COURSE OUTCOMES:
Students should be able to:
1. Identify real phenomena as models of partial derivative equations. Solve real problems by identifying them appropriately from the perspective of partial derivative equations.
2. Demonstrate their understanding of the Dirichlet conditions by using them to evaluate infinite series. Calculate the Fourier transform of elementary functions from the definition.
3. Select and combine the necessary Laplace transform techniques to solve second- order ordinary differential equations involving the Dirac delta (or unit impulse).
4. To understand the concept of solving differentiation and integration using approximation methods.
5. Able to solve algebraic and differential equations using numerical method.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	1	-	70	30	-	-	100	4	-	4

Unit-1 Partial Differential Equations: Formation of Partial Differential Equations, Partial Differential Equations of first order and first degree i.e., Pp+Qq=R, Linear Homogeneous Partial Differential Equations of nth order with constant coefficient, Separation of Variables, Applications to Vibration of String and Transmission Line Equation.

Unit-2 Fourier Series and Fourier Transform: Definition and Derivations, Odd and Even functions, Half-Range Series, Change of Scale. Fourier Integral, Numerical Harmonic Analysis. Fourier Transforms: Sine and Cosine Transform, Applications of Fourier Transforms to solution of Partial Differential Equations.

Unit-3 Laplace Transform: Definition, Laplace Transform of elementary and periodic functions, properties of Laplace Transform and Transforms of derivatives, Inverse Laplace Transform and its properties, Convolution Theorem, Applications of Laplace Transform to solution of linear differential equations with constant and variable coefficients, Simultaneous differential equations.

Unit-4 Calculus of Finite Differences: Difference table, Operators E and Δ, Newton's forwardand backward interpolation formula, Lagrange's interpolation formula, Differentiation and Integration, Difference Equations with constant coefficients.

Unit-5 Numerical Methods: Solution of Algebraic and Transcendental equations using Bisection method, Regular-Falsi method and Newton Raphson method. Numerical solution of simultaneous equations: Gauss Elimination method, Gauss Seidel method. Numerical solution of ordinary differential equations: Taylor's, Picard's and Runge- Kutta method.

Text Books

1. Ramana B V, Higher Engineering Mathematics, Tata McGraw Hill Publishing CompanyLtd., New Delhi, 2006.

2. Balagurusamy E., Numerical Methods, Tata McGraw-Hill Publishing Company Ltd.,New Delhi, 1999.

Reference books

1. Kreyszig Erwin, Advanced Engineering Mathematics, 8th edition, John Willy and sons Publications, 1999.
2. Jain, R.K. and S.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, New-Delhi, 2006.
3. Vedamurthy V.N. and Iyengar S.N., Numerical Methods, Vikas Publishing, 2008.
4. Das H. K, Higher Engineering Mathematics, S. Chand New Delhi, 2011.

Assessment

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%)
2. End semester Theory Exam (70%)

EC25XXX: ELECTRONIC DEVICES

PREREQUISITE: Mathematics-I, Physics

COURSE OUTCOMES:
Student should be able to:
1. Analyse the characteristics and theories in semiconductor materials.
2. Illustrate the operating principle and characteristics of various types of diode, solar cell, & lithium ion battery and analyse diode based electronics circuits.
3. Analyze and design BJT based electronic circuits.
4. Design various applications based on JFET and MOSFET.
5. Acquire the knowledge of fabrication methods of integrated circuits and construction, characteristics & applications of special devices such as DIAC, TRIAC, UJT Phototransistor, Opto-isolator, display unit.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1. Introduction to semiconductor Physics: Bohr's atomic structure, E-K diagrams, Periodic Lattice, energy bands in Intrinsic and Extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors carrier transport, drift and diffusion current, mobility and resistivity, Generation & recombination of carrier, Poisson & continuity equation, Transient and diffusion capacitances, Switching time, Hall effect.

Unit 2. Small signal switching model of P-N junction diode, Avalanche and Zener breakdown & its applications as a voltage regulator, PN junction diode circuits and applications: clipper, clamper, rectifiers, voltage multipliers, Special types diodes: LED, photodiode, tunnel, Schottky their construction, working, characteristics and applications. Solar cell, thermistors.

Unit 3. Charge transport in BJT, Minority carrier distribution and terminal currents, base width modulation, Ebers Moll model, I-V characteristics for CB, CE and CC configurations. Concept of load line, Transistor Biasing circuit design: Fixed biased configuration, Emitter-bias configuration, Voltage divider bias configuration, collector feedback configuration, Emitter follower configuration, Stability concepts. Thermal runaway, Transistor based regulated power supply design.

Unit 4. Review of construction & characteristics of p-channel, n-channel FET/JFET. MOSFET: Depletion type, Enhancement type MOSFET, MOS Capacitance, C-V characteristics. CMOS: constructions, characteristics and applications. I-V characteristics, JFET Biasing: Fixed-bias, Self-bias, voltage divider, source follower, common-gate. Channel length modulation.

Unit 5. Concepts of Integrated circuits and their fabrications. Introduction of Surface mount devices (SMDs), Silicon controlled rectifiers: construction, operation, characteristics, and applications. DIAC, TRIAC, UJT, Phototransistor, Opto-isolator. Display units: Seven segments- common anode, common cathode, Liquid Crystal Displays.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Milliman & Halkias, Integrated Electronics, 2nd ed., 1997 McGraw Hill Pub.
2. Boylestad R., Electronic Devices and Circuit Theory, 7th ed., 2004 PHI.
3. Sedra & Smith, Microelectronic circuits.5th ed., 2004 Oxford university press.

REFERENCE BOOKS RECOMMENDED:-

1. Ben G. Streetman, Solid State Electronics Devices, 5th ed., 2000, PHI.
2. Bhargava, Gupta & kulshreshtha, Basic Electronics and Linear Circuits, 2nd ed., 1990, Tata McGraw Hill Education
3. R.S.Sedha, "A Textbook of applied electronics",2nd ed., 2000, S.Chand

EC25XXX: SIGNALS AND SYSTEMS

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Represent mathematically and analyze different types of signals and systems.
2. Define various properties of LTI systems and determine the response of an arbitrary excitation.
3. Analyze continuous and discrete systems in time and frequency domain using Fourier transforms.
4. Apply the knowledge of Laplace Transform and z-Transforms to analyze LTI systems.
5. Apply sampling and reconstruct a signal and understand applications of signals and systems.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	0	0	100	3	-	3

UNIT 1: Signals and Systems:

Introduction to signals and systems and their applications in engineering and science. Type of signals: periodic and aperiodic signals, continuous and discrete-time signals, continuous and discrete amplitude signals, energy and power signals, even and odd signals, deterministic and random signals. Elementary continuous-time and discrete-time signals: unit impulse, unit step, ramp, exponential, signum and sync functions. Operations on signals, Types of systems, continuous-time and discrete-time systems, systems with and without memory, system properties: linearity, time-invariance, causality, stability, invertibility and inverse systems.

UNIT 2: Linear Time-Invariant (LTI) systems:

Discrete-time LTI systems: The convolution sum, Continuous-time LTI systems: The convolution integral, impulse response and step response of LTI systems, properties of LTI systems: causality, stability and invertibility. System representation through linear constant coefficient differential and difference equations (LCCDE).

UNIT 3: Fourier analysis of signals and systems:

Fourier series representation of periodic signals: Trigonometric and exponential forms, properties of Fourier series, Continuous-time and Discrete-Time Fourier transform representation of signals and their properties, Fourier transforms of standard signals, aperiodic and periodic signal transmission through LTI systems, Parseval's theorem, the impulse response and frequency response of LTI systems and their relationship, Magnitude and Phase response, Time and frequency domain aspects of systems, filtering.

UNIT 4: Laplace and Z transform:

Laplace transform, the region of convergence of Laplace transform, transfer function, poles and zeros of a continuous-time system, properties of Laplace transform, inverse Laplace transform, analysis and characterization of LTI systems using Laplace transform: Transfer function of LTI systems, system behavior, causality, stability and Unilateral Laplace Transform.

Z-transform, ROC of Z-transform, properties of Z-transform, inverse Z-transform, analysis and characterization of LTI systems using Z-transform: system function of discrete time LTI systems, system behavior, causality, stability, Unilateral Z Transform.

UNIT 5: Sampling and applications of signals and systems:

The sampling theorem, Time-domain and frequency-domain analysis of sampled signals, aliasing. Reconstruction of signals from its samples: ideal interpolator, zero-order hold, first-order hold. Applications of signals and systems.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Signals and Systems: Alan. V. Oppenheim, Allan S. Willsky and S. Hamid Nawab, 2nd Edition, Prentice Hall.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems-Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Signals and Systems: Tarun Rawat, Oxford Higher education.

REFERENCE BOOKS RECOMMENDED:

1. Signals and Systems: Hwei P Hsu, Schaum's Outline Series, 2nd Edition, Tata Mc-Graw Hill Education Private Limited.
2. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
3. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, 1998.

EE25XXX: NETWORK THEORY & ANALYSIS

PREREQUISITE: Fundamental of electrical engineering, mathematics.
COURSE OUTCOMES:-
Student should be able to:
1. Apply the knowledge of basic physics and mathematics to develop approximate circuit model of practical elements. Formulation of circuit equations using Kirchhoff's law and network topology.
2. Infer and evaluate transient response, steady state response in time and frequency domain, determine different network functions and analyze the series and parallel resonant circuit.
3. Develop and evaluate two-port model and its parameters, design attenuators, filters and equalizers.
4. Apply the network reduction techniques and network theorems to obtain solution of network
5. Analysis of polyphase circuits and Fourier analysis of various waveforms.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT: 1 Lumped circuits and Kirchhoff's Laws, Circuit elements, physical components v/s circuit elements, Power and energy, Passivity. Network Topology, Loop and Nodal equations, State equations.

UNIT: 2 First and State Second order networks zero state, zero input, transient and steady state response. Solution of network equations using Laplace transform, Network functions, their pole zero description.

UNIT: 3 Two port networks, various two port network parameters and their interrelationships.

UNIT: 4 Sinusoidal steady state analysis, frequency response, resonance, complex power, power factor improvement, maximum power transfer theorem, locus diagram, Superposition, Reciprocity, Thevenin's and Norton's theorem.

UNIT: 5 Magnetically coupled circuit, analysis of circuits with controlled sources. Analysis of balanced and unbalanced polyphase circuits. Fourier analysis of periodic waveforms, frequency spectrum, Power and energy of complex waveforms.

ASSESSMENT:

A. Continuous evaluation through two mid-term test with a weightage of 30% of the total marks. It includes class attendance as well as assignments on the course topics.
B. The end-term theory examination weightage is 70%.

TEXT BOOKS RECOMMENDED:

1. M.E Van Valkenburg, "Network Analysis", Third Edition, PHI, New Delhi, 1998.
2. Desoer and Kuh, "Basic circuit theory", Tata McGraw Hill Edition 2009.
3. William Hart Hayt, Jack E. Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", Eight Edition, McGraw-Hill Higher Education, 2012.

REFERENCES BOOKS:

1. Ronald E. Scott, "Linear circuits Vol.I and II", Addison-Wesley Publication, 2007.
2. Joseph A Edminister, "Electric circuits Schaum's outlines", Fifth Edition, Tata McGraw Hill Education Private Limited 2009.
3. G K Mithal, "Network Analysis", Khanna Publication, edition 2011.
4. Robert L. Boylestad, "Introductory Circuit Analysis", Twelfth Edition, Pearson Education Limited, 2012.

EC25XXX: DIGITAL SYSTEM DESIGN

PREREQUISITE: - Engineering Physics, Electronic Devices

COURSE OUTCOMES:-

Student should be able to:

1. Solve the logical expressions through Boolean algebra and k-map.
2. Implement variety of logical devices using combinational circuits concepts.
3. Analyze sequential circuits like Registers and Counters using flip-flops.
4. Classify different logic families, semiconductor memories and PLD devices.
5. Design converters which facilitate the conversion of real world analog signals to digital and vice versa.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Introduction to digital logic: Review of logic gates & Boolean Algebra, De Morgan Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Quine-Mccluskey method, Implementation of Boolean functions using basic & Universal gates, Mutlilevel implementation using NAND-NOR gates, Binary codes-Weighted/Non-weighted.

UNIT 2: Combinational Logic: Arithmetic circuits: Adders, Subtractors, Comparators. Multiplexers, De-multiplexers, Encoder, Decoder, Serial and Parallel Adders, BCD Adder, Parity Generators & checkers. Code Converters: Binary-to-Gray, Gray-to-Binary, BCD-to-Excess-3, Excess-3-to-BCD.

UNIT 3: Sequential Logic Design: Reviews of Flip-flops: Circuits, characteristics/excitation table. Triggering levels of Flip-flops, conversions between Flip-flops, Race-around condition and its remedies. Shift registers, Synchronous & Asynchronous counters, Decade counters, Up-Down counters, Johnson & Ring counters. Design of Modulo-N counters.

UNIT 4: Logic Families and Semiconductor Memories: Types: RTL, DTL, TTL, ECL, HTL, IIL. NMOS, PMOS & CMOS families. Specifications : Noise margin, Propagation delay, fan-in, fan-out, Comparisons of logic families. Classification of Memories – Static, Dynamic, DDR, PROM, EPROM, EEPROM. Concept of address lines and data lines Programmable logic devices like PLA, PAL. Logic functions implementation using Programmable Devices.

UNIT 5: Applications of digital circuits: Analog to Digital and Digital to Analog converters: Types, Performance parameters like accuracy, processing time, resolution, linearity. Sample and hold circuits, Multivibrators: Bistable, Monostable, Astable. Transistor/IC based Multivibrator circuits. Schmitt trigger, IC555, IC565 & their applications.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

EC25XXX: ELECTRONIC DEVICES LAB

COURSE OUTCOMES:
Student should be able to:

1. Operate measuring instruments such as CRO, Digital multimeter, etc.
2. Understand the operation of various diodes and plot its I-V characteristics.
3. Implement various diode circuits such as clipper circuits', clamper circuits' voltage regulator, rectifier with and without, filter, etc.
4. Understand the operation and biasing circuits of BJT, its testing and characterization in CE, CB, CC configuration.
5. Understand the characteristics of JFET and MOSFET.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S. No.	List of Experiments
1.	To determine the deflection sensitivity of CRO.
2.	Study of V- I characteristics of PN junction diode and LED.
3.	To study the use of diodes in wave-shaping (clipper) circuits and in level-shifting (clamper) circuits.
4.	Study of Zener diode characteristics.
5.	To study Zener diode as voltage regulator.
6.	Study of different types of rectifiers.
7.	Study of different types of filters.
8.	Testing of transistor.
9.	Study of transistor's characteristics in CE (Common emitter) configuration.
10.	To study BJT characteristics in CB (Common base) configuration.
11.	To study the characteristics of BJT in CC (Common collector) configuration.
12.	Study of transistor's characteristics of JFET.
13.	Study of transistor's characteristics of MOSFET.
14.	To study fixed bias circuit with and without emitter resistor.
15.	Study of collector to base bias circuit.
16.	Study of potential divider biasing circuit.
17.	Project design.

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, andAdditional experiments conducted, Quiz, End semester exam.

EE25XXX: NETWORK THEORY AND ANALYSIS LAB

COURSE OUTCOMES:
Student should be able to:

1. Analyze complicated circuits using different network theorems.
2. Apply the knowledge of basic circuital law and simplify the network.
3. Infer and evaluate transient response, Steady state response, and network functions.
4. Obtain the maximum power transfer to the load, and analyze the series resonant and parallel resonant circuit.
5. Evaluate two port network model and its parameters.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S. No.	List of Experiments
1.	To determine the equivalent networks by application of Thevenin's Theorem.
2.	To determine the equivalent networks by application of Norton's Theorem.
3.	To plot current with respect to time and evaluate time constant of Transient in RC circuits.
4.	Analyzed salient feature of series and parallel resonance circuits and draw its characteristics.
5.	To verify the voltage and current relations in star and delta connected systems.
6.	To validate open circuit parameter and short circuit parameter for two port network.
7.	Illustrate linearity property of a circuit using superposition theorem.
8.	Verification of reciprocity theorem.
9.	Evaluate power versus load curve and verify maximum power transfer theorem.
10.	Designing of Passive Low-pass and High-pass Filters.

ASSESSMENT:

A. Continuous evaluation of laboratory journals with a weightage of 40%. It includes lab attendance as well as experiments performed in the lab.
B. The end-term practical examination weightage is 60%.

EC25XXX: DIGITAL SYSTEM DESIGN LAB

COURSE OUTCOMES:
Student should be able to:
1. Familiarize with logic gates and design basic digital logic circuits.
2. Simplify the Boolean expressions and design multilevel logic circuits for arithmetic operations.
3. Construct basic combinational circuits and verify their functionalities.
4. Apply the design procedures to implement basic sequential circuits
5. Analyze sequential circuits like Registers and Counters using flip-flops.

Hours/Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S.No.	List of Experiments
1.	To study various logic gates.
2.	To verify properties of NAND and NOR Gates as universal building block.
3.	Simplification & Implementation of Boolean functions.
4.	Implementation of basic Boolean arithmetic logic circuits.
5.	Implementation of even & odd parity generator & checker.
6.	Conversion from binary to gray and gray to binary code.
7.	To verify 2-bit magnitude comparator for all possible conditions.
8.	Connection of various logical functions using 8-to-1 multiplexer.
9.	Construction of a 4-bit ripple counter & study of its operation.
10.	Design and implement of various types of flip-Flop using JK flip Flop
11.	Design of a 3- bit synchronous counter & study of its operation.
Lab. Project	
1.	To design and develop a IC 555 based Bistable multivibrator.

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

HU 22005/24005/25005/27005: ECONOMICS FOR ENGINEERS

PRE-REQUISITES: NIL COURSE

COURSE OUTCOMES: after completion of course, the students will be able to:
CO-1: Explain economic cyclic flow and Estimate the demand and demand elasticity for a product.
CO-2: Plan the production; choose appropriate production technology (combination of production factors); and estimate feasible range of production.
CO-3: Analyze the production-cost-profit relation and select the suitable project for investment
CO-4: Estimate price and the equilibrium for a firm/organization in different competitive market situations.
CO-5: Review, summarize and compare the financial statements of an accounting entity and able to apply financial ratio technique for financial analysis.
CO-6: Identify the problems, see the opportunity, and ideate the solution to the problems.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
2	-	-	70	30	-	-	100	2	-	2

UNIT 1. Nature and scope of economics, Economic cyclic flow, Central Economic problems, macro and micro economics, concept, determinants and law of demand and supply, Elasticity of demand, Equilibrium price, consumer surplus and equilibrium.

UNIT 2. Production, cost and Revenue: Production function, laws of return to variable proportion, Laws of return to scale, cost concepts, cost functions and their inter relation, Revenue Concepts and functions, break- even analysis, Time value of money and Investment analysis- NPV, IRR, ARR and payback period method.

UNIT 3. Pricing and Market: Price determination and firm's equilibrium under perfect competition and monopoly, price-output determination under monopolistic competition, kinked demand curve, collusive and non-collusive oligopoly.

UNIT 4. Entrepreneur, entrepreneurship and start-up, characteristics of an entrepreneur, forms of business organization, phases of startup, small medium and large scale enterprise, problems, opportunities, Design Thinking and Ideation. Business model.

UNIT 5. Accountancy: Accountancy and bookkeeping, GAAP, Assets, Liabilities and Capital, types of accounts, Journal, Ledger, Trial Balance and Financial Statements, Financial Ratio Analysis.

ASSESSMENT: Through End-Sem. Theory Exam, Theory sessionals, Mid-Sem Tests, and Assignments

Books & Reference Recommendation:
1. JhingalM.l., Economics of development and Planning, Vrinda Publication (40th Ed./latest).
2. Ahuja H. L., Advance economic theory, S Chand Publication, (21st Ed./Latest)
3. Riggs, Bedworth and Randhawa, Engineering Economics, Tata McGraw-Hill, (4th Ed./latest)
4. Principles of accountancy, Nirmal Jain,
5. Entrepreneurship by Rajeev Roy, 2nd edition
6. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hallof India, New Delhi, 2004.
7. Introduction to the Constitution of India, D.D. Basu

CHM2002: ENVIRONMENTAL SCIENCE

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
2	-	-	-	50	-	-	50	2	-	2

UNIT- I: Environment: General Studies
a. Introduction, segments of environment, Energy flow in environment, Composition and structure of atmosphere. Chemical Species and particulates in atmosphere. Reaction and Phenomena occurring in atmosphere.
b. Man and Environment

Unit II: AIR Pollution
a. Air pollution: Sources and effects, particulate control, control of gaseous pollutants (SOx, NOx, oxides of carbon, hydrocarbon pollutants), Air Quality standards and Management.
b. Case studies

UNIT- III: Water Pollution
a. Water Pollution: Types of water pollution, sources, water pollution control. Waste water treatment technologies and Recycle.
b. Case studies.

UNIT- IV: Soil and Noise Pollution
a. Soil Pollution: Introduction, sources/causes, effects and control.
b. Noise Pollution: Introduction, sources/causes, effects and control, noise measuring instruments and noise pollution control technology.

UNIT- V: Environment, Society and Ethics
a. Society and Environment, Solid waste-types, impact on society, solid waste management,specific applications to solid waste management.
b. Environmental Ethics: Need and Types, Regulations: ISO 14000, 9000, pollution Acts andRegulations. Environmental Auditing

Text Books:
1. S.C. Bhatia, "Environmental Pollution and control in chemical process industries", KhannaPublishers, 1st edition, 2001.
2. C.S.Rao, "Environmental Pollution Control Engineering", Wiley Eastern, 1992.

Reference Books:
1. S.P.Mahajan, "Pollution control in Process Industries", Tata McGraw Hill, 1990.
2. F. P. Lees, "Loss prevention in process industries", 2nd edition., Butter worth-Heinemann,1996.
3. Martin Crawford, "Pollution Control Theory", McGraw Hill, 1976.
4. Marell, "Solid Wastes", John Wiley, 1975.

Semester IV
MA25XXX: MATHEMATICS-IV

COURSE OUTCOMES:
On completion of this course, students are able
1. To solve Engineering problems using complex variable techniques and line integrals of a complex valued function.
2. To apply the concept of probability to find the physical significance of various distribution phenomena.
3. Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability.
4. Understand the concepts of reliability and maintainability.
5. To apply principals and concepts of graph theory in practical situation.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	1	-	70	30	-	-	100	4	-	4

COURSE CONTENTS

Unit-1 Functions of Complex Variables: Analytic function, Cauchy-Riemann Equations and Harmonic Functions, Conjugate Functions and their Applications, Complex Integrals, Cauchy's Integral Theorem and Integral Formula, Singularities, Poles, Residues, Residue Theorem, Contour Integration for simple cases, Conformal mapping and its Application to two-dimensional problems in electric field.

Unit-2 Statistics: Modern view of Probability theory, Random Variables, Distribution Function and Density Function, Random Variables of Discrete and Continuous type, Functions of two random variables, Bivariate Probability with Conditional and Marginal Probability Distribution.

Unit-3 Stochastic Process and Markov Chain: General Concepts and Definition of Stochastic Processes, Mean, Auto-correlation and Auto-Covariance, Classification of Stochastic Process and Some Problems. Probability Vectors, Stochastic Matrix, Fixed Point of a Matrix, Definition of Markov Chain, Transition Matrix and Graph, Some Theorems and Applications.

Unit-4 Reliability: Basic concepts, Failure law, Bath Tub Curve, Evaluation of Reliability of a Component from Test Data, System Reliability, Components in Series and Parallel, Redundancy, Non-Series Parallel System.

Unit-5 Graph Theory and Combinatorial Optimization: Graphs – Definitions and Basic Properties, Isomorphism, Euler Circuits and Hamiltonian Cycle, Digraphs, Trees-Properties, Spanning Trees, Planer graphs, Shortest Path Problem, Dijkstra Algorithm, Spanning Tree-Kruskal and Prim Algorithm.

Text Books

1. Ramana B V, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.
2. Das H. K, Higher Engineering Mathematics, S. Chand New Delhi, 2011.
3. Baisnab A, and Jas M, Elements of Probability and Statistics, Tata McGraw HillBook Company, New Delhi, 1993.

Reference books

1. Jain, R.K. and Iyengar S.K, Advanced Engineering Mathematics, Narosa Publishing House, New-Delhi , 2006.
2. Veerarajan T, Statistics, Probability and Random Process, 2nd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi 2003.
3. Balagurusamy E., Reliability Engineering, Tata McGraw-Hill Education Pvt.Ltd., New Delhi, 2012.
4. Goodaire E.G. and Michael M. Permenter, Discrete Mathematics with Graph Theory.

Assessment
1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%)
2. End semester Theory Exam (70%)

EC25XXX: ANALOG CIRCUITS

PREREQUISITE: Network Theory, Electronic Devices and Engineering mathematics

COURSE OUTCOMES:

Student should be able to:

1. Analyze and design BJT and FET based amplifier for required frequencyspecifications.
2. Analyze and design power efficient amplifiers.
3. Improve amplifier performance by varying various parameters and designvarious frequency generators.
4. Analyze and design amplifiers for various linear and non-linear mathematicaloperations using Linear integrated circuits.
5. Analyze and design various wave form generators and active filters usinglinear integrated circuits.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1. Review of BJT & MOSFET biasing, small signal analysis: low frequency model ofBJT & MOSFET & its analysis for different configuration, Multistage amplifier.

Unit 2. High frequency analysis: High frequency model of transistor, Frequency response of amplifier, cascading of amplifier & its effect on gain & Bandwidth, Step response of amplifier. Power amplifier, compensation symmetry, configuration, RF circuit, tuned circuit

Unit 3. Feedback Amplifiers: General feedback theory, characteristics of negative feedback amplifiers, Effect of negative feedback on input and output resistance of amplifiers, analysis of feedback amplifiers. Oscillators: Principle of oscillation, calculation of frequency of oscillation & conditions for sustained oscillations, LC Oscillators - Colpitt's, Hartely and Crystal Oscillators, RC Oscillators: Phase shift & Wien bridge oscillators, Frequency stability criteria and controlled oscillators.Voltage.

Unit 4. Operational Amplifiers: Differential amplifier, its modification & transfer characteristics, Internal Architecture of op-amp, offset error in voltages & currents & their temperature drift, Op-amp parameters such as CMRR, slew rate & their measurements, Frequency response of op-amp, study of op-amp ICs like 741, 324, 308 etc. Temperature compensation techniques, current mirror in op-amp. Linear analog systems using op-amp such as - V to I and I to V converters, integrator, differentiator, Two stage and three stage instrumentation amplifiers.

Unit 5. Non-linear Applications and Active Filters using Operational Amplifiers: Non- Linear analog systems: Zero crossing detectors, Square wave & triangular wave generators, Comparators, Schmitt trigger, Voltage to frequency & frequency to voltage converters, Small signal rectifiers, Sample & hold circuit, Logarithmic amplifier. Active Filters**:** Introduction to active filters: active networks using OP-AMP, approximation to ideal low pass filter, Active filters: LP, HP, BP, BS, & their design guidelines.

<u>**ASSESMENT:**</u> Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

<u>**TEXT BOOKS RECOMMENDED:-**</u>
1. Sedra & Smith L., Electronics Circuits, 5th ed., 2004, McGraw Hill.
2. Gayakwad R.A., Op AMP & Linear Integrated Circuits. 4th ed., 2007, PHI.
3. Van Valkenburg M.E., Analog Filter Design, 2nd ed., 2001, Holt Rinehart &Winston.

<u>**REFERENCE BOOKS RECOMMENDED:-**</u>
1. Milliman & Halkias, Integrated Electronics, 2nd ed., 1997, McGraw Hill.
2. Robert Boylsted, Electronic Devices & Circuits, 2nd ed., 2000, PHI.
3. Millman and Grable, Microelectronics, 2nd ed., 1987, TMH**.**

EC25XXX: ANALOG AND DIGITAL COMMUNICATION

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behaviour of a communication system in presence of noise
3. Investigate pulsed modulation systems and analyze their system performance
4. Analyze different digital modulation schemes and compute the bit error performance
5. Outline various advanced communication systems and relate the concepts of information theory and coding with digital communication systems.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1: Analog Modulation: Review of signals and systems, Frequency domain representation of signals, Modulation and demodulation of AM signals, Power relations in AM, Superheterodyne receivers; Frequency Division Multiplexing; Angle Modulation and demodulation, Spectra of AM, and FM.

Unit 2: Random Processes and Noise: Review of random processes; Line codes, PSD, Transmission of random signals through LTI systems; Sources of noise, Noise Figure, Noise Equivalent Temperature, Gaussian and white noise characteristics; Effects of Noise in amplitude modulation systems and Frequency modulation systems, Pre-emphasis and De-emphasis, SNR comparisons.

Unit 3: Pulse modulation: Sampling of low-pass and bandpass signals, Quantization, Encoding, Pulse code modulation (PCM), Time Division multiplexing (TDM); Differential pulse code modulation (DPCM), Delta modulation (DM), Adaptive Delta modulation (ADM); Noise considerations.

Unit 4: Optimum Receivers and Digital Modulation: Geometric representation of signals, Optimum detection of signals in noise: MAP, ML detection, Optimum receivers. Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion for zero ISI, Equalization; Pass band Digital Modulation: ASK, PSK, FSK and QAM, their generation, detection and Probability of Error evaluations, Synchronization.

Unit 5: Overview of Information Theory, Coding and Advanced Communication Systems: Overview of information theory and coding: Concept of information, and channel capacity; Hamming codes, CRC; Digital Modulation trade-offs; Overview of Multiple-Access Techniques: TDMA, FDMA, CDMA; Introduction to Satellite communications: Radio link analysis, Free-space propagation model, Introduction to Mobile radio, Introduction to Optical communications.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:
1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.

REFERENCE BOOKS RECOMMENDED:
1. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'', John Wiley, 1965.
2. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
3. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

EC25XXX: ELECTROMAGNETIC WAVES

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Study and Analyze various laws to develop the Maxwell equations.
2. Characterize Uniform Plane Wave in different mediums.
3. Calculate reflection and transmission of waves at media interface.
4. Design and Analyze of Transmission lines to carry out the impedances transformations.
5. Analyze wave propagation on metallic waveguides in modal form.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Electromagnetic and Maxwell's Equations:
Basics of vector calculus, Basic Laws of Electrostatics, Gauss's theorem for electrostatics. Equivalence theorem, method of images. Basic laws of magneto statics, Ampere's Law, Duality, Uniqueness and reciprocity theorem. Development of Maxwell's equations.

UNIT 2: Uniform Plane Waves:
Boundary conditions, Wave equation and solution, Wave polarization, Wave propagation in different mediums, Phase and group velocities, Power flow and pointing vector, Surface currents and power loss in a conductor.

UNIT 3: Plane Wave at Media Interface:
Plane waves in arbitrary direction, Reflection and refraction at dielectric interface and total internal reflection, Brewster's angle, Standing waves, Conducting surface, Skin depth. Basic of EMI and EMC, Classes of EMI: Inter and Intra EMI, Classes of EMC: Emission, Susceptibility, and Coupling, Testing for EMI and EMC, Standards of EMI and EMC.

UNIT 4: Transmission Lines:
Transmission Lines, Equations of voltage and current on Transmission lines, Propagation count and characteristics impedance, Reflection coefficient and VSWR, Impedancetransformation on lossless and low loss transmission lines, Power transfer on Transmission lines, Smith chart, admittance Smith chart, Applications of Transmission lines.

UNIT 5: Waveguides:
Wave propagation in parallel plate waveguides, Analysis of wave guides general approach, Rectangular waveguides, TE & TM modes, Surface currents on the waveguide walls, Attenuation in waveguide, Field visualization using simulation software.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT / REFERENCE BOOKS:
1. R.K Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India.
2. Principles of Electromagnetics Matthew N.O Sadiku., 6th edition.
3. David Cheng, Field & wave Electromagnetics.
4. Microwave Engineering, Pozar ,4th edition

EC25XXX: MICROPROCESSOR AND MICROCONTROLLER

COURSE OUTCOMES:

Students should be able to:

1. Understand the basic architecture of 8-bit microprocessors and their operation using assembly language programming and interfacing.
2. Distinguish and analyze the properties of 8-bit and 16 microprocessors with their programming and interfacing.
3. Understand the internal design of the 8051 microcontrollers along with the features and the programming.
4. Apply the architectural knowledge for the real-time problem-solving using interfacing concepts.
5. Design processor and controller-based applications using compatible peripherals.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1: Architecture of 8085 microprocessor, instructions sets, assembly language programming, interfacing with memory and I/O devices, interrupts systems.

UNIT 2: Introduction to 16 bits microprocessors, Architecture of 8086 microprocessor, instruction sets, addressing modes, assembly language and interrupt handling.

UNIT 3: Architecture of 8051 microcontroller, SFR's, instruction sets, assembly language programming, timers and counters, serial communication in 8051.

UNIT 4: Interfacing of 8051: A/D, D/A converter, external memory, LCD, Keyboard, DC and stepper motor

UNIT 5: Introduction to peripheral interface ICs such as PID 8155, PPI 8255, DMA controller and their interfacing with microprocessors and microcontrollers. Real time applications design.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

TEXT BOOKS RECOMMENDED:
1. Gaonkar, Introduction to Microprocessor. 2nd ed., 2004, Prentice Hall.
2. Sridhar and Ghosh, Computer Organizations and Architecture, 2nd ed., 2003, PHI.
3. Mazidi, 8051 Microcontroller and Embedded Systems, 2nd ed. 1998, Pearson Edu.
4. Ayala, The 8051 Microcontroller, 2nd ed. 2001, Penram Publ.

REFERENCE BOOKS RECOMMENDED:
1. Rey Bhurchandi, Advanced Microprocessor Architecture, 2nd ed. 2001, TMH.
2. Bray, The Intel Microprocessors: Architecture, Programming and Interfacing, 2nd ed., 2003 PHI.

EC25XXX: ELECTRONICS WORKSHOP

COURSE OUTCOMES :
Student should be able to:

1. Classify and identify various Active & Passive Electronic Components.
2. Test various electronics components using basic tests and also with measuring instruments.
3. Familiarize with Arduino and bread board. Implement and test circuit on breadboard.
4. Identify various types of PCBs and practice on layout design for any circuit.
5. Write a technical report for the implemented circuit.

Hours/Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S.No.	List of Experiments
1.	Study and identifications of various types of resistors.
2.	Study and identifications of various types of capacitors.
3.	Study and identifications of various types of inductors
4.	Study and identifications of various types of diodes/transistors/MOSFET.
5.	Study and identifications of various types of relays/switches.
6.	Study and identification of surface mount devices (SMDs)
7.	Familiarization with the working of breadboard. Hands-on practice of assembling and testing of circuits on breadboard.
8.	Hands-on practice session on circuit simulation software. Observation of input and output signals before/after circuit simulation.
9.	Circuit and application design using the diodes/transistors and associated components. Implementation and testing of the circuit on breadboard. Comparisons of working with simulation software.
10.	Learning Arduino platform and familiarization with its coding.
11.	Familiarization of various types of Printed Circuit Boards.
12.	Design layout of any circuit using the software. Practice for PCB etching/design and PCB drilling
13.	Practices on soldering techniques
Minor Project	
Design and implement a small electronics project using the following steps: 1) Selection of circuit and its application 2) Component selection and their testing 3) Testing of selected circuit on simulation software and breadboard 4) PCB design including layout making and drilling 5) Soldering of components on PCB and circuit testing 6) Technical report writing for minor project	

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

EC25XXX: ANALOG CIRCUITS LAB

COURSE OUTCOMES:

Student should be able to:

1. Understand single & double stage amplifier, and find its gain and bandwidth.
2. Understand various oscillator circuits and find its frequency of oscillation.
3. Understand op-amp based amplifier, and find its gain for various configurations.
4. Implement various op-amp based circuits.
5. Implement various active filters using op-amp.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S.No.	List of Experiments
1.	To observe the characteristics of single stage R-C coupled amplifier
2.	Verify the characteristics double stage R-C coupled amplifier
3.	Measurement of input impedance and output impedance of single stage R-C coupled amplifier stage
4.	Study of frequency response of a single stage JFET amplifier
5.	Study of frequency response of double stage R-C coupled amplifier (with feedback)
6.	Analyze the characteristics of R-C phase shift oscillator
7.	Analyze Wein bridge oscillator
8.	Study of OP-Amp as: • Inverting Amplifier • Non-inverting Amplifier • Summing Amplifier
9.	Study of integrator circuit & differentiator circuit using Op Amp
10.	Study of class-C amplifier
11.	Study of active low-pass filter of first order
12.	To study active high-pass filter
Lab. Project	
1.	To design and develop a Lab Project based on Hardware / Software.

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

EC25XXX: ANALOG AND DIGITAL COMMUNICATION LAB

COURSE OUTCOMES :
Student should be able to:

1. To analyze the Fourier Synthesis of Periodic Waveforms
2. To observe the Frequency Division Multiplexing of Analog signals
3. To analyze different generation and detection techniques of Amplitude and Frequency Modulated waveforms.
4. To identify different line coding techniques and demonstrate the concepts.
5. To analyze various digital modulation and demodulation schemes.

Hours/Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S.No.	List of Experiments
1.	To measure Fourier Synthesis of various periodic waveforms
2.	Generation of AM and DSB-SC waveform and Multiplexing / De-multiplexing FDM signal
3.	Demodulation and detection of AM and DSB-SCusing Envelope Detector and Synchronous Detection
4.	Modulation and Demodulation of Frequency Modulated waveform
5.	To generate sampled signal of a band limited sinusoidal signal & its reconstruction, and to observe the two channels Time Division Multiplexing waveform
6.	Generation & detection of TDM-PCM signal
7.	Analysis of different methods of data transmission to regenerate the data at receiver or repeater
8.	Verification of Differential Pulse Code Modulation (DPCM) Technique
9.	Verification of DM output for various amplitudes and frequencies of input signal and for various clock frequencies
10.	Generation and detection of BPSK and QPSK signal
11.	Generation and detection of ASK and FSK signal
12.	Study of QAM Modulation and Demodulation
Lab. Project	
1.	To design and develop a Lab Project based on Hardware / Software.

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, andAdditional experiments conducted, Quiz, End semester exam.

EC25XXX: MICROPROCESSOR AND MICROCONTROLLER LAB

COURSE OUTCOMES :

Student should be able to:

1. Learn and practice assembly language programming of 8085/8086 microprocessors on development board and simulator softwares.
2. Practice assembly language/embedded 'C' programming of 8051 microcontroller on Keil software.
3. Design the projects on real time problems using 8051 microcontroller circuits on circuit simulation software and analyze their input/output characteristics.
4. Implement simulated circuit on the breadboard and verify its working.
5. Prepare the layout for working project and design its PCB for final circuit testing. Prepare a technical report of project assigned.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	2	-	-	20	30	50	-	1	1

LIST OF EXPERIMENTS:

S.No.	List of Experiments
	8085 Assembly Language Programs
1.	Write assembly language programs for the following operations (i) Addition of two 8-bit numbers. (ii) Subtraction of two 8-bit numbers. (iii) Addition of two 16-bit numbers. (iv) Multiplication of two 8-bit numbers. (v) Division of two 8-bit numbers.
2.	Write an assembly language program for the multiplication of Eight 8-bit numbers stored at consecutive memory locations.
3.	Write an assembly language program for block copy of Ten bytes from one location to another. (assume the memory locations)
4.	Write an assembly language program for the multiplication of a 16-bit number with 8-bit number.
5.	Write an assembly language program for multiplication of an 8-bit number by 8-bit number using rotate instruction.
6.	Write an assembly language program to find the largest number out of the ten 8-bit numbers.
7.	Write an assembly language program to arrange ten 8-bit numbers in ascending order.
8.	Write an assembly language program to generate a time delay of 50 ms. (Do calculation only)
9.	Write an assembly language program for the addition of two 8-bit numbers in BCD using DAA.
10.	Write an assembly language program to separate nibbles of an eight-bit number.
11.	Write an assembly language program with a subroutine having multiplication of two numbers.
12.	Write an assembly language program to find out positive, negative and zero in a series of data. (assume location and data)
13.	Write an assembly language program to convert ASCII to binary.
14.	Write an assembly language program to convert decimal to seven-segment display.
15.	Write an assembly language program to convert BCD to binary.
16.	Write an assembly language program to find out the square root of a number by subtracting odd integers.
17.	Write an assembly language program to XOR data without using XRA instruction.

18.	Write an assembly language program to add a series of numbers in BCD.
Microcontroller 8051	
19.	Write an assembly language programs to add, subtract, multiply & divide two 8 bit numbers stored in registers R0 & R1 of register bank 0, and store the results of various operations in different registers of register bank 2.
20.	Write an assembly language program to convert given 8-bit binary no. in the accumulator to 3 digit BCD, store 100 R2, 10 digit in R1 & 1s digit in R0 of register bank 1.
21.	Write an assembly language programs to unpack a packed BCD no. in the accumulator & save the result in R0 & R1 of register bank 2.
22.	Write an assembly language program to move a block of 50 bytes from internal RAM of 8051 to external RAM.
23.	Write an assembly language program to count no. of 1s & 0s in a given 8-bit no. in a register. Assume data is at location 3000H of external data memory. Store the counts of 0s & 1s in registers R0 & R1 respectively.
24.	Write an assembly language programs to find the smallest no. in a given array. An array is stored at a location starting from address 3000H.
25.	Write an assembly language program to implement a Boolean logic Y=(A+B).C Use bit addressable area of internal RAM. A, B & C are Boolean variables
26.	Write an assembly language programs to provide a delay of 1 sec.
27.	Write an assembly language programs to transfer a message serially at baud 8-bit data & I stop bit, do this continuously.
28.	Write an assembly language program to generate a square wave of 80% duty cycle on bit 3 of port 1.
29.	Write an assembly language programs to swap lower & upper nibble of any 8 bit data stored in a register without using SWAP instruction.
30.	Write an assembly language programs to find square root of a no. using subtraction of successive odd integers.
31.	Write an assembly language programs to calculate value of function $f(x) = x^2 + x + 1$. Where x is an 8 bit binary number.
32.	Write an assembly language programs assuming that INT 1 pin of 8051 is connected to a switch that is normally high. Whenever it goes low it should turns on an LED connected to P1.3 which is normally off. It should stay ON for few secs an then go down.
33.	Write an assembly language programs to receive a byte serially & check whether the byte is a valid byte or not. If it is a valid byte write 'C' on serial window else write 'E'.
Lab. Project	
1.	Design any real-time problem using 8051 microcontroller using the following steps: (i) Design the circuit on simulator software. (ii) Write/execute its corresponding assembly language /embedded 'C' program on Keil software and generate its Hex file. (iii) Load Hex file in microcontroller in simulator software and simulate the circuit. (iv) Implement the complete hardware on a breadboard and test it.

ASSESMENT: Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

HU 22881/24881/25881/27881: VALUES, HUMANITIES AND PROFESSIONAL ETHICS

PRE-REQUISITES: NIL

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

CO-1**:** Explain and elaborate the social institutions and Constitution of India through which the society and nation is governed.

CO-2: Describe the kinds of values and ethics and their importance.

CO-3: Contextualize the professional attitude and approaches as per needs of society and values.

CO-4: Explain and illustrate the process of Social, Political and Technological changes in context to global changes.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	2	-	-	100	-	-	100	2	-	2

1. Role of Humanities in Engineering education, Morals, Values and Ethics, social institutions and association, social stratification in India, social change, Universal and Situational values, coexistence of self and body and their needs and activities.

2. Constitution of India - Preamble, Rights and Duties. Directive Principles, Parliamentary and presidential democracy, The Problem of hierarchy of values and their choice, the views of Mahatma Gandhi on concept Indian nation and democracy.

3. Ethical and decision making capability and its development: Meaning of Ethical dilemma, Concept of personal and group Ethics: Balance between -rights and duties, The Problem of Sustenance of value in the process of Social, Political and Technological changes.

4. Engineering Ethics: engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger variety of moral issued - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy Models of Professional Roles.

5. Global Issues: Multinational corporations - Environmental ethics - computer ethics - weapons development – engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership.

ASSESSMENT:
Only Sessional Work (100 marks) on the basis of internal viva (30) Attendance (20), Quizes/Tests (30) and Presentations (20) will be awarded against the assessment done throughout the session.

Books for references
1. Little, William: An Introduction of Ethics (allied Publisher, Indian Reprint1955)
2. William, K Frankena: Ethics (Prentice Hall of India,1988)
3. Gaur R. R., Sangal R. and Bagaria G. P., Haman Values and Professional Ethics, Excel Books, New Delhi, 2010
4. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York1996.
5. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", PrenticeHall of India, New Delhi, 2004.
6. Introduction to the Constitution of India, D.D. Basu

HU2XXXX/3XXXX: CONSTITUTION OF INDIA

PRE-REQUISITES: NIL

COURSE OUTCOMES: After completion of course, the students will be able to:
1. Explain and elaborate the Indian Constitution through which the society and nation is governed.
2. Describe the list of fundamental rights and fundamental duties.
3. Elucidate the types of emergencies in Indian constitution.
4. Explain and illustrate the procedure of amendments in Indian constitution.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
2	-	-	-	50	-	-	50	-	-	-

UNIT 1. Meaning and significance of Constitution, Making of Indian Constitution – Sources, Salient features of Indian Constitution and Preamble.

UNIT 2. Scheme of the Fundamental Rights and Duties: right to Equality-article 19- article 21, legal status of duties, Directive Principles of states policy- its importance and implementation.

UNIT 3. Federal structure, legislative and financial powers (union and states), Three lists (union, state and concurrent), parliamentary form of government in India- The constitution powers and status of the President of India.

UNIT 4. Judicial system and local governance in India: Its constitutional powers, Historical perspectives of the constitutional amendments in India, Amendment of the constitutional powers procedure, Local self government - 73rd and 74th Amendment.

UNIT 5. Emergency provisions: President rule, National Emergency, Financial Emergency, Election commission and its constitutional powers and procedures.

ASSESSMENT:
Only Sessional Work (100 marks) on the basis of viva (30) Attendance (20), Quizes/Tests/Activities (30) and Presentations (20) will be awarded against the assessment done throughout the session.

Books Recommended:
1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti

EC 35008 : MICROPROCESSORS AND MICROCONTROLLERS

COURSE OUTCOMES:

Students should be able to
1. Interpret basic architecture of 8-bit microprocessors and their operation using assembly language programming and interfacing concepts.
2. Distinguish the properties of 8-bit and 16 microprocessors with their programming and interfacing models.
3. Explain the internal design of the 8051 microcontrollers along with the features and the programming.
4. Apply the interfacing and programming knowledge of microcontroller for the real-time problem-solving.
5. Design processor and controller-based applications using compatible peripherals.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

Unit 1: Architecture of 8085 microprocessor, instructions sets, assembly language programming, interfacing with memory and I/O devices, interrupts systems.

UNIT 2: Introduction to 16 bits microprocessors, Architecture of 8086 microprocessor, instruction sets, addressing modes, assembly language and interrupt handling.

UNIT 3: Architecture of 8051 microcontroller, SFR's, instruction sets, assembly language programming, timers and counters, serial communication in 8051.

UNIT 4: Interfacing of 8051: A/D, D/A converter, external memory, LCD, Keyboard, DC and stepper motor

UNIT 5: Introduction to peripheral interface ICs such as PID 8155, PPI 8255, DMA controller and their interfacing with microprocessors and microcontrollers. Real time applications design.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

PRACTICALS:

S.No.   List of Programs

1) Write an assembly language program for the addition of two 16 bit numbers. (Use consecutive memory location technique for data and result storage)
2) Write an assembly language program for the multiplication of two 8 bit numbers. (Use consecutive memory location technique for data and result storage)
3) Write an assembly language program for the division of two 8 bit numbers. (Use consecutive memory location technique for data and result storage)
4) Write an assembly language program for multiplication of a 16 bit hex number with 8 bit hex number.
5) Write an assembly language program to find largest number out of the ten 8 bit numbers.
6) Write an assembly language program with subroutine to find out positive, negative and zero in a given series of ten hex data stored at 3000H location.
7) Write an assembly language program to find out square root of a number by subtracting odd integer.
8) Write an assembly language program to XOR data without using XRA instruction.
9) Write an assembly language program with subroutine technique to assembly and

disassembly a given 8 bit words. (Hint: Data 98H can be disassembled as 09H and 08H)

10) Write an assembly language program to add a series of five hex numbers in BCD.

11) Write an assembly language programs to add, subtract, multiply & divide two 8 bit nos. stored in register R0 & R1 of register bank 0 of 8051 microcontroller, store the results of various operations in different registers of register bank 2.

12) Write an assembly language programs convert given 8 bit binary no. in accumulator to 3 digits BCD, store 100 R2, 10 digit in R1 & 1s digit in R0 of register bank 1.

13) Write an assembly language programs to find smallest no. in a given array. Array is stored at location starting from address 3000H.

14) Write an assembly language programs to implement a Boolean logic Y=(A+B).C Use bit addressable area of internal RAM .A,B & C are Boolean variables

15) Write an assembly language programs to generate a square wave of 8O% duty cycle on bit 3 of port 1.

16) Write an assembly language programs to swap lower & upper nibble of any 8 bit data stored in a register without using SWAP instruction.

17) Write an assembly language programs to find square root of a no. using subtraction of successive odd integers.

18) Write an assembly language programs to calculate value of function $f(x) = x^2 + x + 1$. Where x is an 8 bit binary number.

19) Write an assembly language programs assuming that INT 1 pin of 8051 is connected to a switch that is normally high. Whenever it goes low it should turns on an LED connected to P1.3 which is normally off. It should stay ON for few seconds and then go down.

20) Write an assembly language program to display a string of characters on LCD.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam

TEXT BOOKS RECOMMENDED:

1. Gaonkar, Introduction to Microprocessor. 2nd ed., 2004, Prentice Hall.
2. Sridhar and Ghosh, Computer Organizations and Architecture, 2nd ed., 2003,PHI.
3. Mazidi,8051 Microcontroller and Embedded Systems, 2nd ed. 1998, Pearson Edu.
4. Ayala, The 8051 Microcontroller, 2nd ed. 2001, Penram Publ.

REFERENCE BOOKS RECOMMENDED:

1. Rey Bhurchandi, Advanced Microprocessor Architecture, 2nd ed. 2001, TMH.
2. Bray, The Intel Microprocessors: Architecture, Programming and Interfacing, 2nd ed., 2003 PHI.

COURSE OUTCOMES:-
At the end of this course students will demonstrate the ability to:
1. Explain the radiation mechanism of EM waves by antennas and their radiation patterns.
2. Interpret the relationships between antenna performance parameters.
3. Design and analyze different antennas and antenna arrays.
4. Analyze and distinguish different type of antennas.
5. Discuss atmospheric structure and its impact on radio wave propagation.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

Theory:

Unit 1: **Antenna Fundamentals**: Retarded Potential, Radiation Equation. Radiation Mechanism of Antennas. Radiation Integral and Auxiliary Potential Functions. Radiation from Linear Wire Antennas i.e. Infinitesimal Dipole, Small Dipole, Finite Length Dipole and Half Wave Dipole.

Unit 2: **Antenna Performance Parameters**: Radiation pattern i.e. Isotropic, Directional, and Omnidirectional Patterns, Radiation Intensity and Power density, Gain & Directivity, Effective area and Aperture, Band width and beam width, Antenna impedance, Antenna Efficiency, Polarization. Friis Transmission Equation and reciprocity. Antenna Radar Cross Section and SAR.

Unit 3: **Antenna array and Fundamentals:** Linear, planar and circular**.** End fire & broad side arrays, Two and multielement arrays, Technique of multiplication of patterns, Binomial and Dolph Chebycsheff arrays, Phased array, Smart antennas and Beam forming techniques. Antenna Synthesis and techniques.

Unit 4: **Types of Antennas and Analysis**: Linear wire antenna and dipole, MF & HF antennas, Tower antenna, VHF & UHF antenna, GSM antennas, Loop Antenna, Rhombic antenna, Aperture antennas, Broad band antennas, Equiangular and Conical equiangular spiral antenna, Frequency independent antennas, Log periodic antenna, Reflector and Horn antennas, Micro strip antennas, measurement and Design approach.

Unit 5: **Radio Wave Progation:** Ground wave propagation, reflection from earth's surface, Space wave and sky wave propagation, Tropospheric wave and tropospheric scattering, Duct propagation. Ionosphere propagation, Structure of ionosphere and atmosphere, various parameters like Critical frequency, Maximum usable frequency, Least usable frequency, & Virtual heights etc.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

PRACTICALS:
The list of the experiments is as follows:

1. Familiarization and study of Advanced antenna measurement system and RF anechoic chamber.

2. Familiarization and calibration study of vector Network Analyzer (MSP2202).

3. Design and simulation of Microstrip patch antenna (Virtual lab).

4. Characterization of Circular polarization in MSA (Virtual lab).

5. Measurement of Radiation parameters of Microstrip antenna through VNA and anechoic chamber.

6. Measurement of Co-polarization and cross polarization of arbitrary test antenna using RF anechoic chamber and measurement system.

7. Measurement of insertion losses and cable losses using Vector network analyzer.

8. Calculation and generation of radiation pattern of RMSA (Microstrip) in azimuth & elevation plane.

9. Calculation and generation of radiation pattern of YAGI antenna (Microstrip) in azimuth & elevation plane.

10. Calculation and generation of radiation pattern of annular ring antenna (Microstrip) in azimuth & elevation plane.

11. Measure the variation of field strength/inverse square, power flow of arbitrary test antenna in RF anechoic chamber.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Antenna Theory: Analysis and Design, 2nd ed., 2000, Wiley Publication.
2. Kraus J.D., Antennas, 2nd ed., 2000, McGraw Hill.
3. Prasad K. D., Antenna & Wave Propagation, 2nd ed., 2001, Khanna Publication.

REFERENCE BOOKS RECOMMENDED:-

1. Collin R.E., Antennas & Wave Propagation, 3rd ed., 2001, McGraw Hill.
2. Chatterjee Rajeshwari, Antenna theory and practice, 2nd ed. 1998, New Age Publ.
3. Jordan & Ballman, Electromagnetic Wave & Radiation System, 2nd ed., 2006, PHI.

EC 35010 : VLSI DESIGN

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. Study the basic VLSI design flow.
2. Write and simulate HDL code for basic combinational and sequential circuits. & understand the basics of synchronous finite state machines.
3. Analyze the static & dynamic characteristics of cmos inverter.
4. Design combinational & sequential logic circuits
5. Understand the basics of memory design and working of programing logic devies such as CPLD and FPGA.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

Theory:-

Unit 1: Issues and Challenges in Digital IC Design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; MOSFET fabrication: basic steps of fabrication, CMOS p-well and n-well processes, layout design rules; Gajeski's Chart, PLD based design flow, synthesis, simulation, placement and routing, floor planning, verification, back annotation etc.

Unit 2: Finite state machine design: state machines, Mealy and Moore machines, state diagram, state table reduction techniques for state tables, transition tables, design of sequential circuits using FSM. Introduction to HDLs, their features, HDL based design, features of Verilog/VHDL and programming methodologies, various modelling styles in Verilog/VHDL, Digital designing with HDL, test benches, Verilog/VHDL coding for FSM.

Unit 3: Review of the basics of CMOS, operation of NMOS, PMOS, CMOS, MOS Capacitance; CMOS Inverter: MOS Device Model with Sub-micron Effects, VTC Parameters (DC Characteristics), CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power; Interconnects: Resistance, Capacitance Estimation, delays, Buffer Chains, Low Swing Drivers, Power Distribution.

Unit 4: Combinational Logic Design: Static CMOS Construction; Performance Optimization of Digital Circuits by Logical Effort; Sizing; Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design Considerations, noise considerations in dynamic design Power Dissipation in CMOS Logic, Domino and NORA designs; Sequential Circuits Design: Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase clock designs; Design of arithmetic building blocks like adders and multipliers.

Unit 5: Semiconductor memories: non-volatile and volatile memory devices, flash memories, SRAM Cell Design, Differential Sense Amplifiers, DRAM Design. Programmable logic devices: PLA, PAL, PROM etc., programming strategies, circuit implementation, CPLD and FPGA architecture, case study of Intel FPGAs, their features and programming.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

PRACTICALS:

Unit 1(L): SPICE (Open-source) and experiments based on it **(Week-1, Week-2, Week-3)**
Unit 2(L): MAGIC (Open-source) and experiments based on it **(Week-4, Week-5, Week-6)**
Unit 3(L): Introduction to HDLs, their features, HDL based design, features of Verilog/VHDL and programming methodologies, various modelling styles in Verilog/VHDL, Digital designing with HDL, test benches. **(Week-7, Week-8, Week-9, Week-10)**

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2/e, Prentice Hall of India, 2003.
2. N. Weste and D. Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 3/e,Pearson Education India, 2007.
3. S. Brown & Z. Vranesic- Fundamentals of Digital Logic with VHDL
4. Samir Palnitkar, Verilog (Lab)

REFERENCE BOOKS RECOMMENDED:

1. Weste & Eshraghain – principles of CMOS VLSI Design
2. D.L.Perry- VHDL Programming by Example
3. J. Bhasker- VHDL Primer
4. Sung Mo Kang- CMOS Digital Integrated Circuits, TMH

EC 35011: DATA COMMUNICATION

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Understand Concept of Information theory and Channel Capacity .
2. Study various channel coding techniques and theory application.
3. Develop basics of various data communication systems and its components.
4. Analyze various communication systems using different digital data transmission and access techniques.
5. Apply different digital switching techniques and protocols for data   transmission.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit1.InformationTheory:
Concept of amount of information, Entropy of discrete ensembles, Shannon's source coding theorem, Encoding of discrete sources, Mutual information, Channel coding theorem, Calculation of channel capacity of discrete memoryless channels, Shannon's channel's capacity of AWGN channel, Shannon's limit, Modulation-coding trade-offs.

Unit 2. Error Control Coding:
Asynchronous and synchronous transmission, Types of error, Error detection, Error Correction, Hamming distance, Hamming weight, Parity-check codes, Repetition code, Cyclic Redundancy Check (CRC), Error control using forward error correction (FEC), Linear block codes, Cyclic codes, Hamming codes, convolutional codes.

Unit 3. Data transmission and Signal Encoding:
Networks for data communication (LAN, MAN, WAN), Network models: OSI reference model and TCP/IP model, Transmission terminology, Transmission impairments, Data rate limits, Performance parameters, digital signal encoding, Modes of digital data flow (simplex, duplex, full duplex), Transmission modes and media, Scrambling, Discrete Multi-tone Technique (DMT), ADSL .

Unit 4. Multiplexing, Synchronization, Spread Spectrum and Multiple Access:
Review of FDM, TDM, WDM, Synchronization, Digital transmission system hierarchy and their frame structure DS0, DS1, T1, E1 etc. Spread Spectrum: Frequency hop spread spectrum (FHSS), Direct sequence spread spectrum (DSSS), Multiple Access Techniques.

Unit 5: Telecommunication switching and Networks:
Necessity of switching, Introduction to digital switching, Circuit switching, Packet switching, Telephone Network, Dial-up modems, Traffic engineering: Network traffic and load parameters, Erlang formulae, An overview of ISDN architecture and protocol and Voice over Internet Protocol (VoIP), Introduction to ITU and IEEE standards.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Behronz A. Forouzon , " Data Communication and Networking" , Tata Mc graw hill , 4th Edituion, 2007.
2. Bernard Sklar, " Digital Communication Fundamentaks and Applications ", Pearson Education , 2nd Edition , 2001.
3. Simon Haykins , " Communication systems ", John Wiley Publications , 4th Edition , 2000..

REFERENCE BOOKS RECOMMENDED:

1. J. Das S,. K. Mullick P. K. Chatterjee "Principles of Digital Communication: Signal Representation, Detection, Estimation and Information Coding ",John Wiley & Sons (Asia) Pte Ltd (February 1, 1987)
2. Shu lin and Costello, "Error Control Coding : Fundamentals and Applications", Pearson 2nd edition, 2004.
3. R.P. Singh and S.D. Sapre, "Communication Systems " , Tata Mc Graw Hill, 2nd Edition, 2007

CO 35251: DATA STRUCTURES & OPERATING SYSTEMS

COURSE OUTCOMES: -
At the end of this course students will demonstrate the ability to:
1. Identify linear versus nonlinear data structures, Understand common data structures and be able to implement them, choose appropriate data structures for problem solving and show how data structures map onto physical memory.
2. Compare different implementations of the same data structure, Manipulate data structures with basic operations.
3. The general structure and purpose of an operating system, the concepts of process, address space, and file, process deadlock, deadlock avoidance and recovery, Compare and contrast various CPU scheduling algorithms.
4. Understand different memory management techniques and be able to describe the advantages and disadvantages of each, Storage systems– disks

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Data Structure: stack, queue, list, tree, definition of complexity.

Unit 2. Sorting: Theory of sorting, searching, various techniques and their comparison, matrix manipulation, sets and string.

Unit 3. Operating System: Evolution, different types, features of operating system. CPU Scheduling: Types of scheduler, process and processor scheduling, multiprogramming. Input /Output: Asynchronous operation, speed gap, programmed I/O, Interrupt driven I/O.

Unit 4. Memory: Hierarchy, management technique, partitioning, swapping, paging, segmentation, page segmented memory, comparison of techniques, virtual memory, and demand paging and replacement policies.

Unit 5. File System: User and System view of file system, disk organization, disk allocation method: contiguous, linked and Indexed, file protection, system calls, disk scheduling. Deadlock avoidance and deadlock recovery. Case Studies: Linux, Unix, MS-DOS, Window NT.

 ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:
 List of Experiments:
 Lab Assignment # 01
 1. Write a program to implement singly linked list in
 following way: Note: Your output menu should be

following-
***********Menu************
     1. Insertion
     2. Deletion
     3. Traversing
     4. Searching
     Enter your choice: 1
     Where do you want to insert:
     1. At beginning
     2. At a specified position
     3. At end
     One node inserted!!!
     ***********Menu************

     1. Insertion
     2. Deletion
     3. Traversing
     4. Searching
2. Write a program to reverse a singly linked list.
3. Write a program to implement doubly linked list.
4. Write a program to merge two singly linked list in sorted order.

Lab Assignment # 02

1. Write programs to implement stack by following ways:
     a) Using Array
     b) Using Linked List.
2. Write a program to implement Queue.
3. Write a program to implement binary search tree and
     perform following operations on that:
     a) Traversal (inorder,preorder,postorder)
     b) Sort the data of tree in ascending order.
4. Write a program to sort the array elements in following way:
     The sorting technique always maintains a sorted sublist in the lower positions of the list. Begin by assuming that a list with one item (position 0) is already sorted. On each pass, one for each item 1 through $n-1$, the current item is checked against those in the already sorted sublist. As we look back into the already sorted sublist, we shift those items that are greater to the right. When we reach a smaller item or the end of the sublist, the current item can be inserted. (**Hint:** It works the way we sort playing cards in our hands.)

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Galvin and Silberschatz, Operating Systems and concepts, Addison Wesley.
2. Tanenbaum, Operating Systems, PHI
3. Kruze, Data Structures and Program Design, Prentice Hall

REFERENCE BOOKS RECOMMENDED:-

1. William Stallings, Operating systems, PHI
2. Bach A. S., Design of UNIX operating system, PHI.R
3. Tenanbaum, Data structures using C, Pearson Edu.

EC 35252: ELECTRONICS MEASUREMENT

COURSE OUTCOMES:-

At the end of this course students will demonstrate the ability to:

1. Study various types of measuring instruments & their characteristics with their applications in various electronic circuits.
2. Measure signals, diagnose fault in electronics circuits & systems and its rectification.
3. Design and analyze transducer based measurement circuits.
4. Understand the electronic measurement circuits and subsystems.
5. Analyze and measurement of high frequency circuit parameters.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Measurement and their methods, Classification of measuring instruments, Static and dynamic characteristics of instruments, Standards of resistance, voltage, current, frequency and time, shielding and grounding. AC and DC voltmeters.

Unit 2. Basics of sensors and transducers, Types of transducers, LVDT, RVDT, Strain Gauge, Types of strain gauges, Types of microphones, Types of speakers, Opto-electronics and piezoelectric transducers, their calibration and application, Universal product code.

Unit 3. Principle & construction of CRO & its various controls, Dual-beam and dual-trace CROs, Estimation of phase & frequency using CRO, Digital storage oscilloscopes, Attenuators, Measurement of RF frequency, Power, and Impedance.

Unit 4. Principle, construction & applications of frequency meter, Types of frequency meters, Types of Q-meters, AC bridges and their applications, High frequency measurements, Measurements of insertion gain & phase.

Unit 5. Signal & waveform generators, Frequency synthesizers, Digital voltmeter, Digital frequency counters & millimetre's, Spectrum analyzer, RF impedance, Voltage and power meter, Optical power meter, Vector analyzer, Distortion analyzer, VSWR and return loss measurements. Measurement of RF Impedance, RF Voltage and RF Power.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of experiments

1. Introduction to CRO.

2. Measurement of unknown frequency using CRO.

3. Measurement of unknown phase shift using CRO.

4. Introduction to Digital Storage Oscilloscope (DSO)

5. Measurement of parameters from the device characteristic curves displayed by curve tracer.

6. Measurement using general purpose Digital Multimeter.

7. Study of Balanced Modulator as a phase meter.

8. Measurement of insertion gain of a two port network.

9. Measurement of linear displacement.

10. Measurement of displacement utilizing piezoresistive effect.

11. Measurement of linear displacement utilizing the principle of change in capacitance.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Shawney, Electrical & Electronic Measurement, 17th ed., 2005, Dhanpat Rai& Sons.

2. D. V. S. Murthy, Transducers and Sensors, 2nd ed., 2000, PHI.

3. Copper, Electronic Measurement, 5th ed., 2009, PHI.

REFERENCE BOOKS RECOMMENDED:-

1. Patranabis D., Sensors and Transducers, 2nd ed., 2001, S. Chand & Co.

2. Bhattacharya S. K., Electronics, Measurements and instrumentation, 2nd ed., 2001, Khanna Pub.

3. Terman & Petit, Electronic measurements, 3rd ed., 2005, Mc Graw Hill.

HU2XXXX/3XXXX:ESSENCE OF INDIAN KNOWLEDGE TRADITION

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
2	-	-	-	50	-	-	50	-	-	-

PRE-REQUISITES: NIL
Course objectives
1. To make students acquainted with the legacy of ancient Indian knowledge.
2. To make students understand about the role of Indian school of Philosophy and its contribution to the modern world.
3. To make students realize the crucial role and impact of yoga practice in lives.
4. Imparting among students the learning of Indology and significance of Indian linguistics.
5. To focus on the meditative aspects of students in order to improve their lifestyle and revive Indian traditional values.

Course outcomes
Students will be able to
1. Execute their ideas and learning with in Indian context.
2. Apply the Indian linguistics and express them with reason.
3. Define the means and ends of their professional careers.
4. Cope up with challenges in the cognitive development to deal with unforeseen crisis.
5. Adopt a balanced approach towards life, profession and problems.

Course Contents

Unit 1 - Vedic and non-Vedic philosophical traditions: nature and cause of the universe, nature of role of God, concepts of substances/matters and *Samsara, Sukh-Dukh* & rebirth, state of liberation and its path.

Unit 2 - Basic structure and classification of Indian Knowledge Systems: Ashtadash-Vidya, Dwadashanga & Anuyoga, three volumes of Tripitika, some prevalent text literature from religious domain.

Unit 3 - Indian Linguistic Tradition and human behaviour: Phonology, Morphology, Syntax and Semantics, Emotions & Reflection in human behavior.

Unit 4 - Indian Artistic Tradition: Chitrakala, Murtikala, Vastukala, Sthapatya, Sangeet, Nritya and Sahitya.

Unit 5 - Ancient Indian Science: yoga and holistic health care, Indian contribution to modern Science and mathematics, some famous Indian ancient Scientists.

ASSESSMENT:
Only **Sessional Work** (100 marks) on the basis of viva (30) Attendance (20), Quizes/Tests/Activities (30) and Presentations (20) will be awarded against the assessment done throughout the session.

Books for references:

1. **Text Study material** prepared to limit the scope of study of this subject by the Department of Humanities and Social Sciences, SGSITS, Indore.

2. Chatterjee, Satishchandra. *Introduction to Indian Philosophy*. Rupa & Co, 2012.

3. Radhakrishnan, Sarvepalli. *Indian Philosophy*. Oxford Univ. Press, 2009.

4. Upādhyāya Baldev . *Bhāratīya darśana ; BHĀRATAVARSA Kī Vividha darśanika vicāradhāraom KĀ PRĀMĀNIKA VIVECANA* Śārdā Mandira, 1957.

5. Gupta Rāmeśvara Dayāla . (1997). *Vaidika VĀṆMAYA Meṃ vijnāna = Sciences in Vedic literature*. Maharishi Sāndipane Rāshṭrīya Veda Vedyā Pratishṭhāna

6. V. Sivaramkrishnan (Ed.), *Cultural Heritage Of India course material,* Bharitya Vidya Bhavan, Mumbai. 5th Edition.2014

7. Pritchett, Frances. *The Buddha and His DHAMMA, by Dr. B. R. Ambedkar*, www.columbia.edu/itc/mealac/pritchett/00ambedkar/ambedkar_buddha/.

8. Shastri, Dr. Nemichand, et al. "Tirthankar Mahaveer AUR Unki Acharya PARAMPARA Part - 1: Read Jain Books Online at Jainebooks.org." *Jainebooks.org*, Pandit Todarmal Smarak Trust, www.jainebooks.org/books/4129/tirthankar-mahaveer-aur-unki-acharya-parampara-part-1.

EE 35507 CONTROL SYSTEMS

PREREQUISITE: - Engineering Mathematics, Network Analysis

COURSE OUTCOME:-

Students should be able to:

1: Develop mathematics models (TF and state space) of various physical systems.

2: Define time domain and frequency domain specifications of a control system.

3: Determine stability of a control system using time domain techniques and design appropriate controller for a given problem.

4: Propose alternate solution via compensator design to get desired frequency domain specifications.

5: Explain concepts of controllability and observability as well design of state feedback controller.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

THEORY:-

Unit 1. Modeling of Systems and Simulation: Modeling of thermal, hydraulic pneumatic processes, mechanical, electrical systems, impulse response, concept of transfer function, block diagram algebra, signal flow graph, Mason's formula. Control system Component: Error detectors, servomotors, servo-amplifiers, modulators demodulators, pneumatic controllers, hydraulic controller.

Unit 2. General Feedback Theory: Mathematical feedback theory, return ratio, return difference effects of feedback on closed loop performance. Time domain analysis: Test signals, transient behaviour of closed loop systems such as position servo and process servo systems, derivative and rate feedback, control, steady state behaviour of position and process servomechanisms, steady errors, integral control, stability of Routh-Hurwitz Criterion.

Unit 3. Frequency domain analysis: Concept of frequency polar indices plot, bode plots, frequency domain performance, M_p and ω_p effects of adding poles and zeroes of frequency domain performance, conformal mapping, principle of argument. Nyquist criterion, transportation lag, relative stability, conditionally stable system constant M and constant N loci, root loci.

Unit 4. State space analysis: Open loop system. Description, state space, eigenvalues and eigenvectors, modal transformation, solution of state differential equation, method of feedback in state space closed loop system description in state space controllability and observability in the sense of feedback control, effect of feedback on eigenvalues, eigenvectors and on modal transformation, solution of closed loop state differential equation, and introduction of phase plane analysis.

Unit 5. Compensation techniques: Types of compensation, reasons of compensation, design of compensation using phase lead networks. Stability analysis: Concept of BIBO stability, Routh-Hurwitz criteria, Nyquist criterion, relative stability, positive definiteness and semi-definiteness of quadratic forms, Lyapunov stability criteria.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments

1. To determine the performance characteristics of an angular position error detector using potentiometers.
2. To determine the characteristics of a Synchro Transmitter Receiver pair and use as a torque synchro and angular error detector.
3. To find the transfer function of an A.C. Servomotor.
4. To find the transfer function of a D.C. Servomotor.
5. To control the angular position of an AC servo motor as a carrier control system.
6. Determination of the time response characteristics of a DC Servo angular position control system.
7. To perform closed loop Speed control of a D.C Servomotor.
8. To determine the performance characteristics of a DC motor speed control with PWM type power driver.
9. To determine the performance characteristics of a DC motor speed control with SCR type power driver.
10. Analysis of Proportional + Integrator + Derivative (PID) control actions for First and second order systems.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Kuo B.C. Automatic Control System.
2. Ogata K., Modern Control Engineering.
3. Nagrath I.J. and Gopal M., Control Systems Engineering.

REFERENCE BOOKS RECOMMENDED:-

1. Melsa J.L. and Schuttz D.G. Linear Control Systems.

EC35511: MOBILE COMMUNICATION

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:
1. Understand basics of cellular communication and its various standards.
2. To know the fading mechanism and effect of Large Scale Fading on Mobile communication.
3. Analyze the fading channel characteristics on small-scale and study their effects on radio wave propagation.
4. Demonstrate knowledge of different fading mitigation techniques.
5. Understand fundamental concepts of various speech coding, modulation techniques and GSM architecture.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1: Review of cellular architecture, Frequency Re-use, Channel Assignment Strategies, Handoff Process, Factors affecting Handoff Process, Handoff Strategies, Interference and System Capacity, Co-channel Interference (CCI), Adjacent Channel Interference (ACI), Cell Splitting, Sectoring, Microcell Zone concept, Repeaters, Trunked Radio System.

Unit 2: Large Scale Fading: Multipath propagation and fading, Reflection, Diffraction, Scattering, Large scale path loss models, Free Space Propagation loss equation, propagation path loss, Ground reflection (Two-Ray) model, Link budget design, Log-normal Shadowing.

Unit 3: Small Scale Fading: Power delay profile, channel parameters (delay spread, Doppler spread, coherence bandwidth, coherence time, LCR and ADF) and types of fading channel, Rayleigh and Ricean Distributions.

Unit 4: Fading mitigation techniques: Concept of Diversity, Receiver Diversity methods, Transmitter diversity, performance analysis for Rayleigh fading channels, Equalization principle and adaptive equalization, CDMA principle and implementation, OFDM.

Unit 5: Basic properties of speech: Speech coding for wireless system such as time domain and frequency domain coder, vocoders, popular speech coders in GSM. Modulation techniques for mobile communication and their performance. GSM architecture and specification, Radio link features in GSM, GSM logical channels and frame structure.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:-
1. Rappaport T.S., Wireless Communications: Principles and Practice, 2nd ed., 2004 PHI.
2. Aditya K. Jagannatham, Principles of Modern Wireless Communications Systems Published by McGraw-Hill Education
3. Andreas F. Molisch Wireless Communications, 2nd ed., 2001, Wiley Pub.

REFERENCE BOOKS RECOMMENDED:-
1. Wilkis and Garg, Principles of GSM Technology, 2nd ed. 2004, PHI.
2. Fehar K., Wireless Digital Communication, 2nd ed. 2001, PHI.
3. Ramji Prasad and Richard Van Nee, OFDM Wireless Multimedia Communication, 2nd ed. 1998, Artech House.

EC 35513: COMPUTER NETWORKS

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. Understand the basics of Computer Network Architecture, Topology, and Network Model.
2. Analyze the design issues of various MAC layer protocols for deployment of Ethernet/IEEE Standards.
3. Illustrate the design issues of Network Layer and Transport layer protocols in Computer Networks.
4. Develop the concepts of Routing Algorithms and Routing Protocols.
5. Describe the design issues of WAN and Advanced Computer Network Architecture.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

UNIT 1: Review of concepts of layering and layered models - OSI and TCP/IP. Basic Overview of TCP/IP Protocol Stack, Circuit Switching and Packet switching, various types of networks, different LAN, MAN and WAN topologies, Network Hardware and Software Components, Transmission media, access devices like NIC, repeaters, switches, routers, protocols.

UNIT 2: Data Link Layer: Medium Access Protocols, LAN technology: Transmission medium, topology and Medium Access Control (MAC) techniques, Local Area Network types: IEEE 802.x standards – Ethernet, Fast Ethernet, Gigabit Ethernet, Switched Ethernet, Token Ring protocols, FDDI protocols

UNIT 3: Network and Transport layer: Internetworking with TCP/IP:- Internet/ IP addressing schemes & various Internet services, Network Layer: Internet protocol (IP) suite including IPV4 protocol and IPV6 protocol. Transmission Control Protocol:- basic features, transport protocols TCP and UDP, Connection Establishment and Closure, Flow Control and Congestion Control at Transport Layer

UNIT 4: Introduction to IP routing and services: Routing algorithms, various interior Gateway protocols like RIP, OSPF, and Routing among the ISPs using BGP. IP Services: Network Management with SNMP, ARP.

UNIT 5: WAN technology and Application Layer Services (HTTP, FTP, Email, and DNS), WAN technology: Introduction to label switching and MPLS, Introduction to Software defined networking. QoS design guidelines, VoIP

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments:

1. Study and Comparison of Various Network Topologies, Their Advantages, Disadvantages and Applications
2. Study of Various Networking Devices, Their Advantages, Disadvantages and Applications & Case Study of Optical Fiber.
3. To Configure a Machine on WINDOW Platform.
4. To Configure a Machine on LINUX Platform.
5. To Study how to Transfer Data From One Machine to Another Using FTP i.e. File Transfer Protocol
6. Installation of Ubuntu (Open Source LINUX) on a Machine.
7. Configuration of TELNET Service on a LINUX Machine.
8. Configuration of NFS Service on LINUX Machine
9. To Study SAMBA SERVER.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:
1. Comer, Internetworking with TCP/IP Vol. 1, PHI.
2. Stalling W., Data and Computer Communication, PHI.
3. Forouzan B., Data Communication and Networking, TMH.
4. Kurose, Ross, Computer Networking: A Top-Down Approach, Pearson, 7 th edition.

REFERENCE BOOKS RECOMMENDED:
1. Tanenbaum, Computer Networks, PHI.
2. Radia Pearlman, Interconnections, bridges, routers, switches and internetworking protocol.
3. Charles Spurgeon, Ethernet: The Definitive Guide, O'Reilly Media Publication

EC 35514: APPLIED DIGITAL SIGNAL PROCESSING

COURSE OUTCOMES:-
At the end of this course students will demonstrate the ability to:
1. Apply Fourier and z-transforms to represent and analyze LTI discrete time systems.
2. Compute numerically the response of discrete time systems (DTS) for finite time inputs.
3. Analyze and design digital IIR and FIR filters.
4. Implement the DTS and analyze the effects of finite word length and estimate the power spectrum.
5. Analyze and design multirate signal processing systems and understand applications of Digital Signal Processing.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

UNIT 1: Discrete-time Sequences, Discrete-time systems attributes, z-Transform, Transform analysis of LSI systems, Frequency analysis, Inverse systems, Linear phase systems and Minimum phase systems.

UNIT 2: Discrete Fourier Series, Discrete Fourier Transform (DFT), Linear convolution using DFT, Fast Fourier Transform (FFT) Algorithms. Linear filtering approach for computing DFT.

UNIT 3 : Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters.

UNIT 4: Implementation of Discrete Time Systems, Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation.

UNIT 5: Sampling and reconstruction of signals, Discrete time processing of continuous time signals, Sampling rate conversion using Discrete-time processing, Introduction to multirate signal processing. Applications of DSP.

ASSESMENT:
Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:
List of Experiments:
1. Introduction to MATLAB
2. Basic Operations on Matrices
3. Generation of different types of Sinusoidal Signals
4. Generation of different Discrete type sequences
5. Decimation and interpolation for discrete time systems with frequency responses
6. z-Transform & checking stability through pole-zero plot
7. Methods of Inverse z-Transforms & concept of Residues and poles
8. Response of Linear constant co-efficient difference equation [LCCDE]
9. Linear Convolution in time domain and z-domain
10. To calculate DTFT using different methods and plot its magnitude and phase response.

11. Properties of DTFT: Time-shifting, Frequency-shifting, Convolution, Modulation and Time-reversal.
12. N-point DFT & its properties and FFT of various sequences
13. Circular Convolution
14. Sampling and Aliasing concept
15. Plot frequency response of Digital FIR and IIR LPF
16. Plot frequency response of Digital FIR and IIR HPF
17. Plot frequency response of Digital FIR and IIR BPF
18. Plot frequency response of Digital FIR and IIR BRF
19. Plot frequency response of Low-pass and High-pass COMB filter
20. Design a Digital Resonator with given specifications
21. Design a Notch filter with given specifications
22. Design an FIR LPF using a Rectangular window
23. Design an FIR Linear-phase filter using a Hamming window
24. Design an IIR LPF Butterworth filter using Bilinear Transformation
25. Design an IIR LPF Butterworth filter using Impulse Invariant method
26. Image Processing using MATLAB
27. Echo Generation using TMS320C6713 DSP PROCESSOR
28. Design of a Band-pass filter using TMS320C6713 DSP PROCESSOR

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:
1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. D.G.Manolakis and V.K.Ingle Applied Digital Signal Processing: Theory and Practice, Cambridge University Press, 2011.
3. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, 2015

REFERENCE BOOKS RECOMMENDED:
1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
4. E.C.Ifeachor and B.W.Jervis, Digital Signal Processing: A Practical Approach, Pearson.

EC 35661: EMBEDDED SYSTEMS

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

1. Classify various RISC microcontrollers and explain AVR microcontroller's architecture.
2. Identify the features of AVR microcontrollers and interface them with various modules for real-time application designs.
3. Interpret the architecture of mixed-signal processors (MSP430) and learn its programming.
4. Understand the ARM Processor's Architecture and Basic Concept of RTOS.
5. Explain the ARM controller architecture, its programming and make use of RTOS for application designs.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

UNIT-1: AVR Microcontrollers:

Introduction to Embedded system and its architecture. AVR ATmega 8 bit Microcontroller, its architecture, memory mapping, instruction set, addressing modes, assembly language programming.

UNIT-2:AVR Microcontroller's Interfacing & Basic I/O Programming:

ATmega I/O ports, timers/counters, programming to generate delay and wave form generation, Interfacing of ATmega with LoRa Module, ZigBee Module and WiFi Module.

UNIT-3:   MSP 430 Microcontroller:

Introduction to MSP 430 microcontroller, Architecture MSP430 memory organization, I/O system organization, MSP 430 instruction Set and assembly language programming.

UNIT-4: MSP 430 Microcontroller's Interfacing:

Basic Elements of Interfacing of MSP 430, System clock, fundamental Interrupts concept, times and event counter, GPIO ports, Iinterfacing with USART, Modem.

UNIT-5: ARM Microcontroller & RTOS:

Introduction to ARM Microprocessor based systems, Architecture of ARM and Cortex M3, Instruction sets, Assembly and embedded 'C' programming. Interfacing for application development. Introduction of Real Time Operating Systems (RTOS), interrupt routines in RTOS.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

TEXT BOOKS RECOMMENDED:
1. ARM Microprocessor systems, CORTEX M Architecture, programming & interface, CRC press, Muhammad Tahir & Kashif Javed
2. AVR, Microcontroller & Embedded system, Person Edu., Mazidi
3. Introduction to Embedded systems Using microcontroller and the MSP430, Springer, Manuel, Rogelio,   &   Isidoro.

REFERENCE BOOKS RECOMMENDED:
1. Microcontroller in Practice, Springer, L. Susnea, M. MitSecu,
2. Embedded Systems , TMH publications, Prof. Rajkamal
3. MSP 430 Microcontroller Basics, Newnes, John Davies.

IT 35662: INTELLEGENT SYSTEMS

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:

CO1   Explain the basics concepts of A.I. and problem solving through searching.

CO2   Apply fuzzy logic concept for given situation.

CO3   Design the neural network model for given real world scenario.

CO4   Describe various machine learning algorithms to solve real time problem.

CO5   Apply various machine algorithm for given dataset.

CO6   Explain concept of intelligent system and agents and significant of machine learning.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Artificial Intelligence:

Concept of Artificial Intelligence and intelligent agents. Areas of Artificial Intelligence. Problem solving and search methods, Knowledge, reasoning, and planning (KRP), Uncertainties and probabilities in KRP.

UNIT 2: Fuzzy Systems: Foundations of Fuzzy Logic. Foundations of Fuzzy Control. Types of Fuzzy Controllers. Fuzzy Logic Toolbox. Creation of Fuzzy Inference System with Fuzzy Logic Toolbox. Creation of Fuzzy Controllers.

UNIT 3: Neural Networks: Neuron Model. Perceptron Model. Modeling of Basic Logic Functions using the Perceptrons. Feedforward Neural Network with Backpropagation Error. Approximation of Functions by a Two-layer Feedforward eural Network. Character Recognition using Two-layer Feed-forwardNeuralNetwork.

UNIT 4: Machine learning: Basics, Types and Applications of ML
Supervised Learning: Introduction to Supervised Learning, Linear Methods for Regression, Support Vector Machines. Naive Bayes, Decision Tree, Ensemble methods: Bagging, boosting, Evaluating learning algorithms. Classification problems; decision boundaries; nearest neighbor methods, Logistic regression,

UNIT 5: Unsupervised Learning: Introduction to Unsupervised Learning, Cluster Analysis, Clustering K-means, hierarchical agglomeration clustering, Expectation Maximization method, Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), Reinforcement Learning.
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ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

Text Books :-
1. Rich & Knight , "Artificial Intelligence" ,2nd Edition,Tata Mcgraw Hill.
2. Rajsekaran and Pai, "Neural Network and Fuzzy Logic", 2nd Edition,Prentice Hall of India.

3.T.Mitchell "Machine Learning," Mc-Graw Hill, 1997.

Reference Books:-
1. Russel & Norvig, "Artificial Intelligence",2nd Edition ,Pearson Education.
2. Patterson, "Introduction to AI and expert System",2nd Edition, Prentice Hall of India.
3. S.N. Sivananadan & S.N. Deepa, "Principles of Soft Computing", 1st Edition,Wiley India.
4. Ethem Alpaydin,Introduction to Machine Learning", MIT Press,2004.
5. Jacek M Zurada, "Introduction to Artificial Neural System", JAICO Publishing.

EC 35881: ELECTRONICS DESIGN AND SIMULATION

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Understand various types of Microcontrollers and their Architecture.
2. Analyze various Simulation software for Microcontrollers
3. Write code and simulate various microcontroller based circuits.
4. Interface various peripheral devices with microcontroller and calculate power requirement.
5. Install Linux based OS for Microcontrollers.
6. Design a microcontroller based working hardware project.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
-	-	4	-	-	40	60	100	-	2	2

1. Study of Various Microcontroller families and their comparison. Understanding various ports of a microcontroller.

2. Various Simulation software and their limitations, Simulation of microcontroller and there programming methodology.

3. Interfacing various sensors, motors and other peripheral devices with microcontroller.

4. Power calculations. Installation of Linux OS for microcontrollers.

5. **MINOR PROJECT**: Students will submit a microcontroller based project in a group at the end of the semester.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:

1. Muhammad Ali *Mazidi*. Janice Gillispie *Mazidi*. Rolin D. McKinlay.The 8051 Microcontroller and Embedded Systems. , 2e, Pearson Education
2. Rajkamal, Embedded Systems: Architecture Programming and Design, 2e, TMH Education.

REFERENCE BOOKS RECOMMENDED:

1. Jeremy Blum, Exploring Arduino , 1e, Wiley
2. Davies, John H, MSP430 Microcontroller Basics, 1e, Elsevier
3. Muhammad Ali Mazidi. Rolin D. Mckinlay, PIC Microcontroller and Embedded Systems, 1e, Pearson Education India.
4. Simon Monk, Programming the Raspberry Pi: Getting started with Python, 2e, McGraw Hill Education.

EC 45009 : WIRELESS AND MOBILE NETWORKS

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Understand basic technologies implied in 3G and 4G mobile networks.
2. Learn device to device and millimeter wave communication in 5G networks.
3. Develop the basic concepts of wireless sensor network and its protocols
4. Describe the routing mechanism inside wireless sensor networks.
5. Classify the technology and standards of Mobile IP, Bluetooth, ZigBee and RFID.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1: 3G & 4G Mobile Networks
Third Generation mobile Technology 3G –UMTS, UTRAN- Architecture, WCDMA, HSDPA, Spreading and De-Spreading, Scrambling, User Equipment (UE), CS and PS Domain Protocol Architectures, SGSN and GGSN in UMTS, 4G- LTE and LTE-Advance.

Unit 2: Emerging Mobile Networks
Millimeter-wave Communications (5G) – Introduction to MIMO, Beam-forming, physical layer techniques, Interference and mobility management, Massive MIMO - propagation channel models, Channel Estimation, Imperfect CSI. Pilot Contamination, Spatial Modulation (SM), Device to Device (D2D) Communication.

Unit 3: Wireless Sensor Networks: Basic and MAC Protocols
Wireless sensor Network- Architecture, Applications, Technology for sensor nodes & networks, operating environment, Medium Access Control Protocols - Low duty cycle protocols and wakeup concepts -Contention-based and contention-free protocols, Schedule-based hybrid protocols.

Unit 4 Wireless Sensor Networks: Routing Protocols
Routing And Data Gathering Protocols. Routing Challenges and Design Issues in Wireless Sensor Networks. Data centric Routing, Energy aware routing, Gradient-based routing, Rumor Routing, Hierarchical Routing, Location Based Routing.

Unit 5: Short Range wireless networks
Mobile IP, Bluetooth- Protocol stack, RFID and ZigBee technologies and their practical usage. IEEE 802.11 standards and its variants. 6LoWPAN, LoRa.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

TEXT BOOKS RECOMMENDED:
1. Sumith Kaseara, Nishit Narang, "3G Networks Architecture, Protocols", Tata McGraw Hill
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press
3. Feng Zhao and Leonidas Guibas – *Wireless Sensor Networks, An information processing approach* - Morgan Kaufmann publication
4. Kaveh Pahlavan, Prashant Krishnamoorthy – *Principle of wireless networks- A united approach*- Pearson Education, 2002.

REFERENCE BOOKS RECOMMENDED:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati- *Wireless Sensor Networks: Technology, Protocols and Applications* -Wiley publication
2. Martin Sauter "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
3. Vijay K. Garg – *Wireless communication and networking* – Morgan-Kaufmann series in networking- Elsevier publication

EC 45207 : MICROWAVE DEVICES & CIRCUITS

COURSE OUTCOME:-
At the end of this course students will demonstrate the ability to:
1. Understanding the scattering parameters and corresponding instruments.
2. Identify various types of Microwave electronic components and systems.
3. Study of different modes of operation of various RF and Microwave devices and circuits.
4. Design and analysis of dielectric resonator circuits and systems.
5. Solving complex RF amplifiers parameters; Microwave communication network design problems.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Features and applications of microwaves, Wave propagation in striplines and microstrip lines, and Slot lines, Limitations of conventional vacuum tubes, Microwave tubes like Two cavity klystron and Reflex klystron, Magnetron, TWT, Backward wave oscillator etc.

Unit 2. Solid state microwave sources, transferred electron devices, Tunnel diode Gunn diode and oscillators, IMPATT diode, TRAPATT diode, Pin diode, Varactor diode, Schottky diode, Parametric amplifiers, Crystal diode, Frequency multipliers, Microwave BJT & FET.

Unit 3. Scattering matrix, S-parameters & its applications in Network analysis, Matching Network, Detector diodes, detector mounts, detector output indicator, slotted line, measurement of power, impedance & S-parameter, measurement of frequency & VSWR.

Unit 4. Impedance transformer, Microwave filters, Power dividers and Diodirectional couplers, E-plane Tee, H-plane tee, Matched hybrid Tee.Tensor permeability, Wave propagation in ferrite medium, Isolators, Circulators, YIG resonators, Simulation Techniques for design of Microwave Components and devices.

Unit 5. Analysis and design of Dielectric resonators; Design of RF and microwave low noise and power amplifiers & oscillators using S- parameter techniques, Mixer and converter design, diode phase shifters, attenuators, Design of hybrid and monolithic, microwave and millimeter wave integrated circuits.

<u>ASSESMENT:</u> Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

.<u>LIST OF EXPERIMENTS</u>
1. To determine the characteristics and electronic tuning range of Klystron tube amplifier.
2. To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode E.M. propagation .
3. To determine the Standing Wave Ratio and Reflection Coefficient in a Rectangular waveguide system with different loads .
4. To determine an unknown Impedance in a slotted line section using Smith chart.
5. To measure V-I characteristics of Gunn Diode at microwave frequencies .

6. To measure the following parameters in a multi-hole directional coupler
7. Main-line and auxiliary-line VSWR.
8. The coupling factor and directivity.
9. To determine the S-Matrix of Magic Tee.
10. To determine the characteristics of Isolator and Circulators at different microwave frequencies.
11. Design study of microwave amplifier using microwave office (Virtual experiment)
12. To design microwave filter sing electromagnetic software (Virtual experiment)

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:

1. Liao S., Microwave Devices & Circuits''., 2nd ed. 2001,PHI.
2. Gupta K.C., Microwave Engg., 3rd ed.2004,Wiley Easter Pub.
3. Watson, Solid State Microwave Devices, 5th ed.2008,Wiley.
4. David M. Pozar, Microwave Engineering, 3rd edition, 2011 Willey India.

REFERENCE BOOKS RECOMMENDED:

1. Gandhi, Microwave Engineering & Application, 2nd ed.2005,McMillan Int. Ed.
2. Reich, Microwave Principles, 5th ed.2009,CBS Publ.
3. Collin, Foundations for microwave engineering, 4th ed. 2001,Wiley Publ.

EC ……….: ADVANCED ANTENNA DESIGN

Prerequisite: - Physics, Electromagnetic fields and Waves, Transmission lines, Antenna and wave propagation

Course Outcome:-
Students should be able to:
1. Learn approach for mathematical modeling of electromagnetic antenna problems
2. Basic concepts of design of antennas
3. Concepts of antenna Design and fabrication
4. Application of High frequency and numerical techniques in Antenna Design
5. Learn Practical design of various antennas and measurement

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

Theory:

Unit 1: Fundamental Concepts: Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions

Unit 2: Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. **Aperture Antennas**: Huygens' Principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, lens and reflector antennas, design concepts, dielectric resonator antenna (DRA)

Unit 3: Broadband Antennas: Broadband concept, Log-periodic antennas, frequency independent antennas. Helical and Spiral antennas**. Microstrip Antennas**: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Unit 4: Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. **Smart Antennas**: Concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beamforming, beam steering, nulling and direction finding. Frequency selective surfaces (FSS), Metamaterial antennas, Defected ground structure (DGS) antenna

Unit 5: High Frequency techniques for scattering i.e. GTD, UTD, UAT, PTD etc. **Computational Numerical techniques** i.e. Method of moment (MOM), Finite difference time domain (FDTD), Finite element method (FEM).

Text Books Recommended:
1. C.A.Balanis,"Antenna Theory and Design", 3 rd Ed., John Wiley & Sons., 2005.
2. Antenna Theory and Design : Warren L. Stutsman Gary A. Thiele , Wiley Publication.
3. Mathew N.O. Sadiku, Numerical Techniques in Electromagnetic, II edition, CRC press.
4. Ramesh Garg, Computational methods in Electromagnetic, CRC press.
5. Roger F. Harrington, Field computation by Moment Methods, Oxford university press.

Reference Books Recommended:
1. Collin R.E., Antennas & Wave Propagation, 3rd ed., 2001, McGraw Hill.
2. Roger F. Harrington, Introduction to Electromagnetic Engineering. Dover Publication.
3. R.S.Elliot,"Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

List of Experiments

S.N.	Experiments
1	Study and Design of High gain Horn Antenna through simulator
2	Design and check the various performance parameters of 2 by 2 patch antenna Array
3	Estimate the radiation pattern of E plane and H plane Horn antenna through antenna trainer kit
4	Develop the MATLAB programme for estimate various parameters of antenna like directivity, radiation pattern etc.
5	Estimate the radiation pattern of Helical antenna through antenna trainer kit
6	Estimate the performance parameter of High gain antennas through VNA
7	Estimate the various performance parameter like gain, polarization, efficiency etc. of High gain antennas i.e. horn, helical etc. through Anechoic chamber
Project	
8	To design, develop, fabricate, test & measure the suitable high gain antennas in RF and Microwave laboratory for parameters like polarization, efficiency, gain, directivity , and E, H plane 2-d and 3-d radiation pattern.

EC45208: OPTICAL COMMUNICATIONS

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:

1. Understand Optical Fiber Communication System and its parameters.
2. Analyze transmission characteristics of optical fiber and their effects.
3. Understand the construction and operation of various optical sources and detectors.
4. Design and study performance analysis of optical receivers.
5. Brief introduction of optical fiber networks and amplifiers.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Overview of optical fiber communications system: elements of an optical fibre transmission link, Wave propagation in optical fiber, analysis of optical waveguide using ray theory, wave model, Optical fibers : Structure & wave guiding fundamentals, basic optical laws, optical fibre modes & configuration mode, different types of optical fibers, Physical and electrical characteristics of fiber.

Unit 2. Signal degradation in Optical Fiber due to dispersion and attenuation: signal distortion in optical wave guides, pulse broadening in graded index and step index wave guides, mode coupling, Fabrication of fibers, overview of fibre materials and measurement techniques like OTDR.

Unit 3. Optical sources and detectors: LEDs, LASER diodes, basic principle, various structures-semiconductor lasers, distributed feedback lasers Photo-detectors - pin-diodes, APDs, Physical principles of photo diodes, photo detector noise-NEP, detector response time, Avalanche multiplication noise, photo diode materials.

Unit 4. Optical receivers Direct detection and coherent receivers, noise in detection process, System design, power budgeting, rise time budgeting; fibre to fibre joints, and splicing techniques, Optical fibre connectors, Introduction to optical amplifiers (EDFA, SOA), optical switches

Unit 5. Optical networks: Basic networks- SONET/ SDH, WDM network : Broadcast – and –select Networks, wavelength routed networks, DWDM, Passive Optical Access Networks, Introduction to elastic optical network and LiFi.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments

1. To familiarize with the optical communication kit and its specifications and interfaces.
2. To establish data link communication employing intensity modulation and demodulation.

3. To generate frequency and pulse width modulation and demodulation in optical communication.
4. To measure various losses in optical communication
5. To measure the effect of bending on attenuation in optical fiber.
6. To measure the optical parameters.
7. To characterize LED as optical source.
8. To characterize Laser Diode.
9. To establish PC to PC communication using RS232 interface via optical fiber link.
10. Preparation of fiber optic cable termination.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-
1. Senior J.M., Optical Fibre Communications: Principles & Practice, 2nd ed. 2001, PHI.
2. Agrawal Govind P., Fibre Optic Communication Systems, 5th ed. 2001, John Wiley & Sons, students ed.
3. Black Uyless, Optical Networks and 3rd Genration Transport Systems, 3rd ed. 1998, Pearson.

REFERENCE BOOKS RECOMMENDED:-
1. Keiser G, Optical Fibre Communication, 5th ed. 2006, McGraw Hill.
2. Mynbanv and Scheiner, Fibre Optic Communication Technology, 2n^d ed 2010, Pearson Edu.
3. Djfar K Mynbaev & Scheiner, Fibre Optic Communication Technology, 5th ed. 2005, Pearson

CO 45251: DATA SCIENCE

PRE-REQUISITE: NIL

COURSE OUTCOMES: After Completing the course student should be able to:

1. Comprehend the IT-interestingness of data and understand the attributes of data. 2. Preprocess the given data and visualize it for a given application or data exploration/ mining task.

3. Apply techniques of supervised and unsupervised machine learning for various data applications.

4. Implement web search methods by page ranking and can implement models of information retrieval by applying different techniques of text mining.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

COURSE CONTENTS: THEORY:

UNIT 1. Understanding Data: Data Wrangling and Exploratory Analysis, Data Transformation & Cleaning, Feature Extraction, Data Visualization. Introduction to contemporary tools and programming languages like R, Python etc. for data analysis.

UNIT 2. Statistical & Probabilistic analysis of Data: Multiple hypothesis testing, Parameter Estimation methods, Confidence intervals, Bayesian statistics and Data Distributions.

UNIT 3. Introduction to machine learning: Supervised & unsupervised learning: Classification & Clustering Algorithms like Decision Tree based classification and KMeans clustering, Dimensionality reduction: PCA & SVD, Correlation & Regression analysis, Training & Testing data: Overfitting & Under fitting.

UNIT 4. Introduction to Information Retrieval: Boolean Model, Vector model, Probabilistic Model , Text based search: Tokenization , Tf-IDF, stop words and ngrams , synonyms and parts of speech tagging

UNIT 5. Introduction to Web Search & Big Data: Crawling and Indexes, Search Engine architectures, Link Analysis and ranking algorithms such as HITS and Page Rank Hadoop File system & Map Reduce Paradigm.

TEXT BOOKS RECOMMENDED:
1. Field Cady, "The Data Science Handbook" , 1/e , 2018, Publisher: Wiley
2. Sinan Ozdemir, "Principles of Data Science ", 1/e, 2016, Packt Publishing Limited

REFERENCE BOOKS:

1. Peter Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", Shroff/O'Reilly; First edition (2017)

2. Pang-Ning Tan, "Introduction to Data Mining", Pearson Edu., 2007

3. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, "Modern Information Retrieval", Pearson Education, 2004

THEORY ASSESSMENT:

1. Internal Assessment for continuous evaluation, mid-term tests, Tutorials, Quizzes, Class Performance, etc. (30%)

2. End semester Theory Exam (70%)

EC 45301: INTERNET OF THINGS (IoT)

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. Understand IoT architecture and IoT decision framework.
2. Configure Raspberry Pi, understand sensors, actuators & get started with Python on Raspberry Pi.
3. Understand various IoT networking protocols used to develop communication solutions.
4. Able to design architecture for an end-to-end solution and perform data analytics.
5. Understand IoT challenges, business solutions, research scope and current development.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1:
Introduction: Definition, Characteristics of IoT, IoT Conceptual framework, IoT Architectural view, Physical design of IoT, Logical design of IoT, Application of IoT.
(Power constraints for IOT implementation.)

UNIT 2:
Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IoT, data storage in IoT, IoT Cloud Based Services.
(Fog ecosystem for IOT)

UNIT 3:
Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IoT, Media Access control.

UNIT 4:
Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Network Technology.

UNIT 5:
IoT Design methodology: Specification -Requirement, process, model, service, functional & Operational view.IoT Privacy and security solutions, Raspberry Pi & arduino devices. IoT Case studies: smart city streetlights control & monitoring.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. V. Madisetti and A. Bahga, "Internet of things (A-Hand-on-Approach)", Universal Press.
2. Rajkamal, "Internet of Things", Tata McGraw Hill publication.
3. A. Pajankar and A. Kakkar, "Raspberry Pi by Example", Packet Publishing Ltd, Birmingham, UK.

REFERENCE BOOKS RECOMMENDED:

1. F. Dacosta "Rethinking the Internet of things: A Scalable Approach to Connecting Everything", Apress publications.
2. D. Norris, "The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black", McGraw-Hill Education, New Delhi.
3. P. Raj and A.C. Raman, "The Internet of Things", CRC Press (T&F Group), New York

EI 45252: VLSI TECHNOLOGY

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:

1: To describe crystal growth and wafer preparation methods.

2: To discuss layering in terms of chip fabrication.

3: Illustration of various patterning methods.

4: Gain knowledge about layout design rules, stick diagrams etc.

5: Illustration of subsystem design and memories.

Hours /Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

THEORY:

Unit 1. Crystal Growth and wafer preparation: Wafer terminology, different crystalline orientations, CZ method, CMOS IC Design flow, Crystal Defects, Fabrication process of FETs, MOSFETs, and BIMOS etc.

Unit 2. Layering: Epitaxial growth methods, oxidation, Kinetics of oxidation, thin film fabrication, Metallization, Physical Vapor Deposition and Sputtering.

Unit 3. Patterning: Lithography, Optical Lithography, Electron Lithography, X- Ray Lithography, Ion Lithography. Photo masking steps, Resists. Doping: Diffusion; Diffusion models, Ion Implantation; Implantation Equipment, Channeling.

Unit 4. VLSI process techniques and Integration: Floor planning, layout, Design rules, stick diagrams, Test generation, Logic Simulation, Introduction to EDA tools. Contamination control: Clean rooms, HEPA, ULPA Filters and Class numbers.

Unit 5. Subsystem Design: Data-paths; adder, Shift resisters, ALU, Memory; NVRWM, Flash memories, 6-Transistor RAMs. Latch up in CMOS circuits.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. S.K. Gandhi, VLSI Fabrication Principles, Wiley.
2. S.M. Sze, VLSI Technology, II edition, McGraw Hill.
3. P. Van Zandt, Microchip Fabrication, A practical Guide to Semiconductor Processing, Third edition, McGraw Hill.

REFERENCE BOOKS RECOMMENDED:

1. James D Plummer, Silicon VLSI Technology Fundamentals Practice & Modeling Pearson Education Limited
2. Singh R.K., VLSI Technology Design & Basics of Microelectronics, S. Kataria & Sons

2. D. Norris, "The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black", McGraw-Hill Education, New Delhi.
3. P. Raj and A.C. Raman, "The Internet of Things", CRC Press (T&F Group), New York.

EC 45302: ADVANCED DIGITAL SIGNAL PROCESSING

COURSE OUTCOMES:

At the end of the course, the student should be able to:
1. Analyze and apply the concepts of random processes in practical applications
2. Analyze and apply linear estimation and prediction techniques for a given random process
3. Analyze, mathematically model, modify and enhance speech and music signals.
4. Analyze and apply appropriate adaptive algorithm for processing non-stationary signals
5. Analyze and apply wavelet transforms for signal and image processing based applications

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1 : Discrete-Time Random Signals
Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, Response of LTI systems to random processes Power Spectral Density, Some useful random process models.

UNIT 2: Linear Estimation and Prediction
Estimation of mean, variance and covariance, Estimation theory, Spectrum estimation, Optimum Linear filters, Optimal FIR (Wiener) filter, Extraction of signal from noise, Forward and Backward Linear prediction and all-pole signal modeling.

UNIT 3: Speech and Audio Processing
Audio Signal Characteristics, Production model, Hearing and Auditory model, Acoustic characteristic of speech, Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model. Audio signal acquisition, Representation and Modeling, Enhancement of audio signals: Spectral Subtraction, Weiner based filtering, Neural nets.

UNIT 4: Adaptive Filtering:
Concept of adaptive filtering, Method of Steepest descent, LMS adaptive filters: Structure and operation of LMS algorithm, Statistical LMS theory, Other LMS based algorithms, RLS algorithm.

UNIT 5: Introduction to Wavelets:
Piecewise constant approximation - the Haar wavelet, Building up the concept of dyadic Multiresolution Analysis (MRA), Relating dyadic MRA to filter banks, review of discrete signal processing, Elements of multirate systems and two-band filter bank design for dyadic wavelets, The Uncertainty Principle and its implications: the problem and the challenge that Nature imposes, The importance of the Gaussian function.
ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Simon Haykin, Adaptive Filter Theory, Fourth Edition, Pearson Education India, 2002.
2. Vikram Gadre and Aditya Abhyankar, Multiresolution and Multirate Signal Processing: Introduction, Principles and Applications, McGraw Hill Education; First edition, July 2017.
3. Sen, Soumya, Dutta, Anjan, Dey, Nilanjan, Audio Processing and Speech Recognition,1st edition, 2019, Springer.
4. D.G.Manolakis and V.K.Ingle Applied Digital Signal Processing: Theory and Practice,

Cambridge   University Press, 2011.

<u>REFERENCES BOOKS RECOMMENDED</u>:

1. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
2. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
3. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
4. Gold, B.; Morgan, N.; Ellis, D. Speech and audio signal processing: processing and perception of speech and music. 2nd rev. ed. Wiley-Blackwell, 2011.

BM 45… : DIGITAL IMAGE PROCESSING

COURSE OUTCOMES:
1: Study of fundamentals of image processing and image perception.
2: Introduction to image enhancement spatial domain techniques.
3: Introduction to image restoration: noise degradation model.
4: Introduction to different image transforms.
5: Concepts of image analysis, feature extraction etc.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit. 1 Fundamentals of Image Processing and Image Perception
Two-dimensional systems - linear systems and shift invariance. Fourier transform - Z - transform - Block matrices, Toeplitz and Kronecker product. Luminance, brightness and contrast. Color representation, color matching and reproduction, color vision model. Image sampling and quantization. Two dimensional sampling theory, reconstructions of images from its samples. Image acquisition.

Unit. 2 Image Enhancement Spatial Domain Techniques
Image negative, contrast stretching, gray level and bit plane slicing, power law transformation, histogram equalization and histogram specification, local enhancement techniques, image subtraction, averaging and logical operations. Spatial filtering: low pass, high pass and derivative filters, median filtering. Frequency domain filters: low pass, high pass and butterworth filters.

Unit. 3 Image Restoration
Noise degradation model, estimation of degradation model. Restoration in presence of noise- spatial filtering, frequency domain filtering, inverse filter and least mean square error(wiener) filtering.

Unit. 4 Image Transforms
2-D FFT and its properties. Walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, Slant transform, K L transform

Unit. 5 Image Analysis Feature extraction, spatial features, amplitude and histogram features, transform features, edge detection: gradient, Compass Laplace, Sobel, Prewitt operators, stochastic gradients. Line and spot detection. Boundary extraction: connectivity and contour following.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:
1. Gonzalez Rafel C, Wintz Paul , *Digital Image Processing*, Addison Wesley, 1987.
2. Jain Anil K,*Fundamentals of Digital Image Processing* , Prentice Hall, 1996.
3. B. Chanda, D. Majumder,*Digital Image Processing and Analysis*, PHI, 2011.

REFERENCE BOOKS RECOMMENDED:
1. Pratt William K *, Digital Image Processing*, John Wiley and Sons, 2006

IP45010 : INDUSTRIAL ENGINEERING AND MANAGEMENT

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

PRE- REQUISITE: NIL

COURSE OBJECTIVES:

This course aims to develop the productivity improvement skills among students with theapplications of methods and tools of Industrial Engineering and Management.

COURSE OUTCOMES:

CO-1: To understand and apply the concepts of work study for productivity

improvement.CO-2: To comprehend the basic fundamentals of management and

organization.

CO-3: To grasp and apply the concepts of personnel management and identify the problemsassociated with human resource.

CO-4: To identify and solve the problems related to quality management and apply thequantitative decision making in managerial decision making.

COURSE CONTENTS:

Theory:

Unit-1. Productivity, Method Study- Fundamentals, Procedure, Principles of Motion Economyand Therbligs. Work Measurement techniques, Time Study- Fundamentals, Procedure,Equipments, Rating, Allowances and Time standards.

Unit-2. Principles and Functions of Management, Organization- Principles, Types and Structures, Formal and Informal Organization, Span of Control, Delegation, Centralization and Decentralization.

Unit-3. Personnel Management Functions, Communication, Motivation and Leadership Theories, Recruitment, Selection, Training, Performance appraisal, Job Evaluation, and Wage Incentive Schemes.

Unit-4. Quality Control, Economics of Quality Control, Quality Assurance and TQM Fundamentals, Process Capability Studies, Control Charts for Variables and

Attributes, Acceptance Sampling Plans and Economics of Acceptance Sampling.

Unit-5. Quantitative Techniques for Decision Making: Introduction to Operations Research, Models, Linear Programming, Transportation and Assignment Models and Applications,Network Techniques and applications.

COURSE ASSESSMENT: Students will be assessed as following:

Theory paper:
(1) End Semester Exam: 70% weightage,
(2) Continuous assessment: 30% weightage (Two midterm tests: 67% weightage,assignment: 16.5% weightage, regularity 16.5% weightage)

Books & References Recommended :

1. Mahajan M.Industrial Engg. and Production Management, Dhanpat Rai, New Delhi.
2. International Labour Organisation (I. L.O.), Work Study, Geneva.
3. Terry and Franklin, Principles of Management, Irwin.
4. Barnes R.M., Time and Motion Study, Wiley, New York.
5. Grant E.L., Statistical Quality Control. McGraw-Hill, New York.
6. Vohra ND, Quantitative Techniques in Management, TMH, New Delhi.

EE 45203/4503: INDUSTRIAL AND POWER ELECTRONICS

PREREQUISITE: Basic and Analog Electronics, Basic Electrical Engineering
COURSE OUTCOMES:-
At the end of this course students will demonstrate the ability to:

1. To provide students a deep insight in to the operational behaviour of practical power switching devices with respect to their static and dynamic characteristics
2. To learn the working principle of classified topologies of Thyristor based AC/DC, AC/AC, DC/DC and DC/AC converters.
3. To design and analyze the operation of above converters considering their applications.
4. To understand design of firing circuits for Thyristor based line commutated converters.

Hours/ Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Static power devices: Thyristor family, two transistor analogy of SCR, construction, characteristics, parameters, turn on and turn off methods, firing circuits, isolation and amplifier circuits, synchronization circuits.

Unit 2. Converters: AC to DC converters, single phase rectifier circuits with different load, various quadrant operation, basic principle and power circuits of dual converter and cyclo converter.

Unit 3. DC to DC converter: Basic principle of chopper circuits, various chopper circuits and their working, step up chopper, performance analysis.

Unit 4. Inverters: CSI and VSI inverters, single phase inverters, principle of operation, voltage and frequency control techniques.

Unit 5. Industrial Application of Power Electronics, SMPS, UPS, AC and DC drives, Power Supplies.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments

1. Verification of steady state characteristics of different static switches.
2. Phase control of TRIAC using DIAC and RC circuit in light dimming circuit.
3. Firing pulse generation using UJT based relaxation oscillator.
4. Firing pulse generation for SCR using TCA 785 IC.
5. Performance evaluation of single phase uncontrolled converter for R, RL load.
6. Performance evaluation of single phase controlled converter for R, RL load.
7. Performance Analysis of step down chopper
8. Performance evaluation of current commutation circuit for SCR
9. Performance evaluation of voltage commutation circuit for SCR.
10. Effect of duty cycle on the output voltage of buck-boost converter.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Semiconductor Power Electronics, C.M. Pauddar, Jain Brothers
2. Power Electronics, M.H. Rashid, Pearson Education Limited
3. Power Electronics, Ned Mohan, John Wiley & Sons Inc Sea Pvt. Ltd.

REFERENCE BOOKS RECOMMENDED:-

1. Power Electronics, P.C. Sen, Tata Mcgraw Hill Publishing Co Ltd

EC45--: INFORMATION THEORY AN CODING

COURSE OUTCOMES:
1. Design efficient source code for discrete memory less source and source with memory.
2. Calculate the channel capacities of discrete and continuous channel and understand trade off using Shannon's theorem.
3. Construct Galois field and describe their properties.
4. Construct binary and non-binary codes for error detection and correction in transmitted data and investigate their performance.

Hours Per Week			Theory	Practical	Maximum Marks				
L	T	P	Credit	Credit	TH	CW	SW	Pr	Total
3	0	0	3	0	70	30	0	0	100

Theory :
1. **Information theory and Source coding:** Uncertainty, information, entropy and its properties, entropy of binary memoryless source and its extension to discrete memoryless source, source coding theorem, data compression, prefix coding, Huffman coding, Lempel-Ziv coding, Source with memory and its entropy.

2. **Discrete channels:** Binary Symmetric Channel, mutual information & its properties, Channel capacity, channel coding theorem and its application to BSC, Shannon's theorem on channel capacity, capacity of a channel of infinite bandwidth, bandwidth - S/N trade off, practical communication systems in light of Shannon's theorem, Fading channel, channels with memory.

3. **Groups, fields and Linear block codes:** Galois field and its construction in GF (2m) and its basic properties, vector spaces and matrices in GF(2), Linear block codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, probability of undetected error for linear block code in BSC, Hamming code and their applications.

4. **Cyclic codes and Introduction to RS codes:** Basic properties of Cyclic codes, Generator and parity check matrix of cyclic codes, encoding and decoding circuits, syndrome computation and error detection, cyclic Hamming codes, encoding and decoding of RS codes, error location and correction.

5. **Convolutional codes:** Introduction to convolution code, its construction and Viterbi algorithm for maximum likelihood decoding. Automatic repeat request strategies and their throughput efficiency considerations.

Text Books Recommended :
1. Lathi B. P., *Modern Analog and Digital Communication Systems*, Oxford Univ. Press
2. Shu Lin and Costello, *Error Control Coding : Theory and Application*, PH.
3. Sklar, *Digital Communication*, Pearson Education Asia.

Reference Books Recommended :
1. Haykins Simon, *Digital Communication,* Wiley Publ.
2. Proakis, *Digital Communication*, McGraw Hill
3. *Schaum's Outline Series, Analog and Digital Communication.*

EC45602: OPTICAL NETWORKS

PRE-REQUISITES:- Computer networks, Optical Communication.
COURSE OUTCOME:-
Students should be able to:
1. Discuss the second generation of Digital transport network (SONET/SDH).
2. Analyze the architecture of Optical Transport Network.
3. Understand the architecture and operation of WDM Network.
4. Design of optical network consisting of routers.
5. Investigate various optical access networks.

Hours Per Week			Theory	Practical	Maximum Marks				
L	T	P	Credit	Credit	TH	CW	SW	Pr	Total
3	0	0	3	0	70	30	0	0	100

Unit 1: SONET/SDH: Review of SONET/SDH, Frame structure, Functional Components, SONET Problem Detection.

Unit 2: Optical Transport Network: Architecture**,** Current Digital Transport Hierarchy, New Optical transport and Digital Transport Hierarchy, The OTN Layered Model, Generic Framing Procedure (GFP)

Unit 3: WDM networks: Operation, Dense Wave Division Multiplexing (DWDM), Elements of WDM networks, Amplifiers, WADM Input and Output Ports, WDM Cross-connects

Unit 4: Optical Routers: Switching in Optical Internets, Optical Switching Technologies, An Optical Router, Micro Electro Mechanical Systems (MEMS), Optical cross connects

Unit 5: Optical access networks: Architecture, Hybrid fiber coax (HFC), Enhanced HFC, Passive optical networks; Optical burst switching, Optical CDMA: Basic concept and applications.

Text Books:
1. Ramaswami and Sivrajan, *Optical Networks: A Practical Perspective*, Pearson.
2. Uyless Black, *Optical Networks and 3rd Genration Transport Systems*, Pearson
3. Senior J.M., *Optical Fibre Communications: Principles & Practice*, PHI.

References Books:

1. Biswanath Mukherjee **,** *Springer Handbook of Optical Networks***,** Springer

EC 45759: SATELLITE AND RADAR COMMUNICATION SYSTEMS

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:

1. Describe the motion of a satellite in orbit and its mechanism, and apply the concept of communication systems into the satellite communication system.
2. Demonstrate the design strategies for the satellite link budget, and compare the multiple access techniques.
3. Illustrate the concept of GPS and discuss various satellite applications.
4. Implement techniques of design of small satellites and explain the working concept of satellite launch vehicles and their classification.
5. Discuss the working concept of RADAR systems with their applications.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Theory :

 Unit 1. Basics of Satellite Subsystems: Geo-stationary and other Satellite orbits and its location from earth, Satellite Communication Subsystems, Transponders.
 Unit 2. Satellite Channel and link design: Major Frequency allocation, Design of Downlink & Uplink, Earth Station, Multiple access Techniques including DAMA, SCPC.
 Unit 3. Satellite Navigation & Global Positioning Systems: Introduction to GPS Positioning principles, GPS receivers and codes, Satellite Signal Acquisition, GPS Signal Level & timing accuracy, differential GPS, VSAT.
 Unit 4. **Design of small satellites:** Small satellite power budget, applications of small satellites, small satellite bus, power subsystems, structural subsystems, satellite launch vehicle."
 Unit 5. Radar Systems: Historical review of Radar, Range equation and its analysis, Different Display Systems like PPI, E- Scope etc. CW & FM Radar: MTI and Pulse-Doppler radar, Radar Scanning & tracking, Application of Radar such as Navigation Systems etc, and their applications.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:
1. Timothy Pratt & Charles Bostain, Satellite Communication, 2nd ed. 2001, Wiley.
2. I.J.Bahal and P. Bhatia, Micro strip Antenna, 3rd ed. 2004, New ed, Artech house Inc.
3. Tapan & Sarkar, Smart Antenna. IEEE Press/ CRC Press. 4th ed. 2003.

REFERENCE BOOKS RECOMMENDED :
1. Manual of Satellite Communication, 3rd ed.,2008,Tata McGraw Hill.
2. M.I. Skolnik, Introduction to Radar System,3rd ed.,2001,TMH.
3. D. Roddy, Satellite Communication, 4th ed.2001

EC45… : GAME THEORY IN WIRELESS COMMUNICATION

COURSE OUTCOMES:

At the end of this course students will demonstrate the ability to:
1. To Introduce different concepts of game theory
2. To understand application of Game theory in engineering.
3. To have necessary background of Game theory to design wireless systems.
4. To study various Games and to identify their suitability in wireless comm.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Introduction to game theory. Prisoner's dilemma, Nash Equilibrium, Co-operative and Non co-operative games, zero-sum & nonzero-sum games. Types of strategies, Saddle point (Equilibrium) point, rules of determining a saddle point. Optimal strategies.

UNIT 2: Non-cooperative Game Theory, Game in Normal form, Analysing Games: Pareto optimality, Maxmin and Minmax strategies.

UNIT 3: Stochastic games, Bayesian games, Computing equilibria,concept of Shapely value

UNIT 4: Coalition Game Theory and algorithmic game theory, basic concepts and analysis. Transferable Utility, Analyzing Coalitional Games.

UNIT 5: Aplication in Wireless Networks: Resource Allocations, Routing in Sensor and Ad-Hoc Networks ,CDMA Power Control , Radio Spectrum Arbitrary Distribution.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOK RECOMMENDED :

 1. Zhu Han, Game Theory in Wireless and Communication Networks: Theory, Models, and Applications,1edition.

EC-45-- : INTRODUCTION TO CRYPTOGRAPHY

COURSE OUTCOMES:
At the end of this course students will demonstrate the ability to:
1. To understand the need of information security and classification of possible security attacks
2. To conceptualize basic network security model, associated transformation and related terminology.
3. Design of symmetric key systems for data confidentiality and their comparison
4. Design of an asymmetric key system, its application in digital signature and comparison with symmetric key systems
5. Various practical applications of cryptographic techniques for data security

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1: Need for information security, possible security violations (attacks) and their classification, Basic principles of cryptography, Typical mechanisms, network security model and associated terminology.

UNIT 2: Kerckhoff principle of network security, Classification of transformation techniques, Substitution techniques (Caeser, mono-alphabetic, poly-alphabetic, Playfair), transposition techniques (railfence, multiple stages), their comparison on the basis of cryptanalysis, introduction to product cipher.

UNIT 3: Asymmetric key system and its features, RSA algorithm, applications of asymmetric key system, elements of key generation and its management, comparison of asymmetric and symmetric key system.

UNIT 4: Digital signature as data authentication, digital envelope, hash functions and their properties, Secure Hash Function (SHA), Message Digest (MD5) and their comparison.

UNIT 5: Modes of operations (Electronic code book and counter mode) and their applications, security options in social media sites (whatsapp, gmail) and their signifance, IT act section 43 of India, Introduction to General Data Protection Regulations (GDPR), block chain and PGP.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:
1. Kahate A., "Cryptography and network security", Tata MGH publ., second ed.
2. Stallings W., "Cryptography and network security:, Pearson edu. Publ., Second ed.
3. Bose R., "Information theory, coding and cryptography", Tata MGH publ., second ed.

REFERENCE BOOKS RECOMMENDED:
1. Simon Singh, "The code book", Ted Smart Publ.
2. Kaufman C. And Perlman R., "Network security", Pearson Edu. Publ.
3. Zimmerman P., "An introduction to cryptography", PGP corporation
4. Various URLs including www.[iacr.org (International Organization of Cryptographic Research), pgpi.org., nist.org/aes, epic.org, crypto.org, privacy.org, prism-break.org, certin.org, multi factor/two-step authentication/verification]

EC45 -------: Advanced Mobile Communications

Course Outcomes:
At the end of this course students will demonstrate the ability to
1. Understand the currently used cellular technology 3G/4G
2. Evaluate the use of advanced techniques in cellular communications.
3. Perform computations and solve numerical problems while using different transmission technologies.
4. Assess how softwarization of network functions helps in scalability and ease of operations.
5. Learn basics of 6G technology and spectrum related issues.

Hours/Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Course Contents:
Unit 1: Mobile Communications Overview: Reviews of 3G Technology, 3G services and data rates, 4G Technology, LTE, LTE Advanced Pro (3GPP Release 13+), VoLTE, OFDM, MIMO, IMT standards- IMT-2000, IMT-2020 and IMT Advanced.
Unit 2: Introduction to 5G Communication: Overview of Massive MIMO and beam forming, millimeter Wave communication, 5G potential and applications, enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D and V2X communications.
Unit 3: Spectrum and connectivity issues: 5G-spectrum access/sharing, channels and signals/waveforms in 5G, carrier aggregation, small cells, large cells, low mobility large cells (LMLC), dual connectivity. Connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV.
Unit 4: 5G Network: New Radio (NR) and its Standalone and non-standalone mode, NOMA, PHY API Specification, restful API, flexible frame structure, Service Data Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC), SDN, NFV, Network slicing.
Unit 5: Current state and Challenges: 5G penetration in developed countries; deployment challengesin low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, Introduction to 6G technology.

Text and References Books:

1. Mobile communication design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.
2. 5G NR: The Next Generation Wireless Access Technology Mobile Communications Design, Erik Dahlman, Stefan Parkvall, Johan Skold 1st Edition,, 2018
3. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson

Reference Books –
1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson.
2. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGrawHill Education

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