubes and the high frequency limitations of conventional tubes.
5. Analyze the principle, operation and characteristics of different microwave solid state devices.

UNIT - I

Guided Waves: Electromagnetic waves between parallel plates, Propagation of Transverse Electric (TE), Transverse Magnetic (TM) and Transverse Electromagnetic (TEM) waves between parallel planes. Velocity of propagation, attenuation in parallel plane guides, wave impedance.

UNIT – II

Waveguides: Transverse Electric (TE) and Transverse Magnetic (TM) waves in rectangular waveguides. Wave Impedance, Characteristic Wave Impedance, Attenuation and Quality factor of waveguides. Basics of Circular waveguides. Cavity resonators, resonant frequency and Quality factor, Applications of cavity resonator.

UNIT – III

Microwave Circuits and Components: Concept of Microwave circuit, Normalized voltage, Scattering parameters and their properties. Reciprocal and non-reciprocal components: Magic Tee, Directional coupler, E and H Plane Tees and their properties, Attenuators, Phase Shifters, Isolators and Circulators.

UNIT – IV

Microwave Tubes: High frequency limitations of conventional tubes, Bunching and velocity modulation, and mathematical theory of bunching, principles and operation of two-cavity, multi- cavity and Reflex Klystron. Theory of Cross field interaction: Principles and operation of Magnetrons and Cross Field Amplifiers, TWT and BWO.

UNIT – V

Microwave Solid State Devices: Principles of operation, characteristics and applications of Varactor diode, PIN diode, GUNN diode, TRAPATT diode, BARITT diode and IMPATT diode. Elements of strip lines, microstrip lines, slot lines and fin lines and their applications.

TEXT BOOKS:

1. E. C. Jordan & Keith G. Balmain, 'Electromagnetic Waves and Radiating Systems', 2nd edition, Pearson Education, 2006.
2. Samuel Y. Liao, 'Microwave Devices and Circuits', 3rd edition, Pearson Education, 2003.
3. R. E. Collins, "Foundations for Microwave Engineering", 2nd edition, Wiley India Pvt. Ltd., 2012.

REFERENCE BOOKS:

1. Annapurna Das and Sisir K. Das 'Microwave Engineering ', McGraw Hill Education, Third edition, 2014.
2. Skolnik, Krauss, Reich, 'Microwave principles', East West Press, 1976.

PROFESSIONAL ELECTIVE - IV (5PE74XEC)

Course Code	Course Title						Core/Elective
5PE741EC	Digital Design Verification using System Verilog						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
STLD,	L	T	D	P			
VLSI	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To Understand System Verilog as tool to gain knowledge.
2. To describe the concept of OOP in verification.
3. To study concept of System Verilog constructs.
4. To Learn System Verilog Assertions.
5. To understand verification techniques with an example

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand the evolution and importance of System Verilog.
2. Familiarize with the System Verilog tools.
3. Apply the concepts of OOP in verification.
4. Write Programs using the concepts of OOP.
5. Apply verification techniques for digital circuits design.

UNIT - I

Introduction to functional verification languages: Introduction to System Verilog, System Verilog as a Verification Language, Main Benefits of using System Verilog, Drawbacks of using System Verilog, System Verilog Traps and Pitfalls, System Verilog data types, System Verilog procedures, Interfaces and modports, System Verilog routines.

UNIT – II

Introduction to object-oriented programming: Classes and Objects, Inheritance, Composition and Inheritance v/s composition.

UNIT – III

Virtual methods. Parameterized classes, Virtual interface, Using OOP for verification and System Verilog Verification Constructs.

UNIT – IV

System Verilog Assertions: Introduction to assertion, Overview of properties and assertion, Basics of properties and sequences, Advanced properties and sequences, Assertions in design and formal verification, some guidelines in assertion writing.

UNIT – V

Coverage Driven Verification and functional coverage in SV: Coverage Driven Verification, Coverage Metrics, Code Coverage, Introduction to functional coverage, Functional coverage constructs, Assertion Coverage, Coverage measurement, Coverage Analysis SV and C interfacing: Direct Programming Interface (DPI)

TEXT BOOKS :

1. Stuart Sutherland, Simon David Mann, Peter Flake, 'System Verilog for Design: A Guide to Using System Verilog for Hardware Design and Modelling', 2nd ed., Springer, 2014.
2. Chris Spear, "System Verilog for Verification: A Guide to Learning the Test bench Language Features", 2006.
3. J. Bhasker, 'System Verilog Primer', B.S. Publications, 2013.

REFERENCE BOOKS :

1. Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog": An Object- Oriented Framework, Springer, 2007.
2. Ashok B Mehta, 'System Verilog Assertions and Functional Coverage: Guide to Language, Methodology and Applications', Springer, 2013.

Course Code	Course Title						Core/Elective
5PE742EC	Mobile and Cellular Communication						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
AWP,	L	T	D	P			
DC	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand the concept and implementation of frequency reuse and Handoff techniques and to analyse interference and capacity enhancement.
2. To appreciate the factors influencing outdoor and indoor propagation.
3. To understand the concepts related to various Mobile Technologies.
4. To understand the concepts related to GSM and IS -95 Mobile Technologies.
5. To understand the concepts of different types of Wireless Networks.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand the method of selection and reuse of a set of frequency channels, Base station requirements.
2. Appreciate and understand the methods of electromagnetic wave propagation in cellular communication.
3. Identify different methods of mobile access technologies suitable for mobile cellular solutions.
4. Explain features, authentication, operational details of GSM and CDMA mobile cellular systems.
5. Understand the development and limitation of the preliminary and advanced generation mobile systems.

UNIT - I

Basic Cellular system and its operation: frequency reuse, channel assignment strategies, Handoff process, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Cross talk, Enhancing capacity and cell coverage, Trunked radio system. Manual and Automatic Electronic Exchanges.

UNIT – II

Propagation Models: Free space propagation model, basic propagation mechanisms, practical link budget design using path loss models, outdoor propagation models:

Durkin's model and indoor propagation model, partition losses. Small scale multipath propagation, Parameters of mobile, multipath channels, Mobile antennas and their radiation patterns.

UNIT – III

Multiple Access Technologies in Communication: TDMA, FDMA, CDMA, SSMA, FHMA, SDMA, Packet radio protocols, CSMA, Reservation protocols time Frame details.

UNIT – IV

GSM: Services and Features, System architecture, Radio Sub-system, Channel Types, Frame structure and Signal processing. CDMA: Digital Cellular standard IS-95, Forward Channel, Reverse Channel.

UNIT – V

Comparison of Mobile communication Technologies: Introduction to 1G, 2G and 2.5G technology, Features of 3G and 4G LTE, 5G, and WLAN, Bluetooth, PAN, Trends in Radio and Personal Communications, UMTS system architecture and Radio Interface.

TEXT BOOKS:

1. Theodore. S. Rappaport, "Wireless Communications: Principles and Practice", 2/e, Pearson Education, 2010.
2. William. C.Y. Lee, "Mobile Communication Engineering," 2/e, McGraw Hill, 2008.
3. T. L. Singal, "Wireless Communication Systems", 1/e, TMH Publications, 2010.

REFERENCE BOOKS:

1. William C.Y. Lee, "Mobile Cellular Telecommunications: Analog and Digital Systems", 2/e, McGraw Hill, 2011.
2. Nishith D. Tripathi and Jeffrey H. Reed, "Cellular Communications: A Comprehensive and Practical Guide", Wiley, 2014.
3. https://archive.nptel.ac.in/courses/108/106/106106167/#

Course Code	Course Title						Core/Elective
5PE743EC	Biomedical Signal Processing						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
S & S,	L	T	D	P			
PTSP	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course are

1. To Make Students Understand the Sources, Types & Characteristics of Different Noises and Artifacts Present in Biomedical Signals.
2. To Make Students Able to Design Time Domain and Frequency Domain Filters for Noise and Artifact Removal from Biomedical signals.
3. To Make Students Able to Understand and Apply Various Methods for Analyzing Biomedical Signal Characteristics.
4. To Motivate Students to Explore Alternative Techniques of Analyzing Biomedical Signals in Time and Frequency Domain.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Apply the probability theory and random processes techniques in analyzing biological signals.
2. Determine the best class of compression techniques to use for a particular biomedical signal to compress.
3. Possess the basic mathematical, scientific and computational skills necessary to analyze and process cardiological signals as per the requirement.
4. Ability to formulate and solve basic problems in biomedical signal analysis.
5. Possess the basic mathematical, scientific and computational skills necessary to analyze and process neurological signals as per the requirement.

UNIT-I:

Introduction to Biomedical Signals Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPS), Objectives of Biomedical Signal Analysis.

UNIT-II:

Time domain Analysis, Frequency domain Analysis, Time vs Frequency domain Analysis, Short Time Fourier Transform (STFT), Drawbacks of STFT, Wavelet Transform- Continuous Wavelet Transform (CWT), Discrete Wavelet Transform (DWT) and Wavelet Analysis.

UNIT-III:

Removal of Noise and Artifacts from Biomedical Signals, Random and Structured Noise, Physiological Interference, Stationary and Non-stationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.

UNIT-IV:

EEG Signal Processing and Event Detection in Biomedical Signals, EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms, Waves and Transients, Detection of Waves and Transients, Correlation Analysis Ad Coherence Analysis of EEG Channels.

UNIT-V:

Analysis of Non-stationary Signals: Characterization of Non-stationary Signals, Principal Component Analysis and Independent Component Analysis.

TEXT BOOKS:

1. Rangayyan, R.M., "Biomedical signal analysis", (Vol. 33) John Wiley & Sons, 2015.
2. Reddy, D.C., "Biomedical signal processing: principles and techniques", McGraw-Hill Optional Materials, 2005.

REFERENCE BOOKS:

1. Tompkins, W.J., "Biomedical digital signal processing". Editorial Prentice Hall, 1993.
2. Sörnmo, L. and Laguna, P., "Bioelectrical signal processing in cardiac and neurological applications", (Vol. 8). Academic Press, 2005.

Course Code	Course Title						Core/Elective
5PE744EC	Soft Computing Techniques						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Neural Network, Programming	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. Understanding about the fundamentals of machine learning, neural networks and optimization.
2. Enabling the students to acquire knowledge about data selection and classification.
3. Enabling students to learn about evolutionary algorithms.
4. Understanding about the fundamentals of various search techniques
5. Apply soft computing techniques to solve practical problems.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Comprehend the categorization of machine learning algorithms and concepts of python programming.
2. Acquaint with artificial neural network terminologies.
3. Understand advanced algorithms for artificial neural networks.
4. Acquaint with the working mechanisms of evolutionary algorithms.
5. Apply genetic algorithms to solve soft computing problems.

UNIT - I

Learning Problems and Python programming concepts: Different approaches to learning problems (Supervised, Semi-supervised, and unsupervised).

Python: Data structures (Lists, Tuples, Dictionary, Sets), String manipulation, Conditional statements, Functions, Objects and classes.

UNIT – II

Artificial Neural Network-I: Biological inspiration and historical context, Activation functions and their properties, Forward propagation, the role of weights and biases,

McCulloch-Pitts Neuron, Perceptron, Training a single-layer neural network, Limitations of single-layer networks, Applications of single-layer neural networks.

UNIT – III

Artificial Neural Network-II: Introduction to Multilayer Perceptron (MLP), Back propagation algorithm for training MLPs, Stochastic Gradient Descent algorithm and weight optimization techniques ,Hyper parameter tuning in MLPs, Applications of MLP.

UNIT – IV

Optimization in Soft Computing-I: Overview of optimization in soft computing, Basic Evolutionary Processes, Evolutionary Systems as Problem Solvers, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs, Population Size. Applications of Optimization in Soft Computing: Feature selection and dimensionality reduction, Data clustering and classification

UNIT – V

Optimization in Soft Computing-II: Introduction to Genetic algorithms, Biological Background, Traditional Optimization and Search Techniques, Genetic Algorithm and Search Space, Operators in Genetic Algorithm, Stopping Conditions for Genetic Algorithm Flow, Problem Solving Using Genetic Algorithm: Maximizing a Function

TEXT BOOKS:

1. Mohssen Mohammed, Muhammad Badruddin Khan, Eihab Bashier Mohammed Bashier, "Machine Learning Algorithms and Applications", CRC Press, 2017.
2. Aurélien Géron, "Hands-On Machine Learning Concepts, Tools, And Techniques To Build Intelligent Systems", O'Reilly Media Inc., ISBN: 9781492032649, 2019.
3. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley (3rd edition), ISBN: 9788126577132, 2018.

REFERENCE BOOKS:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong. "Mathematics for Machine Learning", Cambridge University Press. ISBN: 9781108679930, 2020.
2. Oswald Campesato, "Artificial Intelligence, Machine Learning, and Deep Learning", Mercury Learning & Information, 2020, ISBN: 9781683924661,

OPEN ELECTIVE - III (5OE7XXXX)

Course Code	Course Title						Core/Elective
6OE703ME	INTRODUCTION TO ROBOTICS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Familiarize with basic terminologies of the robotic science and essential knowledge required to get started in the field of Robotics.
- Learn different types of grippers and sensors used in robotics.
- Understand sensor selection criteria.
- Learn programming languages for robot programming.
- Understand the socio economic aspects and interdisciplinary applications of robotics.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Understand the principles and functions of robotic components.

CO2: Analyze the role of sensors, actuators, and controllers in robotic systems.

CO3: Apply kinematic principles to model and control robot movement.

CO4: Develop basic programming skills for robot control and simulation.

CO5: Understand socio economic aspects of robotics.

Unit-I

Introduction to Robotics:

Brief History, Basic Concepts of Robotics such as Definition, Three laws, Types of robots, Elements of Robotic Systems , DOF, Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc .Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

Unit-II

Grippers and Sensors for Robotics:

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system.

Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Selections of sensors. Need for sensors and vision system in the working and control of a robot.

Unit-III

Drives and Control for Robotics: Drive - Types of Drives, Types of transmission systems & Actuators.

Control Systems: Types of Controllers, Introduction to closed loop control.

Unit- IV

Programming and Languages for Robotics: Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages, Generations of Robotic Languages, Introduction to VAL,RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

Unit - V

Socio-Economic aspect of Robotisation: Socio-Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.

TEXT BOOKS :

1. "Robotics: Modelling, Planning and Control" by Bruno Siciliano, Springer.
2. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson.

REFERENCE BOOKS :

1. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu.
2. "Robot Modeling and Control" by Mark W. Spong.
3. "Robotics: Control, Sensing, Vision, and Intelligence" by C.S.G. Lee and K. S. Fu, McGraw-Hill Education.
4. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson.

Course Code	Course Title						Core/Elective
4OE703EE	PROGRAMMABLE LOGIC CONTROLLERS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understanding of PLC programming, ladder logic.
- Analysis and classification of the process control
- Understanding PLC hardware units and utilizing them

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Describe typical components of a Programmable Logic Controller.

CO 2. State basic PLC terminology and their meanings.

CO 3. Use latch, timer, counter, and other intermediate programming functions.

CO 4. Explain and apply the concept of electrical ladder logic, its history, and its relationship to programmed PLC instruction.

CO 5. Design and program a small, automated industrial production line.

UNIT–I:

Introduction to PLC

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, and limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc

UNIT– II:

Working of PLC

Basic operation and principles of PLC, Scan Cycle, Memory structures, I/O structure, Programming terminal, power supply

UNIT-III:

Instruction Set

Basic instructions like latch, master control self-holding relays, Timer instruction like retentive timers, resetting of timers, Counter instructions like up counter, down

counter, resetting of counters, Arithmetic Instructions (ADD,SUB,DIV,MUL etc.), MOV instruction, RTC(Real Time Clock Function), Watch Dug Timer, Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal.

UNIT–IV:

Ladder Diagram Programming

Programming based on basic instructions, timer, counter, and comparison instructions using ladder program.

UNIT–V:

Applications of PLCs

Object counter,On-off control, Car parking, Sequential starting of motors, Traffic light control, Motor in forward and reverse direction, Star-Delta, DOL Starters, Filling of Bottles, Room Automation.

TEXTBOOKS:

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh

REFERENCE BOOKS :

1. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar.
2. Module on "Allen BradlagPlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
3. Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
4. CHUNGPA, "User's Manual :Universal PLC Training System CPS-3580U", English ver1, 2020.
5. Handbook, P. L. C. "Practical Guide to Programmable Logic Controllers." AutomationDirect. com.

Course Code	Course Title						Core/Elective
1OE703AD	MACHINE LEARNING						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To learn the concepts of machine learning and types of learning
- To study various supervised learning algorithms.
- To learn ensemble techniques and various unsupervised learning algorithms.
- To understand assessment methods and evaluation parameters of machine learning algorithms.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Describe types of data and their pre processing methods

CO2. Describe supervised, unsupervised learning methods and their appropriate evaluation procedures and metrics

CO3. Apply different supervised and unsupervised machine learning algorithms to different datasets

CO4. Evaluate different machine learning approaches and infers the best learning model for a given scenario.

UNIT-I

Introduction: Types of Machine Learning Algorithms: Parametric and Non-parametric Machine Learning Algorithms, Supervised, Unsupervised, Semi-Supervised and Reinforced Learning.

Data Objects and Attribute Types: Nominal Attributes, Binary Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes.

Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode. Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation.

UNIT II

Representation and Learning: Feature Vectors, Feature Spaces

Supervised Algorithms: Regression: Linear Regression, Logistic Regression. Evaluation Measures: SSE, RMSE, R2

UNIT III

Classification: Decision Tree, Naïve Bayes, K-Nearest Neighbors, Support Vector Machines.

Evaluation of classification: cross validation, hold out The Confusion Matrix, Accuracy, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve

UNIT IV

Unsupervised Learning: Cluster Analysis: Similarity Measures.

Categories of clustering algorithms, k-means, Hierarchical Clustering.

UNIT V

Ensemble Algorithms: Bagging, Random Forest, Boosting

TEXT BOOKS :

1. Machine Learning, Tom Mitchell, McGraw-Hill Science/Engineering/Math; (1997).
2. Data Mining -Concepts and Techniques, Jiawei Han, MichelineKamber, Jian Pei, III Edition, Morgan Kauffmann Publisher, 2012.

REFERENCE BOOKS :

1. Machine Learning: An Algorithmic Perspective, Stephen Marsland, II Edition, Chapman & Hall.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer. (2006)
3. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson, 2014.

Course Code	Course Title						Core/Elective
OE703CE	ESSENTIALS OF ROAD SAFETY ENGINEERING						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

C1. Comprehend global and Indian road accident trends to grasp fundamental road safety principles.

C2. Apply statistical and engineering tools to analyze traffic safety data effectively.

C3. Design road infrastructure with safety features considering vehicle and human factors.

C4. Manage traffic effectively to enhance road safety outcomes.

Conduct thorough road safety audits and propose evidence-based improvement strategies.

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Understand fundamental principles of road safety.

CO 2. Analyze traffic safety data using statistical methods and engineering techniques.

CO 3. Apply geometric design principles and integrate safety features into road infrastructure.

CO 4. Master traffic management systems to enhance road safety.

CO 5. Conduct road safety audits and develop comprehensive safety management systems.

Unit - I :

Global and Indian Road Safety Landscape: Current state of road safety, leading causes of accidents, comparison with global trends.

Accident Characteristics: Analyzing real-world accident data, understanding the "who, what, when, where, and why" of crashes.

Unit-II:

Traffic Engineering Fundamentals: Traffic flow, capacity analysis, role of traffic control devices like signs and signals.

Statistical Methods for Action: Applying regression analysis and other statistical tools to identify correlations between factors and accidents, predicting high-risk areas.

Unit-III:

Accident Investigations and Risk Management: Conducting thorough accident investigations, understanding root causes, and preventing future incidents.

Human Factors and Vehicle Characteristics: The impact of human behavior, perception limitations, and vehicle design features on road safety.

Road Design for Safety: Geometric design elements influencing safety (lane width, curves, sight distance) and road equipment (guardrails, delineators).

Road Lifecycle Approach: Strategies for safe and efficient road maintenance, reconstruction, and rehabilitation.

Unit-IV:

Traffic Signals & Street Lighting: Principles of traffic signal design considering traffic flow and pedestrian needs. Importance of proper street lighting for nighttime safety.

Provisions for Vulnerable Users: Dedicated infrastructure and design considerations for the safety of pedestrians, cyclists, and other vulnerable road users.

The Power of Signs and Markings: Different types of road signs and pavement markings, design standards, and their role in guiding drivers and improving safety.

Unit-V:

Traffic Management Systems (TMS) & Intelligent Transportation Systems (ITS): Implementing technology to improve traffic flow and mitigate accidents.

Road Safety Audits: Conducting comprehensive road safety audits to identify potential safety issues in existing or planned road infrastructure.

Safety from Start to Finish: Best practices for construction site safety, including worker protection measures and proper signage.

Text Books:

1. Sarkar, Pradip Kumar, Maitri, Vinay, Joshi, G.J., Transportation Planning: Principles, Practices And Policies, Third Edition, 2021.
2. L.R. Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers, 9th Edition, 2019.

Reference Books:

1. Geetam Tiwari (Editor), Dinesh Mohan (Editor), Transport Planning and Traffic Safety, CRC Press, 1st edition, 2016.
2. HSS Committee, Manual on Road Safety Audit (IRC:SP-088), Indian Road Congress, First Revision, 2019.

Course Code	Course Title						Core/Elective
3OE703CS	HUMAN COMPUTER INTERACTION						Open
Prerequisite	Contact Hours per Week				CIE	SEE	Elective-III
	L	T	D	P			Credits
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- To gain an overview of Human-Computer Interaction (HCI),
- To understand user interface design and alternatives to traditional "keyboard and mouse" computing.
- To become familiar with the vocabulary associated with sensory and cognitive systems as relevant to task performance by humans.
- To apply models from cognitive psychology to predicting user performance in various human-computer interaction tasks.
- To analyze the importance of a design and evaluation methodology that begins with and maintains a focus on the user.

COURSE OUTCOMES:

After completing the course, student will be able to:

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
2. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Describe and use HCI design principles, standards and guidelines.
5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT -I

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT-II

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT-III

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colours, uses problems, choosing colours.

UNIT-IV

HCI in the software process, The software life cycle Usability Engineering Iterative design and proto typing Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

UNIT-V

Cognitive models Goal and task hierarchies

Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research

Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience

Design Focus: Applications of augmented reality Information and data visualization

Design Focus: Getting the size right.

TEXT BOOKS

1. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.
2. Human – Computer Interaction. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg,Pearson Education

REFERENCE BOOKS

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.

Course Code	Course Title						Core/Elective
5OE703EC	MEDICAL ELECTRONICS						Open Elective-III
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. To familiarize students with the fundamental principles of medical electronics and the nature of bioelectric signals.
2. To provide students with the knowledge and skills necessary for the acquisition, processing, and interpretation of biosignals such as ECG, EEG, EOG, and EMG.
3. To enable students to understand the common artifacts and sources of noise in biosignals and develop techniques for artifact removal.
4. To introduce students to the clinical applications of biosignal analysis in the diagnosis and monitoring of various medical conditions.
5. To foster an understanding of emerging trends and technologies in medical electronics and their potential impact on healthcare.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Demonstrate an understanding of the principles underlying bioelectric signals and their relevance in medical diagnostics.
2. Apply appropriate techniques for the acquisition and preprocessing of biosignals using specialized instrumentation.
3. Analyze and interpret biosignals such as ECG, EEG, EOG, and EMG to identify normal and abnormal patterns.
4. Implement signal processing algorithms to remove artifacts and enhance the quality of biosignals for accurate diagnosis.
5. Evaluate the clinical significance of biosignal analysis in the context of specific medical conditions and treatment strategies.

UNIT-I

Medical Electronics Overview: Definition, scope, and importance in healthcare. Bioelectric Signals Basics: Nature, characteristics, and acquisition techniques. Signal Processing Fundamentals: Basics and artifact removal techniques.

UNIT – II

Physiology of the Heart: Understanding the cardiac cycle and ECG signal generation. ECG Signal Acquisition: Electrodes, instruments, and techniques. ECG Interpretation: Normal/abnormal waveforms analysis. ECG Artifacts and Noise: Sources and minimization methods.

UNIT – III

Fundamentals of Brain Signals: EEG signal generation and EEG signal acquisition techniques. EEG Signal Analysis: Preprocessing, feature extraction, and classification. EEG Artifacts: Identification and mitigation strategies.

UNIT – IV

Muscle Physiology: EMG signal generation and EMG signal acquisition techniques. EMG Signal Interpretation: Normal/abnormal waveforms analysis, Noise Sources and minimization methods.

UNIT – V

Other Biosignals Introduction: EOG and EDA overview. Wearable Medical Electronics: Continuous monitoring and diagnosis applications. Medical Electronics Trends: Recent advancements and future directions. Case Studies and Practical Applications: Real-world examples.

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Engineering", 4th Edition, Academic Press, 2012.
2. C. Raja Rao and Sujoy K. Guha, "Principles of Medical Electronics and Biomedical Instrumentation", 5th Edition, McGraw Hill Education, 2018.

REFERENCE BOOKS:

1. Malcolm S. Milner, Iain Hunter, and David G. Sixto Jr., "Biomedical Signal Analysis: A Practical Guide", 3rd Edition, Artech House, 2012.
2. IEEE Transactions on Biomedical Engineering.

OPEN ELECTIVE - IV (5OE7XXXX)

Course Code	Course Title						Core/Elective
5OE704EC	INDUSTRIAL ELECTRONICS						Open
Prerequisite	Contact Hours per Week						Elective-IV
	L	T	D	P	CIE	SEE	Credits
BEE	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims at

1. Introducing electronic device characteristics suitable for industrial applications
2. Designing AC to DC, DC to AC Converters, Amplifiers , inverters and SMPS
3. Understanding various voltage control techniques in power converters.
4. Comprehending quadrant operation of various power converters
5. Introducing various electronic techniques for industrial heating to minimize EM interference.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Understand Industrial Semiconductor devices SCR , DIAC, TRAIC, and MOSFET respectively.
2. Comprehend DC amplifiers, Operational amplifier and Instrumentation amplifier.
3. Design and analysis of DC to DC converters and DC to AC converters and different types of Choppers.
4. Develop skills to build and troubleshoot power electronic circuits.
5. Synthesis of PWM Inverters, UPS and Switched mode regulators

UNIT - I

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT (Qualitative Treatment only), Protections and thermal considerations. Brief introduction to power devices: DIAC and TRIAC, MOS controlled thyristor, Power Integrated Circuit (Smart Power), Concept of fast recovery and Schottky diodes as free-wheeling and feedback diodes.

UNIT – II

DC Amplifiers: Need for DC amplifiers, DC amplifiers: Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Operational Amplifiers, and Instrumentation Amplifiers.

Choppers circuits: Principle, methods and Configurations operations of Type A, Type B, Type C, Type D and type E choppers, TRIACS: Triggering modes, Firing Circuits, Control techniques for choppers: TRC and CLC.

UNIT – III

Regulated Power Supplies: Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques: Short Circuit, over voltage and Thermal Protection. Switched Mode and IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators.

UNIT – IV

Single-Phase Inverters: Principle of operation of full bridge square wave, quasi square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters voltage and harmonic control at output of inverter, Filters at the output of inverters, Single phase current source inverter. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings.

UNIT – V

Industrial Applications-I: Industrial timers, Classification, types, Electronic Timers –Classification, RC and Digital timers. Electronic DC Motor Control.

Industrial Applications-II: High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating: principle, material properties, Electrodes and their Coupling to RF generator.

TEXT BOOKS:

1. Theodore. H. Bogart, “Electronic Devices and circuits”, Pearson Education, 6th Edition, 2003.
2. P.C. Sen., “Modern Power Electronics", 2nd Edition, Chand & Co., 2004.
3. V.R. Moorthi, “Power Electronics”, Oxford University Press, 2005.

REFERENCE BOOKS:

1. G. K. Mithal and Maneesha Gupta, “Industrial and Power Electronics”, Khanna Publishers, 19th Edition, 2003.
2. Ned Mohan, Robbins, “Power electronics”, 3rd Edition, John Wiley and sons, 2002.
3. Biswanth Paul,” Industrial Electronics and Control”, PHI Learning, 3rd edition 2014.
4. S.Chatterjee and Bhattacharya ,” Industrial Electronics and Control”, Technical education series,1st edition 2017.

Course Code	Course Title						Core/Elective
4OE804EE	SENSORS AND TANSDUCERS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

The objective of this course is to make the student

1. To understand the principle of operation of Transducers and Sensors
2. To understand the application of Transducers and Sensors

COURSE OUTCOMES :

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

1. Explain the basic principle of operation of Transducers and Sensors. Distinguish different sensors and transducers.
2. Identify suitable transducer by comparing different industrial standards and procedures for measurement of physical parameters
3. Estimate the performance of different transducers.
4. Design real life electronics and instrumentation measurement systems.
5. Apply smart sensors, bio-sensors, PLC and Internet of Things to different applications.

UNIT – I:

Introduction: Definition, significance of measurement and instruments. Principle of sensing & transduction, transducer classification, Transducer characteristics, emerging fields of sensor technologies.

Resistive transducers: Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.

UNIT – II :

Inductive transducers: Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics. Optical Sensors: LDR, Photo Diode, Stroboscope, IR Sensor.

Capacitive transducers: Variable distance-parallel plate type, variable area- parallel plate type, cylindrical type, differential type, variable dielectric constant type, calculation of sensitivity. Capacitive microphone, fluid level measurement.

UNIT-III:

Piezoelectric transducers: piezoelectric effects, Materials, natural and synthetic types – their comparison, Charge and voltage coefficient, Force and stress sensing, displacement measurement.

Magnetic Transducer: Hall effect sensors

Magneto strictive transducers: principle, positive and negative magneto striction

UNIT –IV:

Thermal sensors: Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple, thermocouple types, construction. IC temperature sensor, PTAT type sensor. Radiation sensors: types, characteristics and comparison. Pyroelectric type.

UNIT – V:

Micro-sensors and smart sensors: Construction, characteristics and applications. Standards for smart sensor interface.

Recent Trends in Sensor Technologies: Introduction; Film sensors (Thick film sensors, thin film sensor)

TEXT BOOKS :

1. Transducers and Instrumentation , D.V.S. Murthy, Prentice Hall, 2008
2. Sensors and Transducers, D. Patranabis, Prentice Hall India, 2003
3. Measurement Systems - Application and Design, E.O. Doebelin, McGraw-Hill, 2008

REFERENCE BOOKS :

1. Instrument Transducers - An Introduction to their Performance and Design", H.K.P. Neubert, Oxford University Press, 1999.
2. Measurement Systems and Sensors, WaldemarNawrocki Artech House, 2016.
3. Semiconductor sensors", S.M. Sze, Wiley - Interscience, 1994
4. Instrumentation Measurement and Analysis", B. C. Nakara&Chaudhry TATA McGraw-Hill, 2009.
5. Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, 2011.

Course Code	Course Title						Core/Elective
1OE804AD	BIG DATA ANALYTICS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Understand the Big Data Platform and overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide handson Hadoop Eco System Pig, Hive
- Understand various Hadoop Eco Systems like H base, Zookeeper

COURSE OUTCOMES:

After completing the course, student will be able to:

CO1: Explain the foundations, definitions, and challenges of Big Data.

CO2. Use Hadoop file system interfaces.

CO3. Program using HADOOP and Map reduce.

CO4. Understand various Hadoop Eco Systems like Pig, Hive.

CO5. Outline Hadoop Eco System using H Base, Zookeeper.

UNIT-I

Introduction to Big Data and HadoopTypes of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with UNIX tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System.

UNIT-II

HDFS (Hadoop Distributed File System)The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file systeminterfaces, Data flow, Hadoop I/O: Compression, Serialization, Avro and File-BasedData structures.

UNIT -III

Map ReduceAnatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort,

Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT IV

Hadoop Eco System-IPig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig withDatabases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

UNIT V

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, Hive QL, Tables, Querying Data and User Defined Functions.

TEXTBOOKS :

1. Hadoop: The Definitive Guide, Tom White, III Edition, O'reily Media, 2012.

REFERENCE BOOKS :

1. Big Data Analytics, Seema Acharya, Subhasini Chellappan, Wiley 2015.
2. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.

Course Code	Course Title						Core/Elective
OE804CE	REMOTE SENSING AND GIS						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

C1. Basics of remote sensing and Sensor Characteristics

C2. Energy interactions with atmosphere and Earth surface features

C3. Map projections and Data models in GIS

C4. Spatial Data creation

C5. Spatial data and Terrain modelling analysis

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Explain the basics of Remote Sensing, different types of satellite and sensors

CO 2. Define the principles of satellite remote sensing, able to comprehend the energy interactions with earth surface features, spectral properties of water bodies

CO 3. Demonstrate the basic concept of GIS and its applications, know different types of data representation in GIS

CO 4. Create the spatial data using various techniques

CO 5. Develop models using spatial & Terrain Analysis

Unit-I

Basics of Remote Sensing: Definition, History, Advantages, Aerial Photography and Satellite Remote Sensing, Components of Remote Sensing System: Energy Source, Energy-Atmosphere Interaction, Energy Interaction with Atmosphere and Surface Materials, Spectral Signatures

Unit-II

Remote Sensing Platforms: Aircrafts and Satellites, Orbital Characteristics of Sun-synchronous and Geostationary satellites - Special Purpose Satellites; Remote

Sensing Sensors: Types of Sensors, Active and Passive; Framing Systems (Cameras) - Scanning System; Sensor Characteristics: Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal Resolution.

Unit-III

Introduction to GIS: History of development of GIS- Geo Spatial Data - GIS operations- Standard GIS packages, Applications of GIS;

Datum and Map Projections: Concept of Datum, Coordinate Systems and Map Projections , Transformations

Unit-IV

Data Models: Spatial and Non-Spatial Data models; Spatial Digital formats

Spatial Data Creation: Scanners, digitizers; Digital Elevation Models; Sources of Errors & Corrections- Rotation and Resampling methods, Morphometric analysis- Triangular Irregular Network (TIN).

Unit-V

Spatial Data Analysis: Raster data analysis; Vector data analysis - Buffering, Overlay, Union, Intersect, Merging, splitting operations

Terrain Modelling & Analysis: Contouring, Vertical profiling, Hill shading, 3D perspectives; Slope & Aspect analysis, Viewshed & watershed analysis.

Software: Introduction to QGIS or ARCGIS software and its interface to perform spatial analysis

TEXT BOOKS:

T1. M.Anji Reddy – "Textbook of Remote Sensing and Geographic Information Systems", 3rd Edition, BS Publications, 2008.

T2. K.T.Chang –"Introduction to Geographic Information Systems", 4th Edition, McGraw Hill International Edition, 2016.

REFERENCE BOOKS:

R1. Lillesand, T., Kiefer, R. W., & Chipman, J. – "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons, 2015.

R2. Punmia, B.C. & Jain A.K.—"Higher Surveying", 15th Edition, Laxmi Publications, 2005.

Course Code	Course Title						Core/Elective
3OE804CS	DATA SCIENCE						Open Elective-IV
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
–	3	-	-	-	40	60	3

COURSE OBJECTIVES:

It is intended to make the students to :

- Learn fundamental knowledge on basics of data science.
- Understand various statistical concepts like linear and logistic regression
- Learn fundamentals of how to obtain, store, explore, and model data efficiently.
- Understand the concepts of classification and clustering

COURSE OUTCOMES:

After completing the course, student will be able to:

CO 1. Recognize the different levels of Data Science concepts for visualization of data.

CO 2. Demonstrate the data visualization and statistical techniques, for describing data structure property.

CO 3. Analyze the basics of probability and statistics models for data exploration

CO 4. Make use of Hypothesis testing for statistical analytics for destroying target based on the mission requirements.

CO 5. Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies

UNIT-I

Introduction: What is Data Science, Where Do We See Data Science, and How Does Data Science Relate to Other Fields, The Relationship between Data Science and Information Science, Computational Thinking, Skills for Data Science, Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science.

UNIT-II

Data Collection and Data Pre-Processing: Data Types-Structured Data, Unstructured Data, Challenges with Unstructured Data, Data Collections- Open Data, Social Media

Data, Multimedia Data, Data Storage and Presentation, Data Pre-processing -Data Cleaning, Data Transformation, Data Reduction, Data Discretization

UNIT-III

Exploratory Data Analysis: data summarization, data distribution, Frequency Distribution, Measures of Centrality, Dispersion of a Distribution, Diagnostic Analytics-Co-relations Predictive Analytics, Perspective Analytics, Exploratory Analysis, hypothesis testing using confidence intervals, using p-values.

UNIT-IV

Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression, Robust Regression. Evaluation Measures: SSE, RMSE.

UNIT-V

Classification: Decision Tree Induction, Support Vector Machine, K-Nearest neighbours (KNN), performance measures: The Confusion Matrix, precision, recall, F-Score, Receiver Operator Characteristic (ROC) Curve. Clustering: K-means Clustering.

TEXT BOOKS:

1. A Hands on Introduction to Data Science, Chirag Shah, Cambridge University Press 2020.
2. Practical Statistics for Data Scientists, Peter Bruce and Andrew Bruce,O.Reilly, 2017.
3. R for Data Science,Hadley Wickham and Garrett Grolemund, O.Reilly, 2017

REFERENCE BOOKS:

1. R Programming for Data science, Roger D Peng, Lean Publishing, 2016.
2. Introduction to Data Science, Rafael A Irizarry, Lean Publishing, 2016.
3. R Data Analysis cookbook, VishwaVishwanathan and Shanthi Vishwanathan, 2015.

Course Code	Course Title						Core/Elective
6OE804ME	INDUSTRIAL ENGINEERING AND MANAGEMENT						Open Elective-IV
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	40	60	3

COURSE OBJECTIVES :

It is intended to make the students to :

- Learn the concept of Management.
- Understand role of PERT and CPM techniques in project management.
- Learn various material procurement policies.
- Understand the costing and cost control in engineering industries.
- Learn job evaluation methods.

COURSE OUTCOMES :

After completing the course, student will be able to:

CO1. Understand the concept of scientific management.

CO2. Apply different types of inventory models in material management.

CO3. Apply the concepts of PERT and CPM techniques in project management.

CO4. Analyse the elements of costing and determine the selling price.

CO5. Apply job evaluation and merit rating techniques to evaluate the performance of employees.

Unit-I

Management: Introduction to Management, Scientific Management, Systems approach to Management, MBO, and Decision Making Process. Personnel Management, Functions of personnel management, types of training, Collective bargaining and labour participation in management.

Unit-II

Cost Accounting and Control: Introduction, Elements of cost, types of cost- prime cost, overhead cost, factory cost, total cost. Selling price, nature of cost, control and accounting of materials, labor, and over head cost, depreciation, break even analysis, break even chart.

Unit III

Job Evaluation and Merit Rating: Job evaluation: Introduction, definition and concept, objectives, procedure and methods-ranking method, classification or grading method, factor comparison method and point method, Merit rating: Introduction, definition, objectives, and methods- rating scale, check list and employee comparison method.

Unit-IV

Material Management: Importance of inventory control, types of inventory models Inventory costs, deterministic inventory models, Basics of EOQ models, production model without shortages, Purchase model with instantaneous replenishment, production model with shortages, Inventory model with price breaks, Inventory model with probabilistic demand.

Unit-V

Project Management: Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management, Assessment of tax burden.

TEXT BOOKS:

1. OP Khanna, Industrial engineering and management, Dhanpat Rai Publications.
2. SK Sharma &Savita Sharma," A course in Industrial Engineering & Operations Management", S K Kataria& Sons.

REFERENCE BOOKS:

1. M.Mahajan, "Industrial Engineering and Production Management", Dhanpatrai& sons, New Delhi.
2. S Kalavathi, "Operations Research", Vikas Publishing House Pvt. Ltd.
3. V. K. Kapoor , "Operations Research", S. Chand, New Delhi.

Course Code	Course Title						Core/Elective
5PC751EC	Microwave Engineering Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
EMTL, AWP	L	T	D	P			
	0	0	-	2	40	60	1

COURSE OBJECTIVES:

This course aims to familiarize

1. Understand the characteristics of Reflex Klystron Oscillator and Gunn oscillator.
2. Measurement of frequency and wavelengths would be learnt by the student.
3. VSWR various TEES would be understood by the student.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand the characteristics of Microwave Sources.
2. Evaluate the mode characteristics of Reflex klystron and V-I Characteristics of Gunn Diode.
3. Analyze frequency, Wave length, SWR and Impedance for Reflex Klystron Oscillator by using its equation.
4. Analyze the characteristics of Circulator, Isolator, Directional Coupler, Tees like (Magic Tee, E & H plane Tees) using the Scattering parameters.
5. Generate the Radiation pattern of different antennas like Yagi-Uda and Horn Antenna and measure the gain of the antennas.

List of Experiments

1. To find and verify characteristics of Reflex Klystron oscillator, mode numbers and efficiencies of different modes.
2. To find and verify characteristics of Gunn diode oscillator, Power Output Vs Frequency, Power Output Vs Bias Voltage.
3. To Measure and verify frequency and guide wavelength calculation using microwave bench setup.
4. To measure low and high VSWR of different components like matched terminations.

5. To measure the impedance of the horn antenna.
6. To measure and verify the S-parameters of Directional coupler.
7. To measure and verify the S-parameters of Tees: E plane, H plane and Magic Tee.
8. To measure and verify the S-parameters of the Circulator.
9. To measure radiation patterns for basic microwave antennas like horn and parabolic reflectors in E-plane and H-plane. Also to find the gain, bandwidth and beam width of these antennas.
10. To design, Simulate and Analyze the Dipole Antenna Structure by using EM simulation software.
11. To design, Simulate and Analyze a Rectangular Microstrip Patch Antenna by using EM simulation software.
12. To design, Simulate and Analyze a Probe fed/MSA Patch Antenna by using EM simulation software.
13. To design, Simulate and Analyze Triangular Microstrip Antenna by using EM simulation software.

Note : Minimum 10 experiments have to be conducted.

Course Code	Course Title						Core/Elective
5PC752EC	Embedded Systems and IOT Applications Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
C	L	T	D	P			
Programming	0	0	-	2	40	60	1

COURSE OBJECTIVES:

This course aims to familiarize

1. Familiarize with the usage of IDE tools and execution of programs using ARM processor
2. Understand the usage of various devices like LCD, Temperature sensor, Buzzer, Stepper Motor by interfacing them to LPC2148.
3. Study the designing and implementation of IoT applications using Arduino/ RPi.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Understand the usage of IDE tools.
2. Develop interfacing applications like display devices and input devices using ARM Processor.
3. Develop program using ARM processor to read the sensor values and display them.
4. Develop the IoT applications using Arduino/Raspberry Pi.
5. Utilize the THINGSPEAK cloud to display the sensor values.

List of Experiments

PART-A

Interfacing Programs using Embedded C on ARM Microcontroller Kit

1. Program to interface 8-Bit LED and switch interface.
2. Program to implement Buzzer interface on IDE environment.
3. Program to display message in a 2-line x 16 characters LCD display.
4. Program to interface stepper motor and rotate in clockwise and anti-clockwise direction.

5. Program to interface a Temperature sensor LM35 and read the values and display it.
6. Program to demonstrate serial communication i.e. to transmit from kit and receive from PC using serial port.

PART-B

Interfacing Programs using C/Python Programming Arduino/Raspberry Pi Kit for IoT Applications

1. Interface a Push button with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed
2. Interface Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED at sensor detection.
3. Interface LCD with Arduino/Raspberry Pi and write a program to display a message on it.
4. Interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings
5. Interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. Interface Bluetooth unit with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when "1"/"0" is received from smart phone using Bluetooth.
7. Program to upload temperature and humidity data to THINGSPEAK cloud using Arduino/Raspberry Pi.

Note : Minimum FIVE experiments from each part have to be conducted.

Course Code	Course Title						Core/Elective
5PW773EC	Project Work - Phase I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	0	0	-	4	40	60	2

COURSE OBJECTIVES :

This course aims to familiarize

1. To familiarize tools and techniques of systematic literature survey and documentation.
2. To expose the students to industry practices and team work.
3. To encourage students to work with innovative and entrepreneurial ideas

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills.
5. Find relevant sources (e.g., library, Internet, experts) and gathers information for preparing reports and other relevant documentation.

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.

The department will appoint a project coordinator who will coordinate the following:

- Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current

industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 Weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.

Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

Course Code	Course Title						Core/Elective
5PW774EC	Summer Internship Evaluation						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	0	0	-	-	40	60	1

COURSE OBJECTIVES:

This course aims to familiarize

1. To get involved in design, development and testing practices followed in the industry.
2. To enhance technical writing skills in reporting as per the industry standards.
3. To participate in teamwork and preferably as part of a multi-disciplinary team.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Apply knowledge and skills learned in company/industry/organization to real-world problems.
2. Demonstrate knowledge of contemporary issues related with engineering in general.
3. Effectively use new tools and technologies for solving engineering problems.
4. Gain experience related to working practices within Industrial/R&D Environments.
5. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organizations/Computer Industry/ Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry coordinator (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

- Overview of company/project
- Safety training

- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed.
2. Present the work through a seminar talk (to be organized by the Department).

Award of sessionals are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (20 Marks) followed by presentation before the committee constituted by the department (20 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of VI semester and credits will be awarded after evaluation in VII semester.

B.E. - ECE - VIII Semester

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination		Credits
			L	T	P	Total Hours	CIE	SEE	
Theory									
1	5PC801EC	Radar Systems and Navigational Aids	3	0	0	3	40	60	3
2	5PE85XEC	Professional Elective – V	3	0	0	3	40	60	3
3	5PE86XEC	Professional Elective – VI	3	0	0	3	40	60	3
Laboratories									
4	5PW875EC	Project Work - Phase II	0	0	16	16	40	60	8
Total Credits									**17**

5PE85XEC	Professional Elective-V
5PE851EC	Optical Fiber Communication
5PE852EC	Wireless Sensor Networks
5PE853EC	Adaptive Signal Processing
5PE854EC	Automotive Electronics

5PE86XEC	Professional Elective-VI
5PE861EC	Cognitive Radio Systems
5PE862EC	5G Communications
5PE863EC	Global Navigation Satellite Systems
5PE864EC	Pattern Recognition Systems

VIII - Semester Detailed Syllabus

Course Code	Course Title						Core/Elective
5PC801EC	Radar Systems and Navigational Aids						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
EMTL,	L	T	D	P			
AWP	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. To derive Radar equation and its dependence on various parameters.
2. To understand the concept of Doppler Effect and get acquainted with the working principles of different types of Radars for surveillance & Tracking.
3. To explain the designing of a Matched Filter and understand Radar Receivers, displays and antennas.
4. Understand the different Navigation methods.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Demonstrate the basic principle of Radar system and develop Radar range equation. Illustrate the importance of various parameters to enhance range estimation for accurate prediction.
2. Describe CW Radar and MTI radar.
3. Illustrate on radar tracking methods and differences among them.
4. Explain principles of navigation, in addition to approach and landing aids as related to navigation.
5. Describe about the navigation systems using the satellite.

UNIT - I

Radar Systems: Description of basic Radar system and its elements, Radar equation, block diagram and operation of a Radar, Radar frequencies, applications of Radar, prediction of range performance, minimum detectable signal, receiver noise figure, effective noise temperature, signal to noise ratio, false alarm time and probability of false alarm, integration, of Radar pulses, Radar cross- section of target, pulse-repetition frequency and range ambiguities, system losses.

UNIT – II

CW and FMCW Radars: Doppler effects, CW Radar, FMCW Radar, multiple frequencies CW Radar, low noise front-ends, A-scope, B-scope, PPI displays, duplexers.

MTI and Pulse Doppler Radar: MTI radar, delay line canceller, multiple and staggered PRF, blind speeds, limitations to MTI performance, MTI using range gated Doppler filters, Pulse Doppler Radar, non-coherent Radar.

UNIT – III

Tracking Radar: Sequential lobing, Conical scan, Mono-pulse amplitude comparison and phase comparison methods, Tracking in range and in Doppler, acquisition, comparison of trackers.

UNIT – IV

Introduction to Navigation and Radio direction finding: Four methods of Navigation, Loop Antenna as direction finder, An Aural-Null Direction Finder, Adcock Direction Finders, Direction Finding at Very High Frequencies, The LF/MF Four course Radio Range, VHF Omni Directional Range (VOR), Errors in Direction Finding.

UNIT – V

Hyperbolic Navigation Systems: Principle of Hyperbolic Navigation Systems, Loran, Decca and Omega System, DME and TACAN, Aids to approach and landing: ILS and MLS, introduction to Doppler Navigation System, GPS principle and operation, Position location determination and applications.

TEXT BOOKS:

1. Merrill I. Skolnik, "Introduction to Radar Systems", 2nd Edition Tata McGraw Hill 2017.
2. N. S. Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, TMH, 2000.

REFERENCE BOOKS:

1. Peyton Z. Peebles, "Radar Principles", John Wiley, 2004.
2. J.C. Toomay, "Principles of Radar", 2nd Edition –PHI, 2004.
3. Sen & Bhattacharya, "Radar Systems and Radio Aids to Navigation", Khanna publishers, 7/e, 2016.

PROFESSIONAL ELECTIVE - V
(5PE85XEC)

Course Code	Course Title						Core/Elective
5PE851EC	Optical Fiber Communication						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Communications	L	T	D	P			
Engineering	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To realize the significance of optical fiber communications.
2. To understand the construction and characteristics of optical fiber cable.
3. To develop the knowledge of optical signal sources and power launching.
4. To identify and understand the operation of various optical detectors.
5. To understand the design of optical systems and WDM.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Analyze the losses inserted in an optical fiber
2. Study of material used and underlying principles of optical signal generation
3. Design of optical detection systems
4. Design an optical link in view of loss and dispersion.
5. Study of modes of optical communication through optical waveguides.

UNIT - I

Overview of Optical Fiber Communication: Introduction, the general Optical Fiber communication system, advantages of optical fiber communications. Optical fiber waveguides Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers- Modes, Fiber materials, Fiber fabrication techniques, fiber optic cables, Classification of Optical Fibers: Single mode fibers, Graded Index fibers.

UNIT – II

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Types of Dispersion: Material dispersion, Wave-guide dispersion, Polarization mode

dispersion, Intermodal dispersion, pulse broadening. Optical fiber Connectors: Connector types, Single mode fiber connectors, Connector return loss.

UNIT – III

Optical Sources, Amplifiers and Coupling: Direct and indirect Band gap materials, LED structures, Light source materials, Quantum efficiency, LED power, Modulation of LED, Laser Diodes, Modes and Threshold condition. Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Lensing schemes, Fiber-to-Fiber joints, Introduction to Optical Fiber splicing.

UNIT – IV

Optical Detectors and Receivers: Physical principles of PIN diode and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation, Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration.

UNIT – V

Optical System Design: Considerations, Component choice, Multiplexing, Point-to- point links, System considerations, Link power budget with examples. Rise time budget with examples.

WDM, Passive DWDM, Components and Elements of optical networks-SONET/ SDH.

TEXT BOOKS :

1. Gerd Keiser, "Optical Fiber Communications", Tata Mc Graw-Hill International edition, 4th Edition, 2008.
2. John M. Senior, "Optical Fiber Communications", PHI, 2nd Edition, 2002.

REFERENCE BOOKS :

1. D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, "Fiber Optic Communications", Pearson Education, 2005.
2. S.C.Gupta, "Text Book on Optical Fibre Communication and it's Applications", PHI, 2005.
3. Govind P. Agarwal , "Fiber Optic Communication Systems", John Wiley, 3rd Ediition, 2004.
4. Joseph C. Palais "Fiber Optic Communications", 4th Edition, Pearson Education, 2004.

Course Code	Course Title						Core/Elective
5PE852EC	Wireless Sensor Networks						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DCCN	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. Determine network architecture, node discovery and localization, deployment strategies, fault tolerant and network security.
2. Build foundation for WSN by presenting challenges of wireless networking at various protocol layers.
3. Determine suitable protocols and radio hardware.
4. Evaluate the performance of the sensor network and identify bottlenecks.
5. Evaluate concepts of security in sensor networks.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. To understand network architecture, node discovery and localization, deployment strategies, fault tolerant and network security.
2. To understand foundation for WSN by presenting challenges of wireless networking at various protocol layers.
3. Study suitable protocols and radio hardware.
4. To understand the performance of sensor networks and identify bottlenecks.
5. To understand concepts of security in sensor networks.

UNIT - I

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Applications of sensor networks- Enabling Technologies for Wireless Sensor Networks.

UNIT – II

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments Network Architecture - Gateway Concepts.

UNIT – III

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols, Routing Protocols- Energy Efficient Routing, Geographic Routing.

UNIT – IV

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Operating Systems for Wireless Sensor Networks.

UNIT – V

Security Architectures, Survey of Security protocols for Wireless Sensor Networks and their Comparisons.

TEXT BOOKS:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2007.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2004.

REFERENCE BOOKS:

1. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
2. Y Wang, "A Survey of Security issues in Wireless Sensor Networks", IEEE Communications Survey and Tutorials.

Course Code	Course Title						Core/Elective
5PE853EC	Adaptive Signal Processing						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
S&S,	L	T	D	P			
DSP	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To introduce stochastic processes and models in LTI systems.
2. To understand the LMS algorithm for iterative estimating the Wiener filter weights.
3. To familiarize prediction filter formulation and applications
4. To derive the Lattice filter architecture from the Levinson-Durbin algorithm.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Derive the response of the LTI system to stochastic processes.
2. Comprehend and derive the Wiener filter for signals with known properties.
3. Familiar with the Lattice filter implementation of the prediction filter.
4. Apply the LMS algorithm to the lattice structure to improve convergence times.
5. Use Recursive Least Squares algorithms in signal processing.

UNIT-I

Adaptive Systems and Signal Analysis: Signal Processing in Unknown Environments: System identification and Linear prediction-Stochastic Processes-Responses of LTI system to stochastic processes

UNIT-II

The Mean Square Error (MSE) Performance Criteria: Introduction to Mean Square Error (MSE) and MSE Surface-Properties of the MSE Surface: The Normal Equations-Geometrical Properties of the Error Surfaces-Wiener filter.

UNIT-III

Linear Prediction and the Lattice Structure: Levinson Durbin's Algorithm-Lattice Derivation- Forward and backward prediction-Adaptive lattice structures.

UNIT-IV

The Method of Steepest Descent Iterative Solution of the Normal Equations-Weight Vector Solutions–Convergence Properties of Steepest Descent-Mean Square Error Propagation

UNIT-V

The Least Mean Squares (LMS) Algorithm and Recursive Least Squares Signal Processing: Effects of Unknown Signal Statistics-Derivation of the LMS Algorithm-Convergence of the LMS Algorithm- LMS Mean Square Error Propagation-Normalized LMS Algorithm Recursive Least Squares (RLS) Adaptive Algorithms-Performance of RLS Adaptive Algorithms-Convergence of RLS versus LMS-QR RLS Algorithm.

TEXT BOOKS:

1. Bernard Widrow, Samuel D.Stearns, "Adaptive signal processing", 1st Edition, Pearson Education, New Delhi, India, 2012.
2. Simon Haykin, "Adaptive Filter Theory", 4thEdition, Pearson Education, New Delhi, India, 2012.

REFERENCEBOOKS:

1. John R. Treichler, C.Richard Johnson, Michael G. Larimore, "Theory and Design of Adaptive filters", 1st Edition, John Wiley & Sons, New Jersey, USA, 2012.
2. Behrouz Farhang, Boroujeny, "Adaptive filters: Theory and Applications", 2nd Edition, John Wiley & Sons, NewJersey, USA, 2013.
3. Dimitris G. Manolakis, Vinay K.Ingle, Stephen M. Kogon, "Statistical and Adaptive Signal processing", 1st Edition, The McGraw Hill Education, New Delhi, India, 2014.

Course Code	Course Title						Core/Elective
5PE854EC	Automotive Electronics						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
AEC, MC	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand the operation of ECU with the suitable mapping of sensors.
2. To analyze response of Transducers and sensors for automotive applications
3. To understand details of the Engine sensor waveforms and methods to analyze the same.
4. To introduce various automotive grade microcontrollers for vehicles.
5. To provide the knowledge of testing the products for emissions and ESD.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Comprehend the concepts of ECU design for automotive applications.
2. Analyze response of Transducers and sensors for automotive applications
3. Understand the operation of automotive sensors and fuel injection systems.
4. Comprehend various Microcontrollers for power train and body electronics.
5. Understand the effects of cable and harnessing in EMI and EMC.

UNIT-I

Electronic Control Unit (ECU) Design: The concepts of ECU design for automotive applications, Need for ECUs, advances in ECUs for automotive, design complexities of ECUs, V- Model for Automotive ECU's Architecture, analog and digital interfaces.

UNIT-II

Transducer Principles: Transducer classification and basic principles, General Input-output configuration, static characteristics and dynamic characteristics of instruments, Variable resistance transducers, and their signal conditioning, Electromagnetic sensors, Piezo electric transducers and their signal conditioning, Ultrasonic sensors.

UNIT-III

Sensors for Transportation: Vehicle Body: Torque sensors/ Force sensors, Flap air flow sensors, Temperature sensor, Ultrasonic sensors, Ranging radar (ACC), Power Train:- Fuel level sensors, Speed and RPM sensors, Lambda Oxygen sensor, Hotwire air mass meter Chassis:- Steering wheel angle sensor, Vibration and acceleration sensors, Pressure sensors, Speed and RPM sensors.

UNIT-IV

Automotive MCU by Applications: Automotive microcontrollers for Power train Control, Hybrid and Electric Auxiliaries, Transmission and Body Electronics.

UNIT-V

Automobile Electrical and Electronics Systems: Vehicle generated radiated emissions, Broadband noise, Narrowband noise, Signal characteristics, Vehicle radiated emission tests.

TEXT BOOKS:

1. Alma Hillier, "Fundamentals of Automotive Electronics Book", 6/e OUP Oxford, 2015.
2. John Turner & Joe Watson, "Automotive Sensors (Sensors Technology)", Momentum Press, 2009.
3. Terence Rybak, Mark Steffka, "Automotive Electromagnetic compatibility", Kluwer Academic Publishers, 2015.

REFERENCE BOOKS:

1. Automotive Sensors, BOSCH. 2002.
2. Ronald K.Jurgen, "Automotive Microcontrollers", Volume 2, SAE publication - 2012.

PROFESSIONAL ELECTIVE - VI (5PE86XEC)

Course Code	Course Title						Core/Elective
5PE861EC	Cognitive Radio Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
DSP,	L	T	D	P			
VLSI	3	-	-	-	40	60	3

COURSE OBJECTIVES :

This course aims to familiarize

1. To understand basic architecture of software defined radio
2. To study signal processing devices and architectures
3. To describe spectrum sensing techniques of cognitive radio

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Gain knowledge on software defined radio and cognitive radio.
2. Describe about signal processing devices and architectures
3. Discuss on software and hardware architecture of Software Defined and Cognitive Radio.
4. Analyze spectrum sensing methods
5. Implement CR and SDR applications on to FPGA and ASICS.

UNIT - I

Introduction to SDR: Requirement for Software-Defined Radio, Benefits of Multi-standard Terminals, Global Roaming, Service Upgrading, Adaptive Modulation and Coding, Operational Requirements, Key Requirements, Handset Model.

UNIT – II

Basic Architecture of a Software Defined Radio: Software Defined Radio Architectures, Ideal Software Defined Radio Architecture, Required Hardware Specifications, Digital Aspects of a Software Defined Radio.

UNIT – III

Signal Processing Devices and Architectures: General Purpose Processors, Digital Signal Processors, Field Programmable Gate Arrays, Specialized Processing Units GPP-Based SDR, FPGA-Based SDR, Architecture for FPGA- Based SDR.

UNIT – IV

Cognitive Radio: Techniques and signal processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio.

UNIT – V

Cognitive Radio Hardware and applications: Spectrum allocation models, Cognitive radio performance analysis, Hardware platforms for Cognitive radio (USRP, WARP), Applications of Cognitive radio.

TEXT BOOKS:

1. Peter B. Kenington, "RF and Baseband Techniques for Software Defined Radio", ARTECH HOUSE, INC, 2005.
2. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, ISBN 10:0-7506-7952-2, 2006.

REFERENCE BOOKS:

1. Eugene Grayver, "Implementing Software Defined Radio", Springer, New York Heidelberg Dordrecht London, ISBN 978-1-4419-9332-8 (eBook) 2013.
2. Huseyin Arslan, "Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Springer, ISBN 978-1-4020-5541-6 (HB), 2007.

Course Code	Course Title						Core/Elective
5PE862EC	5G Communications						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
DCCN	L	T	D	P			
	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. To understand the concept of 5G Communications.
2. To familiarize about the various 5G Channel access methods and Radio access network.
3. To study the Radio access network for 5G.
4. To provide knowledge on the Channel Models for 5G.
5. To familiarize about the various Enabling Technologies for 5G.

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

1. Describe the evolution of 5G Technology advances and their benefits.
2. Distinguish the different 5G channel access methods.
3. Illustrate the 5G Network Architecture and Network Protocols.
4. Describe 5G wireless Propagation Channels.
5. Demonstrate Device to device communication and millimetre wave communication.

UNIT-I

INTRODUCTION TO 5G: Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.

UNIT-II

5G CHANNEL ACCESS METHODS: OFDM and OFDMA – MIMO OFDM – Generalized

Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.

UNIT-III

RADIO ACCESS NETWORK FOR 5G NR: 5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols- Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization-Spectrum Management in 5G.

UNIT-IV

CHANNEL MODELS FOR 5G NR: Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G.

UNIT-V

ENABLING TECHNOLOGIES FOR 5G: Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication – mmWave Communications -Massive MIMO and Beam forming Techniques.

TEXT BOOKS:

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, 1st Edition, CRC Press, 2019.
2. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", 1st Edition, Academic Press, 2018.
3. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", 1st Edition, John Wiley & Sons, 2015.

REFERENCE BOOKS:

1. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
2. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
3. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

Course Code	Course Title						Core/Elective
5PE863EC	Global Navigation Satellite Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Communication	L	T	D	P			
Engineering	3	-	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. Study the fundamentals, signal structures and error sources of Global Position System (GPS).
2. Introduce the architectures of different GPS based augmentation systems
3. Familiarize with the basic concepts of other GNSS constellations

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Understand the fundamentals of GPS.
2. Describe the different types of GNSS Signals and GNSS Datum.
3. Analyze the GPS errors and their modeling techniques.
4. Explain various GPS data processing and GPS integration techniques.
5. Discuss the augmentation systems and regional navigation satellite systems.

UNIT - I

GPS Fundamentals: introduction to Satellite, Basics of satellite communications, trilateration, transit, Principle of operation, GPS Orbits, Orbital mechanics and satellite position determination, Time references, Geometric Dilution of Precision: GDOP, VDOP, PDOP. Solar and Sidereal day, GPS and UTC time, SPS and PPS services, GPS co-ordinate system-ECI, ECEF and WGS-84.

UNIT – II

GPS Signal Structure and GPS modernization: GPS signals, C/A and P-Codes, GPS Signal generation, Spoofing and anti- spoofing. Error sources in GPS: Satellite and receiver clock errors, Ephemeris error, Atmospheric errors, Receiver measurement noise and UERE, GPS modernization-new GPS III Satellites, new operational control segment, future applications and its current status.

UNIT – III

GPS Augmentation systems: Differential GPS. Classification of Augmentations Systems, operating principles of different types of SBAS- Wide area augmentation system (WAAS) architecture, GPS Aided GEO Augmented Navigation (GAGAN), European Geostationary Navigation Overlay Service (EGNOS), MTSAT Satellite-based Augmentation System (MSAS) etc. SBAS current status. Ground based augmentation systems (GBAS)/Local area augmentation system (LAAS) concept, National and International Status of implementation of LAAS. Relative advantages and limitations of SBAS over GBAS.

UNIT – IV

Various GNSSs: Architecture and features of Russian Global Navigation Satellite System (GLONASS), European Navigation System (Galileo), Chinese Global Navigation System (BieDou- 2/COMPASS), GNSS Applications.

UNIT – V

Regional Navigation Satellite Systems (RNSS): Navigation with Indian Constellation (NavIC), Japan's Quasi-Zenith Satellite System (QZSS), and Chinese Area Positioning System (CAPS).

GPS Integration: GPS/GIS, GPS/INS, GPS/Pseudolite, GPS/Cellular integrations.

TEXT BOOKS:

1. Elliot D. Kaplan, "Understanding GPS Principles and Applications", 2/e, Artech House 2005.
2. Rao G.S., "Global Navigation Satellite Systems – with Essentials of Satellite Communications", TMH 2010.
3. Sateesh Gopi, "Global Positioning System: Principles and Applications", 5/e, TMH 1999.

REFERENCE BOOKS:

1. Paul D Groves, "Principles of GNSS, Inertial, and Multi-Sensor Integrated Navigation Systems", Artech House Publishers 2008.
2. Basudeb Bhatta," Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass", B.S. Publications 2010.
3. https://onlinecourses.nptel.ac.in/noc21_ce77.

Course Code	Course Title						Core/Elective
5PE864EC	Pattern Recognition Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Mathematics	L	T	D	P			
	3	0	-	-	40	60	3

COURSE OBJECTIVES:

This course aims to familiarize

1. To provide an introduction to the basic concepts of pattern recognition.
2. To familiar with decision-making algorithms in pattern recognition.
3. To gain knowledge about various decision-making techniques.
4. To understand the concepts of Partition clustering techniques in pattern recognition applications
5. To understand & remember feature selection algorithms in pattern recognition.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Outline basic concepts of pattern recognition.
2. Classify decision-making algorithms in pattern recognition.
3. Apply about various decision-making techniques.
4. Apply Hierarchical and Partition clustering techniques in pattern recognition applications.
5. Analyze feature selection algorithms in pattern recognition.

UNIT – I:

Introduction: Basic concepts, Applications, Fundamental problems in pattern Recognition system design, Design concepts and methodologies, Simple pattern recognition model.

UNIT – II:

Statistical Decision Making: Introduction, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal cost of error, estimation of error rates, the leaving-one-out-techniques, characteristic curves, estimating the composition of populations.

UNIT – III:

Non Parametric Decision Making: Histogram, kernel and window estimation, nearest neighbour classification techniques. Adaptive decision boundaries, adaptive discriminate functions, Minimum squared error discriminate functions, choosing a decision making techniques

UNIT – IV:

Clustering and Partitioning: Hierarchical Clustering: Introduction, agglomerative clustering algorithm, the single linkage, complete-linkage and average-linkage algorithm. Ward's method Partition clustering - Forg's algorithm, K-means's algorithm, Iso data algorithm.

UNIT – V:

Pattern Pre-Processing and Feature Selection: Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection, Applications of Pattern Recognition in bio-metric, facial recognition, Finger prints, etc.

TEXT BOOKS:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost "Pattern recognition and Image Analysis", Pearson India Education, 2015.
2. Tou. Rafael, Gonzalez, "Pattern Recognition Principle", Pearson Education. 1975.

REFERENCE BOOKS:

1. Richard duda, Hart, David Strok, "Pattern Classification", John Wiley, 2nd Edition 2000.
2. Theodoridis, S. and K. Koutroumbas, "Pattern recognition", 4th Ed. 2009, San Diego, CA: Academic Press.

Course Code	Course Title						Core/Elective
5PW875EC	Project Work – Phase II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	0	0	-	16	40	60	8

COURSE OBJECTIVES :

This course aims to familiarize

1. To familiarize tools and techniques of systematic literature survey and documentation. `
2. To expose the students to industry practices and team work.
3. To encourage students to work with innovative and entrepreneurial ideas.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility.
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills.
5. Find relevant sources (e.g., library, Internet, experts) and gathers information for preparing reports and other relevant documentation.

The aim of Project Work–Phase II is to implement and evaluate the proposal made as part of Project Work– Phase I. Students can also be encouraged to do full time internship as part of Project Work– Phase II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of

2. Project Work– Phase I.
3. Re-Allotment of internship students to project guides.
4. Project monitoring at regular intervals.

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project. All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

The first review of projects for 20 marks can be conducted after completion of five weeks. The second review for another 20 marks can be conducted after 12 weeks of instruction. Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

SERVICE SUBJECTS

Course Code	Course Title						Core/Elective
7ES301EC	Logic Design and Computer Architecture						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
Basic Mathematics, Number Systems	L	T	D	P			
	4	-	-	-	40	60	4

COURSE OBJECTIVES:

This course aims to familiarize

1. To understand basic number systems, logical gates, Boolean algebra & k map to minimize the Boolean expressions.
2. To understand design of combinational and sequential circuits.
3. To learn the fundamentals of computer organization and its relevance to classical and modern problems of computer design.
4. To be familiarized with the hardware components and concepts related to the memory organization.
5. To be familiarized with the hardware components and instruction set related to 8086 microprocessor.

COURSE OUTCOMES:

On successful completion of the course, the students will be able to

1. Understand the number systems, binary codes logic gates, Boolean algebra and k- map method to minimize the Boolean expressions.
2. Design the combinational and sequential circuits.
3. Understand the basic concept of block diagram of computer (CPU) with Microprocessor processor unit (MPU).
4. Understand the internal architecture and register organization of 8086.
5. Categorize memory organization and explain the function of each element of a memory hierarchy.

UNIT - I

Binary Systems, Boolean algebra and Logic Gates: Number Base Conversions-Binary, Decimal, Octal and Hexadecimal, Complements, Digital Logic gates, Boolean algebra, Boolean Functions, Canonical and Standard Forms.

Gate Level Minimization: The K Map Method. Four-Variable Map, Product of Sums Simplification. Don't Care Conditions.

UNIT - II

Combinational Logic Design: NAND and NOR Implementation, Exclusive-OR Function, Design Procedure for Binary Adder, Subtractor, Decoders, Encoders, Multiplexer, De-multiplexer. Sequential Logic Design: Latches, Flip-Flops and conversion.

UNIT - III

Registers and Counters: Registers, Shift Registers and Counters.

Basic Computer Organization: Functions of CPU, I/O Units, Memory.

Instruction Formats: One address, two addresses, zero addresses and three addresses, addressing modes with numeric examples, Instruction cycle.

UNIT - IV

Input-Output Organizations Programmed I/O, Interrupt Initiated I/O, DMA.

Memory Organizations: Memory hierarchy, Main Memory, Cache Memory, Miss and Hit ratio, Virtual memory.

UNIT - V

8086 Architecture: general purpose registers, Segment register, 8086 Flag register, Addressing modes, Instruction set, Simple Assembly Language Programs.

TEXTBOOKS:

1. M. Morris Mano, "Digital Design", 3/e, Pearson Education, 2002.
2. Sunil Mathur, "Microprocessor 8086: Architecture, Programming and Interfacing", PHI, 2010.
3. V. Carl Hamacher, Safwat G. Zaky, ZvonkoVranesic, Zvonko G Vranesic, "Computer Organization" 5th Edition, McGraw-Hill, 2002.

REFERENCE BOOKS:

1. A. Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2002.
2. Barry B. Brey, "The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 - Architecture, Programming, and Interfacing", 8/e, Pearson, 2009.
3. Er Sandeep Ravikanti, "Computer Organization and 8086 Microprocessor", Notion Press, 2021.

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M21 - SCHEME OF INSTRUCTIONS and SYLLABI of III to VIII Semesters for B.E. Four Year Degree Programme in Electronics and Communication Engineering

(With Effect from the Academic Year 2022-23)
(As approved in Academic Council Meeting)

Empower Youth - Architects of Future World