SECOND YEAR
THIRD SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
*1.	MA 231	ENGINEERING MATHEMATICS –III	3	1	0	70	30	-	100	3.5
*2.	HU 231	ECONOMICS FOR ENGINEERS	2	0	0	35	15	-	50	2.0
*3.	ME 231	ENGINEERING MECHANICS	3	1	0	70	30	-	100	3.5
*4.	CS 231	PROGRAMMING AND DATA STRUCTURES	3	0	0	70	30	-	100	3.0
5.	EC 231	NETWORK THEORY	3	0	0	70	30	-	100	3.0
6.	EC 232	SEMICONDUCTOR DEVICES AND CIRCUITS	3	1	0	70	30	-	100	3.5
		SUB-TOTAL							550	18.5
		PRACTICAL/DESIGN								
7.	ME 231P	ENGINEERING GRAPHICS	1	0	3	-	30	70	100	2.5
8.	CS 231 P	PROGRAMMING AND DATA STRUCTURES LAB	0	0	3	-	30	70	100	1.5
9.	EC 232P	SEMICONDUCTOR DEVICES AND CIRCUITS LAB.	0	0	3	-	15	35	50	1.5
		SUB-TOTAL							250	5.5
		TOTAL	**18**	**3**	**9**				**800**	**24.0**
10.	***NC 231***	***TECHNICAL ENGLISH***	***2***	***0***	***1***	***-***	***35****	***15****	***-***	***0.0***
11.	***NC 232***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50****	***-***	***0.0***

MA 231 ENGINEERING MATHEMATICS - III

L T P C
3 1 0 3.5 Full Marks: 100 (70+30)

Fourier Series:
Derichlet's condition-General Fourier series- odd and even functions, Half range-sine and cosine series-complex form of Fourier series, Practical Harmonic analysis.

Fourier Transforms:
Statement of Fourier integral theorem, Fourier transforms pairs, Fourier sine and cosine transforms, properties, transform of simple functions, convolution theorems, Parsevel's identity.

Boundary Value Problems:
Classification of second order quasi linear partial differential equations-solution of one dimensional wave equation, one dimensional heat equation-steady state solution of two dimensional heat equation(insulated edges exclude)-Solution by separation of variables.

Solution in Series:
Series solution of second order differential equations, Bessel's and Legendre's equations- their series solutions, elementary of properties of Bessel functions and Legendre polynomials-recurrence relations-generating functions-orthogonality conditions

Complex Variables:
Analytic functions-properties, Cauchy-Rieman equations, construction of analytic fuction, determination of conjugate harmonic, application to two dimensional potential problems; Conformal transformations- $w=z+a$, $w=az$, $w=1/z$ and Bilinear Transformation. Cauchy's Integral theorem and Cauchy's integral formula (statement only), Taylor's and Laurent's expansions, isolated singularities, residues-Cauchy's residues theorem (statement only), contour integration-over unit circle and semi-circle(excluding poles on real axis).

Suggested Text Books & References:

1. R.V. Churchill, "Fourier Series and Boundary Value Problems", McGraw Hill,
2. I.N. Sneddon, "Fourier Transforms" McGraw Hill, 1951.
3. Churchill, Brown and Verhy, "Complex Variables and Applications", McGraw Hill,
4. B. S. Grewal, Higher Engineering Mathematics, Khanna Plublication, 41st Edn., New Delhi.

***HU 231 ECONOMICS FOR ENGINEERS**

L	T	P	C	
2	0	0	2	**Full Marks: 50 (35 + 15)**

Economics:
Meaning, Definition, Scope: Micro and Macro, Assumptions and Methods. Usefulness

Market demand and cost concepts:
Economic reasoning, Circular Flow in an economy, Law of supply and demand, Economic efficiency, Element of costs, Marginal cost, Marginal

Revenue, Sunk cost, Private and Social cost, Opportunity cost, Functions of Money and commercial Banking.

Inflation and deflation:
Concepts and regulatory measures, Economic Policy Reforms in India since 1991: Industrial policy, Foreign Trade policy, Monetary and fiscal policy, Impact on industry.

Accounting:
Book keeping single and double entry system, Journal and ledger, Preparation of Trial Balance, Trading account, Profit and loss account, Balance sheet(with simple adjustments).

Suggested Text Books & References:
1. Modern Economic Theory, by K.K. Dewett.
2. Introduction to Accountancy, by T.S. Grewal.
3. Panneer Selvam, R, Engineering economics, Prentice Hall of India, New Delhi.
4. Wheeler R (Ed) Engineering economic analysis, Oxford University Press.
5. A Text Book of Economic Theory : Stonier and Hauge.
6. Engineering Economics: Degramo.
7. International Economics: Bo Sodersten
8. Principles of Macroeconomics : Rangarajan and Dholakia.
9. Monetary Economics : Suraj B. Gupta
10. Cost Accounting : Jawahar Lal
11. Project Planning Analysis, Selection Implementation and Review: Prasanna Chandra

ME 231 ENGINEERING MECHANICS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70 + 30)**

System of Forces:
Introduction to mechanics, laws of mechanics, concept of a force, system of forces, resultant and equilibrium of system of coplanar concurrent forces , resultant and equilibrium of system of coplanar non- concurrent forces.

Friction:
Frictional force, types of friction, laws of friction, coefficient of friction, angle of friction, angle of repose, cone friction, impending motion of connected bodies, wedge, screw jack and rope friction.

Centroid & Area Moment of Inertia:
Centroid, Centre of gravity, Centroid of simple figures and composite sections. Area moment of inertia, polar moment of inertia, radius of gyration, theorems of moment of inertia, moment of inertia of standard figures and moment of inertia of composite sections.

Centre of Gravity & Mass Moment of Inertia:
Centre of gravity from first principles, centre of gravity of composite bodies and theorem of Pappus- Guldinus. Definitions, Mass moment of inertia from first principles, transfer formula and mass moment of inertia of composite bodies.

Kinematics:
Introduction to Dynamics, Linear motion- motion with uniform velocity and uniform acceleration, Acceleration due to gravity, motion with varying acceleration. Curvilinear motion- motion of body associated with horizontal projection and inclined projection.

Kinetics:
Introduction, laws of motion, rectilinear motion of a particle, D'Alembert's Principle, Work- Energy Principle- work energy equation for translation, motion of connected bodies.

Suggested Text Books & References:
1. Engineering Mechanics, S. S. Bhavikattis, New Age International Pvt. Ltd.
2. Engineering Mechanics, K.L. Kumar, Harper & Row Publishers, New Delhi.
3. Engineering Mechanics, R. K. Rajput, DhanpatRai Publications, New Delhi.
4. Engineering Mechanics, A. Nelson, Tata McGraw Hill Education Pvt. Ltd.
5. Engineering Mechanics, R. K. Bansal and Sanjay Bansal.
6. Engineering Mechanics, Ferdin and L. Singer
7. Engineering Mechanics, A.K. Tayal
8. Engineering Mechanics, Irving H. Shames, Printice Hall of India Pvt. Ltd.
9. Engineering Mechanics, S. Timoshenko, D.H. Young & J. V. Rao – Tata McGraw Hill

***CS 231 PROGRAMMING AND DATA STRUCTURES**

L	T	P	C	
3	0	0	3	**Full Marks: 100 (70 + 30)**

Introduction to Algorithms

Algorithm Development, Complexity analysis, Asymptotic Notations-Big-O,big-Theta, Big-Omega, little-o etc- Recursion and examples

Linear Data Structures

Stacks-Operations and Applications, Queues-Operations and Applications, Circular Queues-Operations and Applications, Links Lists-Operation – Creations, insertion, Deletion, Circular Lists, Doubly Linked List, stacks, queues-implementations and applications- Sorting- Bubble sort- Insertion sort-Gnome sort-Selection sort-Stooge sort-Merge sort-Heapsort-Quicksort-Radix sort

TREE STRUCTURES

Tree – tree traversals –Binary Tree – expression trees – applications of trees – binary search tree – AVL trees – binary heaps

HASHING AND SETS

Hashing – hashing functions- Separate chaining – open addressing – rehashing – extendible hashing – Sets-Representation -Operations -Union and Find.

GRAPHS

Definitions – Representations- breadth-first traversal – shortest-path algorithms – minimum spanning tree – Prim's and Kruskal's algorithms – Depth-first traversal – applications of graphs

Suggested Text Books & References:

1. Seymour Lipschutz, Data Structures (Schaum Series.) McGraw Hill.
2. Seymour Lipschutz, Data Structures With C (Schaum Series) 1st Edition 2010, McGraw Hill Education (India) Private Limited.
3. Horowitz, Sahni, Anderson-Freed, Fundamentals Of Data Structures In C,2nd Edition 2008, Orient Longman.

EC 231 Network Theory

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Basic Concepts:
Practical sources, Source transformations, Network reduction using Star-Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.

Network Topology:
Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set and cut-set schedules, Formulation of equilibrium equations in matrix form, Solution of resistive networks, Principle of duality**.**

Network Theorems:
Superposition, Reciprocity and Millman's theorems, Thevinin's and Norton's theorems; Maximum Power transfer theorem.

Resonant Circuits:
Series and parallel resonance, frequency response of series and Parallel circuits, Q factor, Bandwidth.

Transient analysis:
Review of Laplace transform & its properties, Laplace transform of important signal waveforms Periodic functions- Initial value and final value Theorems behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuits for AC and DC excitations.

Two port network :
Definition of z, y, h and transmission parameters, modelling with these parameters, relationship between parameters sets.

Network Synthesis :
Realizability concept – Hurwitz property – positive realness – properties of positive real function – Synthesis of R, L, RC and LC driving point functions – Foster and Cauer forms.

Suggested Text Books & References:

1. Network Analysis M.E Van Valkenburg, PHI
2. Circuits and Networks Analysis & synthesis A. Sudhakar & S P Shyam Mohan
3. Network and Systems D Roy Chaudhury
4. Circuit theory (Analysis & Synthesis) A. Chakrabati, Dhanpat Rai & Co, 6th edition
5. Network Analysis and Synthesis Franklin F Kuo John Wiley & Sons
6. Engineering Circuit Analysis W H Hayt & Jack Kennerly McGraw Hill
7. Basic Engineering Circuit Analysis-J. David Irwin R. Mark Nelms, John Wiley, 8th Ed, 2006.
8. Fundamentals of Electric Circuits- Charles K Alexander and Mathew N O Sadiku, Tata McGraw Hill, 3rd Ed,

EC 232 Semiconductor Devices and Circuits

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Semiconductor physics:

Review of Band Theory of solids, intrinsic semiconductors, Generation and Recombination of electrons and holes. Thermal equilibrium, Doped semiconductors n and p types, Fermi level and carrier concentrations of n and p type semiconductors. Carrier mobility and conductivity, diffusion, Continuity equation, Hall Effect and its applications.

Semiconductor Diodes:

Open circuited p-n junction, charge distribution, electrostatic potential, contact potential, potential barrier, biasing, VI characteristics, temperature dependence of VI characteristics, piece-wise linear diode model, small signal model, minority carrier concentrations and law of the junction, quantitative theory of p-n junction diode, Current equations, Depletion and diffusion capacitances, switching characteristics, SPICE model, Breakdown mechanisms, Zener diode, the principles of Photo diode, LED, Varactor diode and Tunnel diode.

Applications of Diodes:

Rectifiers with and without filters, Clipping and clamping circuits, voltage multiplier circuits, Zener diode voltage regulator.

Bipolar Junction Transistor (BJT):
Physical structure, modes of operation, transistor current components, transistor as an amplifier, the Ebers-Moll model, VI characteristics, CE cut-off and saturation regions, typical junction voltage values, transistor as a switch. SPICE model of BJT, phototransistor.

The Field Effect Transistors:
Structure, operation, volt-ampere characteristics, small signal models of JFET and MOSFET, MOS capacitor CV and concept of accumulation, depletion and inversion, SPICE model of MOSFET; Structures and volt-ampere characteristics of UJT and SCR.

Transistor Biasing and Thermal Stabilization:
AC and DC load lines, The Operating point, Bias stability, Self bias, stabilization, bias compensation, thermal runaway thermal stability. JFET and MOSFET biasing.

Small Signal Low Frequency Transistor Amplifier Circuits:
Transistor hybrid and r_e models, Analysis of transistor amplifier circuits using 'h' and r_e parameters, Conversion formulae for the parameters of the three configurations, Analysis of single stage transistor amplifier circuits, simplified CE hybrid model, Single stage RC coupled amplifier, Effects of bypass and coupling capacitors, Emitter follower amplifier. JFET and MOSFET amplifiers.

Suggested Text Books & References:

1. J. Millman and Halkias, Integrated Electronics, TMH, 2nd Edition, 2010.
2. Y.N. Bapat, Electronic devices and circuits, Discrete and Integrated, 3rd Edition, Tata McGraw Hill, 2011.
3. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, 1997.
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International, 1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. B. Kumar and S B Jain, Electronics Devices and Circuits, PHI

PRACTICAL / DESIGN

***ME 231P ENGINEERING GRAPHICS**

L	T	P	C	
1	0	3	2.5	**Full Marks: 100 (70 + 30)**

Fundamentals, Engineering Curves and Scale:

A) Fundamentals of Engineering Graphics: Introduction to Drawing instruments and their uses. Layout of drawing sheets, different types of lines used in drawing practice, dimensioning system as per BIS.

B) Engineering curves: Construction of regular polygons (up to hexagon). Construction of ellipse, parabola and hyperbola.

C) Scales: Scale and representative fraction, construction and reading of plain and diagonal scales.

Projections of lines & Planes:

Introduction to first angle and third angle methods of projection.

A) Projections of straight lines: perpendicular to one plane and parallel to the other, parallel to both the planes, parallel to one plane and inclined to the other, inclined to both the planes.

B) Projections of planes: perpendicular to one plane and parallel to the other, perpendicular to both the planes, one plane and inclined to the other, inclined to both the planes.

Orthographic Projections of solids:

Projections of Prisms, Pyramids, Cylinder and Cones in simple position, axis perpendicular to one plane and parallel to the other, axis parallel to both planes, parallel to the to one plane & inclined to one plane (Excluding frustum and sphere).

Sections of solids & Development of surfaces:

A) Sections of solids: Prisms, Pyramids, Cylinders and Cones (Simple positions and inclined to one plane and parallel to other).

B) Development of plane and curved surfaces: Prisms, Pyramids, Cylinders and Cones along with cutting planes.

Isometric projections:

Isometric projections: Introduction to isometric, Isometric scale, Isometric projections and Isometric views of planes and solids – prisms, cones, pyramids and spheres.

Note: The above syllabus is to be covered in first angle method of projection.

Suggested Text Books & References:

1. Engineering Drawing and Graphics by K. Venugopal, New Age Publication.
2. Engineering Drawing by N. D. Bhatt, Charotor Publication House, Mumbai.
3. Fundamentals of Engineering by W. J. Luzadder, Drawing, Prentice Hall of India.
4. Graphic Science by French and Vierck, McGraw Hill International.
5. A text book of Engineering Drawing by R. K. Dhawan, S. Chand and Co.
6. Engineering Drawing by N. B. Shaha and B. C. Rana, Pearson Education.
7. Engineering Drawing and Graphics Using AutoCAD by T. Jeyapoovan, Vikas Publication.
8. Engineering Drawing by K.L. Narayana, P. Kannaya & K. Venkata Reddy.

*CS 231P PROGRAMMING AND DATA STRUCTURES LAB.

L	T	P	C	
0	0	3	1.5	**Full Marks: 100 (70 + 30)**

Based on CS231: Programming and Data Structure.

EC 232P Semiconductor Devices and Circuits Laboratory

L	T	P	C	
0	0	3	1.5	**Full Marks: 50(35+15)**

LIST OF EXPERIMENTS

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs).
2. Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;
3. Study and Operation of Analog and Digital Multi Meter, Function/Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; DSO
4. Soldering practice
5. V-I Characteristics of Si and Ge Diodes
5. Zener Diode Characteristics and Zener Diode as Voltage Regulator
6. Half Wave and Full Wave Rectifiers with Filters
7. BJT Characteristics
9. FET Characteristics
10. BJT Biasing
11. FET Biasing
12. BJT CE Amplifier

NC 231 TECHNICAL ENGLISH

L	T	P	C	
2	0	1	0	**Full Marks: 50 (Non Credit)**

Style and organization in technical communication:
Listening, speaking, reading and writing as skills; Objectivity, clarity, precision as defining features of technical communication; Various types of business writing: Letters, reports, notes, memos; Language and format of various types of business letters; Language and style of reports; Report writing strategies; Analysis of a sample report.

Oral Presentation and professional speaking:
Basics of English pronunciation; Elements of effective presentation; Body Language and use of voice during presentation; Connecting with the audience during presentation; Projecting a positive image while speaking; Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Basics of public speaking; Preparing for a speech.

Career Oriental Communication:
covering, Resume and bio-data: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process; How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Group Discussion: structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion;

Language Practice:
Emphasizing Listening and comprehension skills; Reading Skills; Sound Structure of English and intonation patterns; training in speaking skills covering oral presentations.

Suggested Text Books & References:

1. Fred Luthans, Organizational Behaviour, McGraw Hill
2. Lesikar and petit, Report writing for Business
3. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill
4. Wallace and masters, Personal Development for Life and Work, Thomson Learning
5. Hartman Lemay, Presentation Success, Thomson Learning
6. Malcolm Goodale, Professional Presentations
7. Farhathullah, T. M. Communication skills for Technical Students
8. Michael Muckian, John Woods, The Business letters Handbook
9. Herta A. Murphy, Effective Business Communication

SECOND YEAR
FOURTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
***1.	MA 241	NUMERICAL METHODS AND COMPUTATION	3	1	0	70	30	-	100	3.5
2.	MA 242	PROBABILITY THEORYAND RANDOM PROCESS	3	1	0	70	30	-	100	3.5
3.	EC 241	DIGITAL ELECTRONICS	3	0	0	70	30	-	100	3.0
4.	EC 242	ANALOG ELECTRONICS - I	3	1	0	70	30	-	100	3.5
5.	EC 243	SIGNALS AND SYSTEMS	3	0	0	70	30	-	100	3.0
6.	EC 244	PRINCIPLES OF COMMUNICATION	3	1	0	70	30	-	100	3.5
		SUB-TOTAL				-	-	-	600	20
		PRACTICAL/DESIGN				-	-	-		
7.	EC 241P	DIGITAL ELECTRONICS LAB.	0	0	2	-	15	35	50	1.0
8.	EC 242P	ANALOG ELECTRONICS LAB -I	0	0	2	-	15	35	50	1.0
9.	EC 244P	COMMUNICATION LAB	0	0	2	-	15	35	50	1.0
10.	EC 245P	SIMULATION LAB.	0	0	2	-	15	35	50	1.0
		SUB-TOTAL				-			200	4.0
		TOTAL	**18**	**4**	**8**	**-**			**800**	**24.0**
11.	***NC 241***	***SOFT SKILL-I***	***3***	***0***	***0***	***-***	***50****	***-***	***-***	***0.0***
12.	***NC 242***	***PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50****	***-***	***0.0***

***MA 241 NUMERICAL METHODS AND COMPUTATION

L T P C

3 1 0 3.5 Full Marks: 100(70+30)

Computer Arithmetic and Errors:

Floating point representation, Concept of zero in floating point, Four fundamental arithmetic operations, consequences such as non-associativity of arithmetic, Pitfalls in computing , Pitfalls in computing, Errors representation- Inherent and truncation, Absolute, relative, general errors formulae.

Solution of Algebraic and Transcendental Equations:
Bisection, Regular-Falsi, Newton-Raphson and iterative methods, their convergence conditions, Generalisations of Newton-Raphson and iterative methods to simultaneous non-linear equations.

Solutions of Linear System of Equations:
Gaussian elimination method with partial pivoting, Factorization method, Matrix Inverse method, Gauss-Gacobi and Gaus-Siedel iterative methods, Method of Least square fit.

Solution of Differential Equations:
Picard's Taylor series, Euler's Modified Euler's, Runge-Kutta and Milne's methods, solution of two-point boundary value problems; Explicit and implicit schemes for one-dimensional parabolic equations, Finite difference method for elliptic and hyperbolic equations.

Eigen-Values and Eigen-Vectors:
Gershgorin's Theorem, Power method for dominant, sub-dominant and the smallest Eigen-values, Determination of Eigen-values and Eigen-vectors of symmetric and non-symmetric matrices with special reference to the methods of Jacobi and Givens algorithms.

Suggested Text Books & References:
1. Grewal B.S., "Numerical Methods", Khanna Pub., New Delhi
2. Shartry S.S., "Numerical Methods", Prentice Hall Inc., India
3. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", Addison Wesley,
4. J.H. Wilkinson, "Algebraic Eigen – Value Problems", Oxford Univ. Press
5. G.D. Smith, "Numerical Solution of Partial Differential Equations", Oxford Univ. Press

MA 242 PROBABILITY THEORY AND RANDOM PROCESS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Probability:
Sample spaces, events, probability axioms, joint probability, conditional probability, total probability, Baye's theorem, multiple events, properties of independent events.

Random of Variable:
Deffinition of random variable, function of random variables, discrete and continuous random variables, distribution and density functions, Binomial, Poisson, Uniform and Gaussian random variables, conditional distribution and density functions. Bivariate distribution, joint distribution and density, marginal distribution and density functions, conditional distribution and density, statistical independence, distribution and density of a sum and product of random variables.

Operation on one random variable:
Expected value of a random variable, conditional expected value, moments about a point, moment generating function, variance, skew ness and kurtosis, covariance, correlation and regression transformation of random variables.

Stochastic Random Processes:
Random process concept, classification of processes, special processes-Poisson process, wiener process, stationary and independence, distribution and density functions, statistical independence, first order stationary process, second order and wide sense stationary, time averages and ergodicity, correlation functions, covariance functions.

Spectral Characteristics of random process:
Power density, spectrum and its properties, bandwidth of power density of spectrum, relationship between power spectrum and autocorrelation function, cross power spectral density and its properties.

Suggested Text Books & References:
1. Probability, Random Variables and Stochastic Process, A Papoulis, McGraw Hill.
2. Probability Theory and Random Processes, S. P. Eugence Xavier, S Chand & Co.
3. Probability and Statistics, Murry Speigel, Mc Graw Hill.
4. Introductoin to Probability and Statistics, J. S. Milton, J. C. Arnold, Mc Graw Hill.
5. Probability and Random Processes, S. Palaniammal, Eastern Economy Edition, PHI Learning Pvt. New Delhi-110001

EC 241 DIGITAL ELECTRONICS

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Unit-1:

Introduction- Digital Systems; Data representation and coding; Logic circuits, integrated circuits; Analysis, design and implementation of digital systems; CAD tools. Number Systems and Codes- Positional number system; Binary, octal and hexadecimal number systems; Methods of base conversions; Binary, octal and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimalcodes; Gray codes; Error detection and correction codes - parity check codes and Hamming code.

Unit-2:

Combinatorial Logic Systems- Definition and specification; Truth table; Basic logic operation and logic gates. Boolean Algebra and Switching Functions- Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions - SOP and POS forms; Simplification of switching functions - K-map and Quine-McCluskey tabular methods; Synthesis of combinational logic circuits.

Unit-3:

Logic families-Introduction to different logic families; Operational characteristics of BJT in saturation and cut-off regions; Operational characteristics of MOSFET as switch; TTL inverter - circuit description and operation; CMOS inverter – circuit description and operation; Structure and operations of TTL and CMOS gates; Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. Combinational Logic Modules and their applications-Decoders, encoders, multiplexers, demultiplexers and their applications; Parity circuits and comparators; Arithmetic modules- adders, subtractors and ALU; Design examples.

Unit-4:

Sequential Logic systems- Definition of state machines, state machine as asequential controller; Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop; Timing hazards and races; Analysis of state machines using D flip-flops and JK flip-flops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples. State machine design approach-Designing state machine using ASM charts; Designing state machine using state diagram; Design examples.

Unit-5:
Sequential logic modules and their applications- Multi-bit latches and registers, counters, shift register, application examples.
Memory- Read-only memory, read/write memory – SRAM and DRAM. Programmable Logic Devices-PLAs, PALs and their applications; Sequential PLDs and their applications; State- machine design with sequential PLDs; Introduction to field programmable gate arrays (FPGAs).

Suggested Text Books & References:

1. J. F. Wakerly: Digital Design, Principles and Practices, 4th Edition, Pearson Education
2. Charles H Roth: Digital Systems Design using VHDL, Thomson Learning
3. H. Taub and D. Schilling, Digital Integrated Electronics, McGraw Hill
4. D.A. Hodges & H.G. Jackson, Analysis & Design of Digital Integrated Circuits, McGraw Hill
5. F.J. Hill and G.L. Peterson, Switching Theory and Logic Design, John Wiley
6. Z. Kohavi, Switching and Finite Automata Theory, McGraw Hill

EC 242 ANALOG ELECTRONICS - I

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

The Transistor at High Frequencies:
The hybrid- π common emitter model transistor model, hybrid- π conductances and capacitances, variations of hybrid- πparameters, CE short circuit current gain, current gain with resistive load, Single-stage CE transistor amplifiers, the gain-bandwidth product, emitter follower at high frequencies.

Multistage Amplifiers:
Classification of amplifiers, Distortion in amplifiers, Frequency response of an Amplifier, Bode plots, Step response of an amplifier, coupling methods in multistage amplifiers, Analysis of Multistage amplifier, Design of two stage amplifier, Common Source and Common Drain amplifier at high frequencies, Frequency response of cascaded stages, Cascode amplifiers, Darlington pair, The effect of coupling and bypass capacitors, Differential amplifiers, Analysis of Differential amplifiers.

Feedback Amplifiers:
Classification and representation of amplifiers, Feedback concept, and the transfer gain with feedback, General characteristics of negative feedback

amplifiers. Impedance in feedback amplifiers, Properties of feedback amplifier topologies, Approx. analysis of feedback amplifiers, Method of analysis of a feedback amplifier, Feedback amplifier topologies.

Stability and Oscillator:
Effect of feedback on bandwidth, Stability, Test of stability, Compensation, General method of compensation, Frequency response of feedback amplifier double pole transfer function, Phase Margin and gain Margin, Three pole transfer function with feedback amplifier response, approximate analysis of a multi-pole feedback amplifier. Sinusoidal oscillators, Barkhausen Criterion, Analysis and design of RC phase shift (FET/ BJT) oscillator, Wien bridge oscillators, Resonant circuit oscillators, General form of oscillator circuit (Hartley & Colpitts), Crystal oscillators.

Power Amplifier: Class A, B, AB, and C power amplifiers, push – pull and complementary symmetry push-pull amplifier. Design of heat sinks, power output, efficiency, crossover distortion and harmonic distortion.

Tuned Amplifier:
Design and analysis of single tuned amplifier circuit with a capacitor coupled load, Double tuned inter-stage design. Stability consideration, Class B and class C tuned power amplifiers.

Suggested Text Books & References:

1. J. Millman and Halkias, Integrated Electronics, TMH, 2nd Edition
2. J. Millman and A. Grabel, Micro Electronics, TMH, 2nd Edition
3. A. S. Sedra and K. C. Smith, Micro Electronic Circuits, Oxford press, 4th Edition, 4. Md. Gausi, Electronic circuits, John Wiley, 1st Edition.
4. Y.N. Bapat, Electronic devices and circuits, Discrete and Integrated, 3rd Edition, Tata
5. B.Kumar and S B Jain, Electronics Devices and Circuits, PHI

EC 243 SIGNAL AND SYSTEMS

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Introduction:
Definitions of a signal and a system, classification of signals - Continuous time signals (CT signals), discrete time signals (DT signals);Classification of CT and DT signals - periodic & aperiodic, random &deterministic signals, Even& Odd Signals, Energy & Power Signals; elementary signals- Step, Ramp, Pulse, Impulse, Exponential, sinusoidal; Basic Operations on signals- scaling, shifting, reflection; Systems viewed as Interconnections of operations Description of continuous time and discrete time systems, properties of systems.

Time-domain representations for LTI systems:
Convolution, impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.

Fourier representation for signals:
Introduction, Discrete time and continuous time Fourier series and their properties .Discrete and continuous Fourier transforms and their properties.

Applications of Fourier representations:
Introduction, Frequency response of LTI systems, Fourier transform representation of periodic signals, Fourier transform representation of discrete time signals. Sampling theorem and Nyquist rate, Aliasing.

Z-Transforms:
Introduction, Z – transform, properties of ROC, properties of Z – transforms, inversion of Z – transforms. Transform analysis of LTI Systems, unilateral Z-Transform and its application to solve difference equations.

Suggested Text Books & References:

1. Simon Haykin, “Signals and Systems”, John Wiley India Pvt. Ltd., 2nd Edn,
2. Michael Roberts, “Fundamentals of Signals & Systems”, 2nd Edn., Tata McGraw-Hill
3. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, “Signals and Systems” PearsonEducation Asia / PHI, 2nd Edition, 1997. Indian Reprint
4. H. P Hsu, R. Ranjan, “Signals and Systems”, Schaum’s outlines, TMH
5. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press
6. Ganesh Rao and SatishTunga, “Signals and Systems”, Pearson/Sanguine Technical Publishers

EC 244 PRINCIPLES OF COMMUNICATION

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Introduction:
Elements of communication system, Various frequency bands used for communication, Types of Communication and need of modulation. Different types of modulation schemes.

Amplitude modulation Techniques:
Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Modulation index, Phase diagram, Power relations, Efficiency, Spectrum diagram of AM, DSB-SC & SSB systems.AM modulation with a complex wave,

AM Transmitters and Receivers:
AM Transmitters: Generation of AM, low level and high level modulation, comparison of levels, AM transmitter block diagram, collector class C modulator, Base Modulator, DSB S/C modulator, SSB modulator, AM Receiver: Tuned radio frequency (TRF) receiver. Super heterodyne receiver, RF section and characteristics, mixers, frequency changing and tracking, IF rejection and IF amplifiers. Detection and automatic gain control (AGC), AM receiver characteristics.

Angle modulation:
Theory of frequency modulation, mathematical analysis of FM, spectra of FM signals, narrow band of FM, Wide band FM, Transmission Bandwidth of FM signals, Phase Modulation ,relationship between FM & PM, Comparison of AM and FM.

FM Transmitters and Receivers:
FM Transmitters: Basic requirements and generation of FM, FM Modulation methods: Direct methods, Variable capacitor Modulator, Varactor Diode Modulator, FET Reactance Modulator, Transistor Reactance Modulator, AFC in reactance modulator, Disadvantages of direct method, Indirect modulators, RC-phase shift modulators, Armstrong FM systems. FM Receivers: Limiters, single and double-tuned demodulators, balanced slope detector, Foster-Seely or Phase Discriminator, ratio Detector, Block diagram of FM Receivers, RF Amplifiers, FM Receiver characteristics.

Noise Theory:
Sources of Noise-Shot Noise-Resistor Noise-Calculation of Noise in Linear systems-Noise bandwidth-available Power-Noise temperature-Noise in two port networks, Noise figure, Measurement of Noise figure-Signal in presence of noise-Narrow Band noise

Noise Performance of AM & FM receivers:
Noises in AM receiver threshold effect-Noise in FM receivers capture effect-FM threshold effect-Pre emphasis &De emphasis in FM.

Pulse Modulation Transmissions and Reception:
Introduction, Sampling Theorem Pulse Amplitude Modulation (PAM), Natural PAM Frequency Spectra for PAM, Flat-top PAM, Sample and hold circuits, Time division Multiplexing, PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM); Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), PPM Demodulator.

Suggested Text Books & References:

1. Haykin S., "Communications Systems", John Wiley and Sons
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education,
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,
4. Electronic communication Systems by Kennedy & Davis, Tata Mcgraw Hill
5. B.P. Lathi," Modern Digital & Analog Communication", Prison Books Pvt Ltd.,

PRACTICAL / DESIGN

EC 241P DIGITAL ELECTRONICS LAB

L	T	P	C	
0	**0**	**2**	**1**	**Full Marks: 50 (35+15)**

Experiments based on the contents covered in EC 241

EC 242P ANALOG ELECTRONICS LAB

L	T	P	C	
0	**0**	**2**	**1**	**Full Marks: 50 (35+15)**

1. Single stage BJT amplifier
2. Two stage BJT amplifier
3. FET amplifier

4. Differential amplifier
5. Design of negative feedback amplifier
6. RC phase shift oscillator
7. Wien bridge oscillator
8. LC/ crystal oscillator
9. Design of Power amplifiers
10. Design of tuned amplifier
11. Simulation of the above circuits using SPICE or Equivalent software

EC244P Communication Lab

L	T	P	C	
0	**0**	**2**	**1**	**Full Marks: 50 (35+15)**

LIST OF EXPERIMENTS

HARDWARE

1. Amplitude Modulator
2. Envelope Detector
3. Frequency Modulator using VCO
4. Frequency Demodulation using PLL
5. PAM modulation and demodulation
6. Pre emphasis and De-emphasis
7. Analog Multiplexing
8. PWM & PPM modulator & Demodulator
9. Sampling Theorem & Reconstruction of Signal from its samples using Natural Sampling, Flat Top Sampling & Sample & Hold Circuits & effect of duty cycle.

SOFTWARE

1. Amplitude Modulation using P Spice
2. Frequency Modulation using P Spice
3. PAM modulation using P Spice
4. PAM demodulation using P Spice
5. pre emphasis and de emphasis using P Spice
6. Amplitude Modulation using MATLAB
7. Frequency Modulation using MATLAB

EC 245P SIMULATION LAB

L	T	P	C	
0	0	2	1	**Full Marks: 50 (35+15)**

1. **SIMULATION LAB USING MATLAB**
2. **CIRCUIT SIMULATION USING SPICE OR EQUIVALENT CIRCUIT SIMULATION SOFTWARE**

NC 241 SOFT SKILL - I

L	T	P	C	
3	0	0	0	**Full Marks: 50 (Non Credit)**

Self Analysis:
SWOT Analysis, Who am I, Attributes, Importance of Self Confidence, Self Esteem

Attitude:
Factors influencing Attitude, Challenges and lessons from Attitude.

Change Management:
Exploring Challenges, Risking Comfort Zone, Managing Change

Motivation:
Factors of motivation, self-talk, Intrinsic & Extrinsic Motivators.

Goal Setting:
Wish List, SMART Goals, Blue print for success, Short Term, Long Term, Life Time Goals.

Time Management:
Value of time, Diagnosing Time Management, Weekly Planner, to do list, Prioritizing work.

Creativity:
Out of box thinking, Lateral Thinking

Suggested Text Books & References:

1. INSIGHT, 2012, Career Development Centre, SRM Publications.
2. Covey Sean, Seven Habits of Highly Effective Teens, New York, Fireside Publishers, 1998.
3. Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998.
4. Thomas A Harris, I am ok, You are ok , New York - Harper and Row, 1972
5. Daniel Coleman, Emotional Intelligence , Bantam Book, 2006

THIRD YEAR
FIFTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
1.	EC 351	ELECTROMAGNETIC THEORY	3	0	0	70	30	-	100	3.0
2.	EC 352	DIGITAL SIGNAL PROCESSING	3	1	0	70	30	-	100	3.5
3.	EC 353	ANALOG ELECTRONICS - II	3	1	0	70	30	-	100	3.5
4.	EC 354	INSTRUMENTATION & MEASUREMENT	3	0	0	70	30	-	100	3.0
5.	EC 355	COMMUNICATION SYSTEMS	3	1	0	70	30	-	100	3.5
		SUB-TOTAL							500	16.5
		PRACTICAL/DESIGN								
6.	EC 352P	DIGITAL SIGNAL PROCESSING LAB.	0	0	4		30	70	100	2.0
7.	EC 353P	ANALOG ELECTRONICS LAB.-II	0	0	4		30	70	100	2.0
8.	EC 355P	COMMUNICATION SYSTEMS LAB.	0	0	4		30	70	100	2.0
		SUB-TOTAL							300	6.0
		TOTAL	**15**	**3**	**12**				**800**	**22.5**
9.	***NC 351***	***NCC / N.S.S.***	***0***	***0***	***3***	**-**	**-**	***50****	**-**	***0.0***
10.	***NC 352***	***PHYSICAL TRAINING***	***0***	***0***	***3***	**-**	**-**	***50****	**-**	***0.0***

EC 351 ELECTROMAGNETIC THEORY

L T P C

3 0 0 3 Full Marks: 100 (70+30)

Electrostatics:

Coulomb's Law, Electric field intensity, Field due to continuous charge distribution, Electric flux density, Gauss' law and its applications, Vector operator, Divergence Theorem, Maxwell's Two equations of Electrostatics Fields, Electric potential& Potential difference,, Laplace's & Poisson's equation, energy storage in electric field, Potential gradient , Energy density in an electrostatic field, Convection current & Conduction Current, Dielectrics : linear, isotropic, homogeneous.

Magneto-statics:

Biot-Savart law, Ampere's circuital law and its applications, Stoke's Theorem, Magnetic flux and flux density, Maxwell's two equations of magneto-statics, Scalar and Vector magnetic potentials, Force on a moving charge and differential current element, Force between differential current elements.

Maxwell's Equations (Time Varying Fields):
Faraday's law, displacement current & displacement current density, Maxwell's Equations in different forms, Boundary conditions, Wave equation.

Uniform plane wave:
Properties of plane wave, Wave propagation in free space and dielectrics, Poynting vector & Poynting's theorem, propagation in good conductors, Wave polarization, Surface current and power loss in a conductor, Reflection and refraction at media interface, Brewster Angle, Critical angle and Total internal reflection.

Introduction to Transmission Lines:
Types of transmission line, Equations of Voltage and Current on TX line, Propagation constant, Characteristic impedance, Impedance Transformation, Impedance Matching, VSWR, Smith Chart& its applications.

Suggested Text Books & References:

1. "Engineering Electromagnetics", William Hayt Jr. and John A Buck, Tata McGraw-Hill, 7th edition, 2006
2. "Electromagnetics with Applications", John Krauss and Daniel A Fleisch, McGraw-Hill, 5th edition, 1999
3. "Electromagnetic Waves And Radiating Systems," Edward C. Jordan and Keith G Balmain, Prentice – Hall of India / Pearson Education, 2nd edition, 1968. Reprint
4. Elements of Electromagnetics, Matthew N. O. Sadiku, Oxford University Press, 6th Ed. 2014.
5. "Field and Wave Electromagnetics", David K Cheng, Pearson Education Asia, 2nd edition, - 1989, Indian Reprint – 2001.

EC 352 DIGITAL SIGNAL PROCESSING

L	T	P	C	
3	1	0	3.5	Full Marks: 100(70+30)

Discrete Fourier Transforms (DFT):
Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms.

Properties of DFT:
Multiplication of two DFTs- the circular convolution, additional DFT properties. DFT in linear filtering, overlap-save and overlap-add method. Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT–

decimation in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform.

IIR filter design:
Characteristics of commonly used analog filters – Butterworth and Chebysheve filters, analog to analog frequency transformations.

Implementation of discrete-time systems:
Structures for IIR and FIR systems, direct form I and direct form II systems, cascade, lattice and parallel realization.

FIR filter design:
Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Bartlet and Kaiser windows, FIR filter design using frequency sampling technique.

Design of IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions:
Approximation of derivative (backward difference and bilinear transformation) method, Matched z transforms, Verification for stability and linearity during mapping.

Suggested Text Books & References:

1. Digital signal processing – Principles Algorithms & Applications, Proakis & Monalakis, Pearson education, 4th Edition, New Delhi, 2007.
2. Discrete Time Signal Processing, Oppenheim & Schaffer, PHI, 2003.
3. Digital Signal Processing, S. K. Mitra, Tata Mc-Graw Hill, 3rd Edition, 2010.
4. Digital Signal Processing, Lee Tan: Elsivier publications, 2007

EC 353 ANALOG ELECTRONICS –II

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Unit-1:
Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR, the emitter coupled differential

amplifier. Operational Amplifier (OP-AMP): Block diagram, ideal characteristics, Pin configuration of 741 op-amp, Bias, offsets and drift, bandwidth and slew rate, Offset and Frequency compensation.

Unit-2:
Inverting and non-inverting amplifiers, inverting and non- inverting summers, difference amplifier, differentiator and integrator, Voltage to current and current to voltage converters, buffer, Instrumentation amplifier, Log and antilog amplifiers, Precision rectifier.

Unit-3:
Comparators, regenerative comparators, Schmitt trigger, multivibrators, Triangular and square wave- generators, applications of VCO IC 566, RC-phaseshift oscillator, Wein's bridge oscillator,

Unit-4:
Active Filters: 1^{st} and 2^{nd} orders , Low pass, High pass, Band pass and Band Reject filters, Butterworth, Chebychev filters, Different first and second order filter Topologies, Frequency Transformation.

Unit-5:
Timer and PLL: 555 Timer functional diagram, monostable and astable operation, applications, Schmitt trigger. PLL - basic block diagram and operation, capture range and lock range; applications of PLL IC 565, AM detection, FM detection and FSK demodulation.

Unit-6:
Digital-to-analog and Analog-to-digital converters: DAC: Weighted resistor, R-2R ladder, resistorstring etc. ADC: Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Unit-7:
Linear and Switching Voltage Regulators: Transistor series regulator, OP-AMP voltage regulator, three terminal IC voltage regulator, IC 723 general purpose regulator, Switching Regulator.

Suggested Text Books & References:

1. G B Clayton, Operational Amplifiers, 5th Edition, Elsevier science, 2003
2. Sergio Franco, Design With Operational Amplifier And Analog Integrated Circuits, 4th Edition, TMH
3. Roy Choudary D. and Shail B. Jain, Linear Integrated circuits, 4th Edition, New Age International Publishers, 2010
4. RamakantA. Gayakward, Op-Amps and Linear Integrated Circuits, 4th Edition, PHI,
5. David A Bell, Operational Amplifiers and Linear ICs

EC 354 INSTRUMENTATION & MEASUREMENT

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Unit-1:

Performance characteristics of instruments, Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Error in measurement, statistical analysis, Dynamic Characteristics-speed of response, Fidelity, Lag and Dynamic error. DC Voltmeters- Multirange, Range Extension. AC voltmeters- multirange, range extension, shunt. Thermocouple type RF ammeter, Ohmmeter series type, shunt type, calibration, Multirange. Multimeter as DC voltmeter, Ac voltmeter, DC ammeter and Ohmmeter.

Unit-2:

Signal Generators and Analysers **-** Fixed and variable AF oscillator, Standard and AF sine and square wave signal generators , Function generator, Square and Pulse generator, Sweep, frequency generator, Frequency synthesizer. Wave analyser, Harmonic distortion analyser, spectrum analyser.

Unit-3:

Oscilloscopes CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, Dual beam CRO.

Unit-4:

Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope, Lissajous method of frequency measurement, capacitance & inductance measurement, standard specification of CRO, probes for CRO- Active and Passive, attenuator type, frequency counter, time and period measurement.

Unit-5:
AC bridge measurement of inductance- Maxwell's Bridge, Hay's Bridge, Anderson Bridge. Measurement of capacitance–Schering Bridge. DC bridge measurement of resistance- Kelvin's Bridge, wheat stone bridge. Measurement of frequency –Wein Bridge. Error and precautions in using bridges.Q-meter.

Unit-6:
Transducers- active and passive transducers: Resistance, Capacitance, inductance; Strain gauges, LVDT, flow meters, Piezo Electric transducers, Resistance thermometers, Thermocouples, Thermistors, Sensistors.

Unit-7:
Measurement of physical parameters force, pressure, velocity, humidity, moisture, vacuum level, accelerations, speed, proximity and displacement. Data acquisition systems.

Suggested Text Books & References:

1. Electronic Instrumentation, second edition Tata McGraw Hill.
2. Modern Electronic Instrumentations and measurement techniques – A.D Helfrick and W.D. Cooper, PHI, 5th Edition
3. Electronic instrumentation and measurement – David A.Bell, PHI 2nd edition
4. Electronic test instruments, Analog and Digital measurements- Robert A. Witte, Pearson Education, 2nd edition
5. Measuring system, application and design- E.O. Doeblin, McGraw Hill, 4th Edn,
6. Electronic Measurement- Oliver and Cage, ISE McGraw Hill
7. Electronic Measurement and Instrumentation by K. Lal Kishore, Pearson Education
8. Measurements and Instrumentation by A.k. Shwaney, S. Chand publication.

EC 355 Communication Systems

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

Pulse Code Modulation:
Model of a digital communication system, advantages of digital communication Quantization of Signals-Quantization error-PCM Systems-Noise Considerations in PCM system-Over all Signal-to-noise ratio for PCM system-Threshold effect-Channel Capacity-Virtues, Limitations & Modification of PCM system-PCM Signal Multiplexing, companding, Differential PCM, Delta Modulation, Noise Considerations in Delta Modulation, SNR Calculations-Comparison of PCM, DPCM & DM ,MPEG audio coding standard.

Digital Multiplexing :
Fundamentals of time division multiplexing, electronic commutator, bit, byte interleaving E1 Carrier system, Synchronization and signalling of E1, TDM, PCM hierarchy.

Digital Baseband Transmission :
Line coding and its properties. NRZ & RZ types, signalling format for Unipolar, polar, bipolar, Matched filter receiver, Probability error of the Matched filter, Inter symbol interference, Nyquist criterion for distortion less base band transmission-Correlative coding-Base band M-ary PAM transmission-Eye pattern, adaptive equalization for data transmission.

Digital Modulation Techniques:
Types of digital modulation, wave forms for amplitude, frequency and phase shift keying. Method of generation and detection of coherent & non –coherent binary ASK, FSK &PSK, differential phase shift keying, QPSK, M-Ary PSK, Quadrature amplitude modulation (QAM), minimum shift keying (MSK),GMSK, bandwidth consideration and probability of error calculations for ASK, PSK, FSK schemes.

Introduction to Spread Spectrum Techniques:
Introduction-Discrete Sequence Spread Spectrumtechnique-Use of Spread Spectrum with CDMA-Ranging Using Discrete Sequence Spread Spectrum-Frequency Hopping Spread Spectrum-Generation & Characteristics of PN Sequence-Acquisition of FH a Signal-Tracking of FH a signal-Acquisition of a DS Signal-Tracking of a DS signal

Suggested Text Books & References:

1. Taub& Schilling "Principles of Communication Systems" Tata McGraw-Hill
2. Singh, R.P. &Sapre, S.D. "Communication Systems: Analog & Digital" Tata McGraw-Hill.
3. A.B. Carlson "Communication Systems" Tata McGraw-Hill.
4. ProakisJ. J "Digital Communications" McGraw Hill
5. Schaum'sOutlines "Analog & Digital Communication" Tata McGraw-Hill.
6. Kennedy, George & Davis, Bernard "Electronic communication systems" Tata McGraw-Hill.
7. P. Lathi Modern Analog 86 Digital Communication Oxford Univ Press.
8. Simon Haykin Digital Communication John Wiley.
9. Simon Haykin Communication Systems. John Wiley Qv Ed.

PRACTICAL/DESIGN

EC 352P Digital Signal Processing Laboratory

L	T	P	C	
0	0	4	2	**Full Marks: 100(70+30)**

List of experiments using MATLAB/SCILAB/OCTAVE

1. To develop elementary signal for unit sample, unit step, exponential sinusoidal and unit ramp sequences.
2. Write a program in MATLAB to generate standard sequences.
3. Write a program in MATLAB to compute power density spectrum of a sequence.
4. To develop program based on operation on sequences like signal Shifting, signal folding, signal addition and signal multiplication.
5. Write a program in MATLAB to verify linear convolution.
6. Write a program in MATLAB to verify the circular convolution.
7. To develop program for finding magnitude and phase response of LTI system
8. To develop program for finding response of the LTI system described by the difference equation.
9. To develop program for computing inverse Z-transform.
10. To develop program for computing DFT and IDFT.

11. To write a MATLAB programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of a CTS and DTS.
12. Write a program in MATLAB to find frequency response of different types of analog filters.
13. Write a program in MATLAB to design FIR filter (LP/HP) through Window techniques

EC 353P ANALOG ELECTRONICS LABORATORY-II

L	T	P	C	
0	**0**	**4**	**2**	**Full Marks: 100(70+30)**

1. Study of ICs: OP-AMP 741, 555 Timer, 566 PLL.
2. OP-AMP applications: Adder, Subtractor, comparators, Integrator, differentiator and Instrumentation amplifier using IC 741.
3. Active Filter: LPF, HPF, BPF, Band Reject and Notch Filters.
4. IC 741 oscillators circuits: Phase shift and Wien bridge oscillators
5. Function Generator using OP-AMP
6. IC 555 circuits: Astable, Monostable and Schmitt Trigger
7. Applications of PLL IC 565.
8. Three terminal voltage regulators
9. Voltage Regulator using IC 723.
10. Simulation of the above circuits using SPICE or equivalent software.

EC355P Communication systems Laboratory

L	T	P	C	
0	**0**	**4**	**2**	**Full Marks: 100(70+30)**

HARDWARE

1. Study of Time Division Multiplexing system.
2. Study of pulse code modulation and demodulation.
3. Study of delta modulation and demodulation and observe effect of slope overload.
4. Study pulse data coding techniques for various formats.
5. Data decoding techniques for various formats.

6. Study of amplitude shift keying modulator and demodulator.
7. Study of frequency shift keying modulator and demodulator.
8. Study of phase shift keying modulator and demodulator.
9. Error Detection & Correction using Hamming Code

SOFTWARE –MATLAB

1. FSK Modulation and Demodulation
2. PSK Modulation and Demodulation
3. QPSK Modulation
4. M-ary PSK Modulation and Demodulation
5. ASK Modulation and demodulation
6. DPSK Modulation and demodulation
7. Delta modulation and demodulation
8. Digital link simulation; error introduction & error estimation in a digital link using MATLAB (SIMULINK)/ communication simulation packages.

THIRD YEAR
SIXTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
1.	EC 361	MICROWAVE ENGINEERING	3	1	0	70	30	-	100	3.5
2.	EC 362	MICROPROCESSOR AND MICROCONTROLLER	3	1	0	70	30	-	100	3.5
3.	EC 363	INTRODUCTION TO VLSI DESIGN	3	0	0	70	30	-	100	3.0
4.	EC 364	COMMUNICATION NETWORKS	3	0	0	70	30	-	100	3.0
5.	EC 365	CONTROL SYSTEMS	3	0	0	70	30	-	100	3.0
6.	EC 366	PULSE AND DIGITAL CIRCUITS	3	0	0	70	30	-	100	3.0
		SUB-TOTAL							600	19.0
		PRACTICAL/DESIGN								
7.	EC 361P	MICROWAVE ENGINEERING LAB.	0	0	3		15	35	50	1.5
8.	EC362P	MICROPROCESSOR AND MICRO-CONTROLLER LAB.	0	0	3		15	35	50	1.5
9.	EC 366P	PULSE AND DIGITAL CIRCUITS LAB	0	0	4		30	70	100	2.0
		SUB-TOTAL								5
		GRAND TOTAL	**18**	**2**	**10**				**800**	**24**
10.	***NC 361***	***NCC / N.S.S.***	***0***	***0***	***3***	**-**	**-**	***50*****	**-**	***0.0***
11.	***NC 362***	***PHYSICAL TRAINING***	***0***	***0***	***3***	**-**	**-**	***50*****	**-**	***0.0***

EC 361 MICROWAVE ENGINEERING

L T P C
3 1 0 3.5 Full Marks: 100(70+30)

Introduction to Microwaves:

History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.

Microwave Transmission:

Concept of Mode, Features of TEM, TE and TM Modes, Microwave Transmission Lines- Coaxial line.

Microwave Waveguides and Components:
Rectangular waveguide, circular waveguide, microwave cavities, microwave hybrid circuits, directional couplers, circulators and isolators.

Microwave Diodes:
Transfer electron devices: Introduction, GUNN effect diodes – GaAs diode, RWH theory, Modes of operation, Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, Parametric amplifiers. Other diodes: PIN diodes, Schottky barrier diodes.

Microwave Network Theory and Passive Devices:
Symmetrical Z and Y parameters, for reciprocal Networks, S matrix representation of multi port networks. Microwave passive devices, Coaxial connectors and adapters, Phase shifters, Attenuators, Waveguide Tees, Magic tees.

Microwave Tubes:
Klystron, TWT, Magnetron.

Microwave Antennas:
Horn Antennas, Parabolic antenna, Lens antenna.

Microwave Measurement:
Frequency, Impedance and Power measurement, Noise figure measurement, Antenna measurements, Time domain reflectrometry, Principle of operation of Network Analyzer.

Strip Lines:
Introduction to different planar transmission lines, microstrip line, strip line, CPW line.

Suggested Text Books & References*:*

1. Microwave Devices and circuits- Liao , Pearson Education.
2. Microwave Circuits- R.E. Collins, McGraw Hill
3. Microwave Engineering – Annapurna Das, Sisir K Das, TMH Publication, 2nd
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn,

EC 362 MICRO PROCESSORS AND MICROCONTROLLERS

L	T	P	C	
3	1	0	3.5	**Full Marks: 100 (70+30)**

Introduction to 8-bit Microprocessors:
Evolution and Introduction to 8-bit Intel 8085 microprocessor architecture, interrupt and DMA Processes. Introduction to 8085 Assembly Language Programming (ALP) Intel 8085 interfacing techniques with: memory and I/O devices, 8255 PPI (Programmable Peripheral Interface), 8279 keyboard/display controller, data converters (ADC/DAC), 8253/8254 programmable interval timer, 8259 programmable interrupt controller, 8237 DMA controller, 8251 serial communication interface.

Applications of Microprocessors and Interfacing:
Basic sequencing, data acquisition, process control systems.

Important Features of 16-bit Microprocessors:
Intel 8088/8086, memory segmentation, parallel processing, queuing, co-processor, design features of 32-bit microprocessors and characteristics of Intel 80386, 80486 and Pentium processors, RISC Processors

Evolution & Introduction to 8-bit Single-chip Microcontrollers:
Features of Intel MCS- 51 Family, overview of Intel 8051 architecture and instruction set and basic applications. Introduction to ARM microcontrollers interface designs

Suggested Text Books & References:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing
2. 2.D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing,
5. “The 8051 Microcontroller and Embedded Systems – using assembly and C ”-, Muhammad Ali Mazidi and Janice Gillespie MazidiandRollin D. McKinlay; PHI, 2006 , Pearson.

EC 363 INTRODUCTION TO VLSI DESIGN

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Basic MOS Technology:
Integrated circuit's era. Enhancement and depletion mode MOS transistors. nMOS fabrication. CMOS fabrication. Thermal aspects of processing. BiCMOS technology. Production of E-beam masks.

MOS Transistor Theory:
Introduction, MOS Device Design Equations, The Complementary CMOS Inverter – DC Characteristics, Static Load MOS Inverters, The Differential Inverter, The Transmission Gate, Tristate Inverter.

Circuit Design Processes:
MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams. Tutorial exercises. Basic Physical Design of Simple logic gates.

CMOS LOGIC STRUCTURES:
CMOS Complementary Logic, Bi CMOS Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic Cascaded Voltage Switch Logic (CVSL).

Basic Circuit Concepts:
Sheet resistance. Area capacitances. Capacitance calculations. The delay unit. Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances.

Scaling of MOS Circuits:
Scaling models and factors. Limits on scaling. Limits due to current density and noise.

CMOS Subsystem Design:
Architectural issues, Switch logic, Gate logic, Design examples – combinational logic, Clocked circuits, Other system considerations, Clocking Strategies

CMOS Subsystem Design Process:
General considerations, Process illustration, ALU subsystem, Adders, Multipliers.

Memory, Registers and Clodk:
Timing considerations, Memory elements, Memory cell arrays.

Suggested Text Books & References:

1. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley.
2. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley
3. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
4. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India,
5. D. Perry, VHDL, 2nd Ed., McGraw Hill International, 1995.
6. Principles of CMOS VLSI Design: A Systems Perspective, Neil H. E. Weste, K. Eshragian3rd edition, Pearson Education (Asia) Pvt. Ltd.
7. Basic VLSI Design - Douglas A. Pucknell& Kamran Eshraghian, PHI 3rd Edition
8. CMOS Digital Integrated Circuits: Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi,

EC 364 Communication Networks

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Data Communication and Networking Basics:
Data transfer modes, Telephone system, Protocols & standards, Multiplexing, Circuit switching, Message & packet switching, Introduction to LAN, MAN & WAN - IEEE standards for LAN – Network topologies.

Network Models:
OSI layer architecture, Issues in data traffic over network .

OSI Lower Layers:
Physical layer standards ,transmission media; Data link control: Framing, Flow and error control, Protocols, ARQ schemes, HDLC protocol, Medium Access Sub layer – ALOHA, carrier sense multiple access, collision free protocols,

Network Layer:
Need for Internetworking – Addressing – Routing Issues – Internet protocol (IPV4/V6) – Congestion & flow control mechanism – TCP/IP model.

OSI Higher Layers:
Transport layer – TCP & UDP, Session layer issues, ATM AAL Layer Protocols.

Application Layer:
Network Security: FTP, HTTP, Domain Name system: Electronic Mail; The worldwide web; Compression techniques. Introduction to ISDN – Broadband ISDN Features – ATM Concept.

Suggested Text Books & References:

1. Data Communication and Networking, B.Forouzan, 4 Ed, TMH
2. Computer Networks, Andrew S. *Tanenbaum, 4th Edn. Pearson edn.*
3. Computer Networks, James F. Kurose, Keith W. Ross: Pearson education, 2nd Edition
4. Introduction to Data communication and Networking, WayneTomasi: Pearson education

EC 365 Control Systems

L	T	P	C	
3	**0**	**0**	**3**	**Full Marks: 100(70+30)**

Modeling of Systems:
Introduction to Control Systems, Types of Control Systems, Effect of Feedback Systems, Differential equation of Physical Systems -Mechanical systems, Friction, Translational systems (Mechanical accelerometer, systems excluded), Rotational systems, Gear trains, Electrical systems, Analogous systems.

Block diagrams and signal flow graphs:
Transfer functions, Block diagram algebra, Signal Flow graphs .

Time Response of feedback control systems :
Standard test signals, Unit step response of First and second order systems, Time response specifications, Time response specifications of second order systems, steady – state errors and error constants. Introduction to PID Controllers(excluding design)

Stability analysis:
Concepts of stability, Necessary conditions for Stability, Routh- stability criterion, Relative stability analysis; More on the Routh stability criterion.

Root–Locus Techniques :
Introduction, The root locus concepts, Construction of root loci.

Frequency domain analysis:
Correlation between time and frequency response, Bode plots, Experimental determination of transfer functions, Assessment of relative stability using Bode Plots. Introduction to lead, lag and lead-lag compensating networks).

Stability in the frequency domain:
Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, Assessment of relative stability using Nyquist criterion, (Systems with transportation lag excluded).

Introduction to State variable analysis:
Concepts of state, state variable and state models for electrical systems, Solution of state equations.

Suggested Text Books & References:

1. J. Nagarath and M.Gopal , “Control Systems Engineering”, New Age International (P) Limited, Publishers,
2. “Modern Control Engineering “, K. Ogata, Pearson Education Asia/ PHI,
3. “Automatic Control Systems”, Benjamin C. Kuo, John Wiley India Pvt. Ltd.,
4. “Feedback and Control System”, Joseph J Distefano III et al., Schaum’s Outlines, TMH

EC 366 PULSE DIGITAL CIRCUITS

L	T	P	C	
3	0	0	3	**Full Marks: 100(70+30)**

Wave Shaping Circuits:
High pass and low pass circuits, Response to sine, step, pulse, square, exponential and ramp inputs with different time constants, High pass as a differentiator, Low pass as an Integrator, Attenuators- response to step input, compensated attenuator.

Clipping circuits:
Diode clippers, transistor clippers and two level clippers, clamping circuits using diodes, Clamping theorem, voltage comparators

Switching Circuits:
Diode as a switch, piecewise linear diode model, diode switching time, Transistor as a switch, saturation parameters of Transistor, switching times, Design of transistor switch.

Multivibrators:
Analysis of Astable, Mono-stable and Bistable Multivibrators (both collector and emitter coupled), and Schmitt trigger circuit using transistors.

Time Base Generators:
General features of a time base generator, methods of generating a time-base waveform, exponential sweep circuits, sweep circuit using UJT, Miller and Bootstrap time base generators, current time base generators.

Realization of Logic Gates using Diodes and Transistors:
AND, OR, NAND and NOR gates, TTL, ECL, IIL, MOS and CMOS Logic families.

Suggested Text Books & References:

1. Millman and Taub, Pulse, Digital and Switching Waveforms, 3rd Edition, Tata McGraw-Hill
2. L. Strauss, Wave Generation and Shaping, 3rd Edition, TMH
3. David A. Bell, Solid State Pulse Circuits, 4th Edition, Prentice Hall India
4. A Anand Kumar, Pulse Digital and Switching circuits

PRACTICAL / DESIGN

EC361P MICROWAVE ENGINEERING LAB

L	T	P	C	
0	0	3	1.5	**Full Marks: 50(35+15)**

List of Experiments:

1. Study of microwave components and instruments.
2. Measurement of crystal characteristics and proof of the square law characteristics of the diode.
3. Measurement of klystron characteristics.
4. Measurement of VSWR and standing wave ratio.
5. Measurement of Dielectric constants.

6. Measurement of Directivity and coupling coefficient of a directional coupler.
7. Measurement of Q of a cavity.
8. Calibration of the attenuation constant of an attenuator.
9. Determination of the radiation characteristics and gain of an antenna.
10. Determination of the phase-shift of a phase shifter.
11. Determination of the standing wave pattern on a transmission line and finding the length and position of the short circuited stub.
12. Gain and radiation pattern of Horn antenna.
13. Design of Micro strip antenna.

EC 362P MICROPROCESSOR AND MICROCONTROLLER LAB.

L	T	P	C	
0	**0**	**3**	**1.5**	**Full Marks: 50(35+15)**

Experiments based on the contents covered in EC 362.

EC 366P PULSE DIGITAL CIRCUITS LAB

L	T	P	C	
0	**0**	**4**	**2**	**Full Marks: 50(35+15)**

List of Experiments:

1. RC High Pass & low pass responses to square input for various time constants.
2. Diode Clipper and Clamper
3. Transistor Switching timer
4. Multivibrator circuits (Bistable, Monostable, Astablemultivibrator)
5. Schmitt trigger
6. Miller Sweep circuit
7. Boot Strap Sweep circuit
8. U.J.T. (Relaxation) Sweep Generator.

FOURTH YEAR
SEVENTH SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
***1.	HU 471	PRINCIPLES OF MANAGEMENT	3	1	0	70	30	-	100	3.5
2.	EC 471/X	ELECTIVE – I	3	1	0	70	30	-	100	3.5
3.	EC 472/X	ELECTIVE - II	3	1	0	70	30	-	100	3.5
4.	EC 473/X	ELECTIVE - III	3	1	0	70	30	-	100	3.5
5.	EC 474/X	OPEN ELECTIVE - I	3	1	0	70	30	-	100	3.5
		SUB-TOTAL							500	17.5
		PRACTICAL/DESIGN								
6.	EC 475 P	PROJECT- I	0	0	6	-	-	-	100	3.0
7.	EC 476 P	LOGIC DESIGN USING HDL	0	0	4	-	30	70	100	2.0
		SUB-TOTAL							200	5.0
		TOTAL	**15**	**5**	**10**				**700**	**22..5**
8.	***NC 471***	***NCC / N.S.S.***	***0***	***0***	***3***	**-**	**-**	***50****	**-**	***0.0***
9.	***NC 472***	***PHYSICAL TRAINING***	***0***	***0***	***3***	**-**	**-**	***50****	**-**	***0.0***

HU 471 PRINCIPLE OF MANAGEMENT

L T P C

3 0 0 3 Full Marks: 100(70+30)

Overview of Management:

Definition -Management -Role of managers-Evolution of Management thought -Organization and the environmental factors –Trends and Challenges of Management in Global Scenario.

Planning:

Nature and purpose of planning-Planning process -Types of plans – Objectives - Managing by objective (MBO) Strategies -Types of strategies - Policies -Decision Making -Types of decision -Decision Making Process - Rational Decision Making.

Organising:

Nature and purpose of organizing -Organization structure - Formal and informal groups organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority -Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

Directing:
Creativity and Innovation - Motivation and Satisfaction -Motivation Theories- Leadership Styles -Leadership theories - Communication - Barriers to effective communication - Organization Culture -Elements and types of culture - Managing cultural diversity.

Controlling:
Process of controlling -Types of control -Budgetary and non-budgetary control Q techniques -Managing Productivity - Cost Control -Purchase Control – Maintenance Control - Quality Control - Planning operations

Suggested Text Book & References:

1. Tripathi, Principles Of Management, TMH
2. P. K. Saxena, Principles of Management: A Modern Approach, Global India Publication
3. D. Chandra Bose, Principles of Management and Administration, Phi
4. L.M. Prasad, Principles and Practices of Management, S. Chand & Sons
5. J.C. Vanhom, Fundamentals of Financial Management, PHI.

EC 471/X ELECTIVE – I

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

EC 472/X ELECTIVE – II

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

EC 473/X ELECTIVE – III

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

EC 474/X OPEN ELECTIVE-I

L	T	P	C	
3	1	0	3.5	**Full Marks: 100(70+30)**

PRACTICAL / DESIGN

EC 475P PROJECT – I

L	T	P	C	
0	0	6	3	**Full Marks: 100**

Details of the Project – I is to be decided by the Department.

EC 476P LOGIC DESIGN USING HDL

L	T	P	C	
0	0	4	2	**Full Marks: 50(35+15)**

1. Write structural and dataflow HDL models for
   a. 4-bit ripple carry adder.
   b. 4-bit carry Adder – cum Subtractor.
   c. 2-digit BCD adder / subtractor.
   d. 4-bit carry look ahead adder
   e. 8-bit comparator
2. Write a HDL program in structural model for
   a. 16:1 mux realization
   b. 3:8 decoder realization through 2:4 decoder
3. Write a HDL program in behavioral model for
   a. 16:1 mux
   b. 3:8 decoder
   c. 8:3 encoder
   d. 8 bit parity generator and checker
4. Write a HDL program in structural and behavioral models for
   a. 8 bit asynchronous up-down counter
   b. 8 bit synchronous up-down counter
5. Write a HDL program for 4 bit sequence detector through Mealy and Moore state machines.
6. Write a HDL program for traffic light controller realization through state machine.
7. Write a HDL program for vending machine controller through state machine.
8. Write a HDL program in behavioral model for 8 bit booth's multiplier.
9. Write a HDL program in behavioral model for 8 bit shift and add multiplier.
10. Write a HDL program in structural model for 8 bit Universal Shift Register.
11. Write a HDL program for implementation of data path and controller units
    a. Serial Adder
    b. Shift and add multiplier
    c. Booth's multiplier
    d. ALU
    e. MIPS processor.

FOURTH YEAR
EIGHT SEMESTER

Sl. No.	Course No.	Subject	Hours/Week			Marks				
			L	T	P	Theory	Sess.	Pract.	Total	Credit
1.	EC 481/X	ELECTIVE – IV	3	0	0	70	30	-	100	3.0
2.	EC 482/X	ELECTIVE - V	3	0	0	70	30	-	100	3.0
3.	EC 483/X	OPEN ELECTIVE - II	3	0	0	70	30	-	100	3.0
		SUB-TOTAL							300	9.0
		PRACTICAL/DESIGN								
4.	EC 484 P	PROJECT - II	0	0	18	-	120	280	400	9.0
5.	EC 485 P	SEMINAR	0	0	3	-	50	-	50	1.5
		SUB-TOTAL							450	10.5
		TOTAL	**9**	**0**	**21**				**750**	**19.5**
6.	***NC 481***	***SOFT SKILL - II***	***3***	***0***	***0***	***-***	***50*****	***-***	***-***	***0.0***
7.	***NC 482***	***PLACEMENT/PHYSICAL TRAINING***	***0***	***0***	***3***	***-***	***-***	***50*****	***-***	***0.0***

EC 481/X ELECTIVE – IV
L T P C
3 0 0 3 Full Marks: 100(70+30)

EC 482/X ELECTIVE – V
L T P C
3 0 0 3 Full Marks: 100(70+30)

EC 483/X OPEN ELECTIVE-II
L T P C
3 0 0 3 Full Marks: 100(70+30)

PRACTICAL / DESIGN

EC 484P PROJECT – II

L	T	P	C	
0	0	18	9.5	**Full Marks: 400(120 + 280)**

In continuation and fulfilment of EC 475P - PROJECT – I.

EC 485P SEMINAR

L	T	P	C	
0	0	3	1.5	**Full Marks: 50**

Seminar to be presented by each student on latest topics related to Electronics & Communication Engineering.

LIST OF SUBJECTS FOR – ELECTIVE – I, ELECTIVE – II, ELECTIVE – III, ELECTIVE – IV, & ELECTIVE – V

1. INFORMATION THEORY AND CODING
2. SATELLITE COMMUNICATION
3. VLSI TECHNOLOGY
4. VLSI DESIGN
5. WIRELESS COMMUNICATION
6. FIBRE OPTIC COMMUNICATION
7. BIO-MEDICAL ELECTRONICS
8. CMOS ANALOG I.C. DESIGN
9. TELECOMMUNICATION SWITCHING SYSTEMS
10. ANTENNA AND WAVE PROPAGATION
11. LOW POWER VLSI DESIGN
12. EMBEDDED SYSTEM
13. ASIC DESIGN
14. DSP ALGORITHMS AND ARCHITECTURE
15. RADAR AND NAVIGATION
16. INDUSTRIAL ELECTRONICS

1. INFORMATION THEORY AND CODING

Information theory:
Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark off statistical model for information source, Entropy and information rate of
mark-off source.

Source coding:
Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.

Fundamental limits on performance:
Source coding theorem, Huffman coding, Discrete memory less Channels, Mutual information, Channel Capacity.

Channel coding theorem :
Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.

introduction to error control coding:
Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

Binary Cycle Codes, Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation.BCH codes.

RS codes, Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes.

Convolution Codes, Time domain approach. Transform domain approach.

Suggested Text Books & References:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley India Pvt. Ltd, 1996.
2. Digital communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
3. Error control coding: Fundamentals and application, Shulin & D.J.Costello, (2nd Edn.), Prentice Hall
4. Digital Communications - Glover and Grant; Pearson Ed. 2nd Ed 2008.

2. SATELLITE COMMUNICATION

Over View of Satellite Systems:
Introduction, frequency allocation, INTELSAT.

Orbits:
Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, orbital plane, local mean time and sun synchronous orbits,
Geostationary orbit: Introduction, antenna, look angles, limits of visibility, earth eclipse of satellite, sun transit outage.

Propagation Impairments and Space Link:
Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.

Space Link:
Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR.

Space Segment:
Introduction, power supply units, altitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem.

Earth Segment:
Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx – Rx earth station.

Interference and Satellite Access:
Introduction, interference between satellite circuits, satellite access, single access, pre-assigned FDMA, SCPC (spade system), TDMA, pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA.

DBS, Satellite Mobile and Specialized Services:
Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, VSAT, Radar-SAT, GPS, Indian Satellite systems.

Suggested Text Books & References:

1. Satellite Communications, Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.
2. Satellite Communication Systems Engineering, W. L. Pritchard, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.
3. Satellite Communications, D.C Agarwal, Khanna Publications, 5th Ed.
4. Fundamentals of Satellite Communications K.N.Raja Rao,PHI, 2004.
5. Satellite Communications, Dennis Roddy, 4th Edition, McGraw-Hill International edition, 2006.

3. VLSI TECHNOLOGY

Environment for VLSI Technology:
Clean room and safety requirements. Wafer cleaning processes and wet chemical etching techniques.

Impurity incorporation:
Solid State diffusion modeling and technology; Ion Implantation modeling, technology and damage annealing; characterization of Impurity profiles.

Oxidation:
Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films; High k and low k dielectrics for ULSI.

Lithography:
Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation.

Chemical Vapour Deposition techniques:
CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; Epitaxial growth of silicon; modelling and technology.

Metal film deposition:
Evaporation and sputtering techniques. Failure mechanisms in metal interconnects; Multi-level metallisation schemes.

Plasma and Rapid Thermal Processing:
PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI. Process integration for NMOS, CMOS and Bipolar circuits; Advanced MOS technologies.

Suggested Text Books & References:

1. C.Y. Chang and S.M. Sze (Ed), ULSI Technology, McGraw Hill Companies Inc
2. S.K. Ghandhi, VLSI Fabrication Principles, John Wiley Inc., New York
3. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill

4. VLSI DESIGN

Review of digital design:
MUX based digital design, Design using ROM, Programmable Logic Arrays (PLA) and Programmable Array Logic (PAL) Sequential circuits and timing - Setup and hold times, Sequential circuit design - design of Moore and Mealy circuits, Design of a pattern sequence detector using MUX, ROM and PAL , and Design of a vending machine controller using PAL.

Introduction to Verilog coding:
Introduction to Verilog, Realization of Combinational and sequential circuits, RTL coding guidelines, Coding organization and writing a test bench.

Simulation, Synthesis, Place and Route, and Back Annotation:
Design flow, Simulation using Model sim, Synthesis using Synplify, Place and Route, and Back Annotation using Xilinx

Design using Algorithmic State Machine Charts:
Derivation of ASM charts, Design examples such as dice game, etc. using ASM charts, Implementation of ASM charts using microprogramming, and Verilog design of bus arbitrator

Design of memories:
Verilog realization of Read Only Memory, Verilog realization of Random Access Memory (RAM), and Verilog coding of controller for accessing external memory.

Design of Arithmetic functions:
Pipelining concept, Verilog design of a pipelined adder/subtractor, Design of Multipliers, and Verilog design of a pipelined Multiplier.

Design for testability:
Testing combinational and sequential logic, Boundary scan testing, and Built-in self test.

Design Applications:
Design of a traffic light controller using Verilog, and Design of discrete cosine transform and quantization processor for video compression using Verilog.

Hardware implementation using FPGA board:
Features of FPGA board and demonstration of traffic light controller design, and Universal, asynchronous, receiver-transmitter design using FPGA board.

Suggested Text Books & References:

1. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley
2. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley
3. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley,
4. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India,
5. D. Perry, VHDL, 2nd Ed., McGraw Hill International

5. WIRELESS COMMUNICAION

Introduction:
History of wireless communication, Evolution of Mobile Communication, Mobile and Wireless devices. A basic cellular system, performance criteria, operation of cellular systems, planning a cellular system, analog & digital cellular systems. Examples of Wireless Communication Systems.

Elements of Cellular Radio Systems Design:
General description of the problem, Cellular concept: cell structure, frequency reuse, System capacity, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, Antenna sectoring, cell splitting, channel assignment, handoff, interference, capacity, power control.

Wireless Channel Characteristics:
Radio wave propagation issues in Personal wireless systems, Elementary treatment of Propagation Models, Multipath fading and base band impulse response models, Parameters of mobile multipath channels.

Modulation and Multiple Access Techniques for Wireless Communications:
Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation OFDM.

Multiple Access Schemes:
Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access, Orthogonal Frequency Multiple Access (OFDMA)

Digital Cellular Systems:
Global system for mobile (GSM) GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM; GPRS; EDGE;

CDMA Digital Cellular Standard:
Frequency and channel specifications, Forward CDMA channel, Reverse CDMA channel; overview of future trends in cellular systems.

Wireless Standards: Introduction to wireless LAN 802.11X technologies, Evolution of Wireless LAN Introduction to 802.15X technologies in PAN Application and architecture Bluetooth Introduction to Broadband wireless MAN, 802.16X technologies.

Suggested Text Books & References:

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson
2. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
3. William Stallings, “ Wireless Communication & Networking”, Pearson Education Asia
4. Feher K. “Wireless Digital Communications”, Pearson education.
5. Schiller, “Mobile Communication”, Pearson Education Asia Ltd., 2000.
6. Jon W Mark, WeihuaZhuang, Wireless Communications and Networking, Prentice hall

6. FIBER OPTIC COMMUNICATION

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Optical sources - LEDs and Lasers, Photo-detectors - pin-detectors, detector responsibility, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Optical switches - coupled mode analysis of directional couplers, electro-optic switches.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solution based communication. Optical amplifiers - EDFA, Raman amplifier, and WDM systems.

Suggested Text Books & References:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 2nd Ed. 1992.
2. J.E. Midwinter, Optical fibers for transmission, John Wiley, 1979.
3. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
5. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
6. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
7. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1992
8. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

7. BIO-MEDICAL ELECTRONICS

Bioelectronics signal:

Origins of Bioelectric signals, The Human Body – Overview. The heart and circulatory system. Electrodes, Sensors and Transducers, Bio electric Amplifiers Electrocardiographs Electrocardiogram (ECG), Electromyogram (EMG). Recording Electrodes, Electrodes for ECG, EEG and EMG, Physiological Transducers: Pressure Transducers, Temperature sensors, Pulse sensors.

Recording and Monitoring Instruments:

Biomedical Recorders: Block diagrams of electrocardiogram phonocardiograph, Electroencephalograph, Electromyography, measurement of heart rate, blood pressure measurement, and temperature measurement respiration rate. Foetal Monitoring System: Methods of monitoring Foetal Heart Rate, Abdomen Foetal Electrocardiogram and Foetal Phonocardiogram. Biomedical Telemetry: Introduction, block diagram and description of single channel/multi channel telemetry systems.

Imaging Systems:
Introduction, Basic principle and block diagram of x-ray machine, x-ray computed topography (C.T. Scanner) and Nuclear Magnetic resonance (NMR) Topography, Ultrasonic Imaging System, Introduction, medical ultrasound, block diagram of pulse echo-system.

Therapeutic and Physiotherapy Equipments:
Type of cardiac Pacemakers, Cardiac Defibrillator, Kidney Machine, Short-wave Diathermy, Microwave Diathermy, Ultrasound Therapy unit.

Patient Safety:
Electric shock hazard, leakage currents, Test Instruments for checking safety parameters of Biomedical Equipments.

Suggested Text Books & References:

1. R.S. Khandpur. Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi. Simon Haykin: Communication systems - John-Wiley & sons, Inc.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pferffer Biomedical Instrumentation and Measurements Prentice Hall of India, New Delhi.
3. Joseph J Carr & John M Brown – Introduction to Biomedical Equipment Technology, 4th Edn., Pearson Education.
4. T. K. Attuwood & D J Pary Smith, Introduction to Bioinformatics, 1999, Pearson

8. CMOS ANALOG IC DESIGN

Large Signal Models of MOS Transistors:
I-V Characteristics, Early Effect, Channel Length Modulation, Back Gate Effect and other Second-Order Effects.

Passive Components:
Properties of Resistors and Capacitors and Matching Considerations

Analog Sub-circuits:
Basic MOS Amplifiers, Differential Pairs, Current Sources, MOS Switches, and Basic Sample/Hold Circuit Basic Two-Stage Op-Amp Design: NMOS and CMOS architectures, DC Design, Frequency Compensation, Slew Rate, Power Supply Rejection, Offset Voltage calculation and Noise considerations. Advanced CMOS OP Amp Configurations: Folded-Cascode Op-amp, Class AB Op-amps, and Fully Differential op-amp

Voltage References:

Basic Design and Evaluation of Band Gap Reference, and CMOS Band Gap References MOS Voltage Comparators: Various Configurations and Offset Cancellation Techniques Digital-to-Analog and analog to digital converters Current scaling DAC, Voltage scalling DAC charge scaling DAC, Extending resolution of parallel DAC, similar scaled DACs High speed ADCS, parallel or flash ADCS, interpolating ADCS, folding ADCS, Multibit pipeline ADCS delta sigma modular, Decimators filters.

Switched Capacitor Filters:

Basic Switched Capacitor Integrators, Z-transforms, and Switched Capacitor Filter Design, MOSFET-C Filters and techniques of non linearity cancellation in MOS circuit

Suggested Text Books & References:

1. "Design of Analog CMOS Integrated Circuits" by Behzad Razavi; Tata McGraw-Hill
2. "CMOS analog Circuit Design" by Allen Holberg; Oxford University Press
3. "Analog VLSI Signal and Information Processing" by Mohammed Ismail Terri Fiez; McGraw Hill International Editions.
4. "Analog MOS Integrated Circuits for Signal Processing" by Roubik Gregorian and Gabor C. Temes; Wiley series on filters
5. "Analysis and Design of Analog Integrated Circuits", Fourth Edition by Gray Hurst Lewis Meyer, Wiley

9. TELECOMMUNICATION SWITCHING SYSTEM

Introduction:

Developments of telecommunications, Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM, TDM, PDH and SDH, Transmission performance.

Evolution of Switching Systems:

Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronic switching, Digital switching systems. Subscriber loop systems, switching hierarchy and routing, transmission plan, numbering plan, charging plans.

Digital Switching System:
Fundamentals - Purpose of analysis, Basic central office linkages, Outside plant versus inside plant, Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, Basic call processing.

Telecommunication Traffic:
Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems. Signalling Techniques: In channel signalling, common channel signalling. Single stage networks, Gradings, Link Systems, GOS of Linked systems.

Time Division Switching:
Introduction, space and time switching, Time switching networks, Synchronisation.

Integrated Services Digital Network (ISDN) :
Introduction, motivation, ISDN architecture, ISDN interfaces, functional grouping, reference points, protocol architecture, signaling, numbering, addressing, BISDN.

DSL Technology:
ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS. SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, STS I, Virtual Tributaries and Higher rate of service.

Suggested Text Books & References:
1. Tele communication switching system and networks-Thyagarajan Viswanath, PHI, 2000.
2. Advanced electronic communications systems - Wayne Tomasi, PHI, 2004.
3. Digital telephony - J. Bellamy, John Wiley, 2nd edition, 2001.
4. Telecommunication switching, Traffic and Networks - J E Flood, Pearson Education, 2002.
5. Principles of Communication Systems – H. Taub & D. Schilling, TMH, 2nd Edition, 2003.

10. ANTENNA AND WAVE PROPAGATION

Radiation:
Retarded potentials, radiation from an oscillation dipole in free space, induction and radiation fields. Radiated power from a current element, radiation resistance, short antennas, radiation from a quarter wave monopole and half wave dipole.

Antenna Fundamentals:
Reciprocity properties of antennas, radiation patterns, directional properties of dipole antennas. Antenna gain and aperture, antenna terminal impedance, self and mutual impedance, front to back ratio, antenna beam width and bandwidth, antenna efficiency, antenna beam area, polarization, antenna temperature and
signal to noise ratio.

Antenna Arrays:
Various forms of arrays, Arrays of two point sources, linear arrays of n-point sources, pattern multiplication Arrays of equal amplitude and spacing (Broadside and end fire arrays), array factor, directivity and beam width, Binomial array.

Practical Antennas:
VLF and LF antennas(Hertz and Marconi antennas),effects of antenna height and effect of ground on performance of antenna , medium frequency antenna and Rhombic antennas, Loop antennas , receiving antenna and radio direction finders.VHF, UHF and SHF antennas: Folded dipole antennas, Yagi-uda antenna, slotted and horn antennas, microwave dish, helical antennas, frequency independent antennas, turnstile antenna, microstrip antennas, fractal antennas.

Ground Wave Propagation:
Characteristics for ground wave propagation, reflection at the surface of a finitely conducting plane, earth (on ground), Attenuation Calculation of field strength at a distance.

Ionosphere Propagation:
The ionosphere, formation of the various layers, their effective characteristics, reflection and refraction of waves by ionosphere, virtual height, maximum frequency, skip distance, regular and irregular variation of ionosphere, Fading and Diversity reception, ordinary and extraordinary waves.

Space Wave Propagation:
Space wave, range and effect of earth, Troposphere waves-reflection, refraction, duct propagation, Troposphere scatter propagation link.
Introduction to planar (Rectangular) waveguides- TE and TM and TEM modes.

Suggested Text Books & References:

1. J.D. Kraus, "Antennas, "McGraw Hill.
2. C.A. Balanis “Antennas Theory and Design”, Willey
3. K D Prasad “Antenna & Wave Propagation”
4. E.C. Jorden & B.C. Balmann," Electromagnetic waves & radiating System", P.H.I.
5. R.E. Collins, 'Antennas and Radio Propagation ", McGraw-Hill, 1987.

11. LOW POWER VLSI DESIGN

Introduction, MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, The Differential Inverter, The Transmission Gate, The Tristate Inverter, Bipolar Devices (Diodes, BJT, BiCMOS). Silicon Semiconductor Technology: An overview, Basic CMOS Technology, CMOS Process Enhancements Layout Design Rules, Latch up, Technology-related CAD Issues. Resistance Estimation, Capacitance Estimation, Inductance, Switching Characteristics, CMOS-Gate Transistor Sizing, Power Dissipation, Sizing Routing Conductor, Charge Sharing, CMOS Logic Gate Design, Basic Physical Design of Simple Logic Gates CMOS Logic Structures, Clocking Strategies ,I/O Structures (Overall Organization, Output pads, Input pads), Low-power Design. Design Strategies, CMOS Chip Design Options (programmable logic, programmable Gate arrays, Design Methods, Design-capture Tools, Design Verification Tools. The Need for Testing, Manufacturing Test Principles (Automatic Test Pattern Generation (ATPG)), Delay fault analysis, Design Strategies for Test Chip Level Test Techniques, System Level Test Techniques. Data path Operations (Addition/ Subtraction, Parity Generators, Binary Counters), Boolean Operations-ALUs, Multiplication, Memory Elements, Control.

Suggested Text Books & References:

1. KiatSeng Yeo and Kaushik Roy, Low- Voltage, Low-Power VLSI Subsystemss, Edition 2009,Tata McGraw Hill
2. Soudris D, Piguet C and Goutis C, Designing CMOS Circuits for Low Power, Kluwer Academic Publishers, 2002
3. Jan Rabaey, Low Power Design Essentials, Springer

12. EMBEDDED SYSTEM

Embedded systems Overview, Characteristics of embedded computing applications. Design Challenges, Common Design Metrics. Processor Technology, IC Technology, Trade-offs, the development process, requirements. Specification, Architecture Design, Designing Hardware and Software components. System Integration and Testing, Types of Hardware Platforms, Single board computers. PC Add-on cards, custom-built hardware platforms, ARM Processor, CPU performance. CPU power consumption, Bus-based computer systems. Memory devices, I/O devices, component interfacing, designing with microprocessors, system level performance analysis. components for embedded programs, Models of programs, Assembly, Linking, and loading, basic compilation techniques. Software performance optimization, program level energy and Power analysis, Program validation and Testing.

Suggested Text Books & References:

1. Wayne Wolf, Computers as Components-Principles of Embedded Computer System Design, Morgun Kaufmann Publisher, 2006.
2. David E-Simon, An Embedded software Primer, Pearson Education, 2007.

13. ASIC DESIGN

Introduction, Types of ASIC's Design Flow, CMOS Logic. ASIC Library Design, Transistor Parasitic Capacitance, Input Slew Rate, Library-Cell Design, Library Architecture. Programmable ASICs. The Antifuse Metal Antifuse, Static RAM, EPROM and EEPROM Technology, Practical Issues.

Programmable ASIC Logic Cells, Actel, Xilinx LCA., XC3000 CLB, XC4000 Logic Block, XC5200 Logic Block, Xilinx CLB Analysis,. Logic Expanders. Programmable ASIC I/O Cells, Totem-Pole Output, Mixed-Voltage Systems, Metastability, Xilinx I/O Block. Boundary Scan.

Programmable ASIC Interconnect and Programmable ASIC Design Software. Actel ACT, RC Delay in Antifuse Connections, Xilinx EPLD Logic Synthesis, FPGA Synthesis, Third-party Software. Low level design entry, logic synthesis, simulation, Test and ASIC construction, VHDL, Verilog HDL, Logic Synthesis, Simulation.

Suggested Text Books & References:

1. Michael John, Sebastian Smith, Application Specific Integrated Circuits, Addison Wesley Publishing Company, 1997.
2. Elaine Rhodes: ASIC Basics, Lulu, 2005.

14. DSP ALGORITHMS AND ARCHITECTURE

Introduction to Digital Signal Processing:

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.

Architectures for Programmable Digital Signal-Processors:

Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.

Programmable Digital Signal Processors:

Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx., Memory Space of TMS32OC54xx Processors, Program Control.

Detail Study of TMS320C54X & 54xx Instructions and Programming, On Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.

Implementation of Basic DSP Algorithms:

Introduction, The Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case).

Implementation of FFT Algorithms:

Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS32OC54xx.

Interfacing memory and parallel I/O Peripherals to DSP devices:

Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA).

Interfacing and Applications of DSP Processor:
Introduction, Synchronous Serial Interface, A CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System.

Suggested Text Books & References:

1. "Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning,
2. Digital Signal Processing: A practical approach, Ife achor E. C., Jervis B. W Pearson-Education, PHI
3. "Digital Signal Processors", B Venkataramani and M Bhaskar ,TMH
4. "Architectures for Digital Signal Processing", Peter Pirsch John Weily

15. RADAR AND NAVIGATION

Nature of Radar:
Radar block diagram & operation, Radar range performance & its equations, Minimum detectable signal, Cross-section of a target, PRF & Range ambiguity, Antenna parameters

MTI & Doppler radar:
Doppler effect, CW radar, FM CW, Delay line cancellers, Multiple or staggered, PRF, Non coherent MTI, Pulse Doppler Radar

Scanning, Duplexers and Radar receivers:
Sequential lobing, Conical Scanning, Mono pulse Tracking RADAR, Tracking with surveillance RADAR, Acquisition, Radar receiver, Display Duplexers

Electronic Navigation:
Introduction, loop antenna, loop input circuits, Aural null detection finder, Goniometer, Adcock detection finder, VHF omni directional range finder, The LF/MF four course radio range

Navigation Systems and Clutter:
VOR receiving equipment, Loran-A, DECCA navigation system, DME, TACAN, Surface clutters Radar equation, Sea clutter, Land clutter

Suggested Text Books & References:

1. Skolnik M. I. "Introduction to Radar Systems" McGraw Hill
2. Nagraja, N.S. "Elements of Electronic Navigation" Tata McGraw Hill 2nd Ed.
3. Nathanson, Fred E. "Radar An Overview Design Principles"PrenticeHall (India)
4. Toomay, J.C. "Principles of Radar" Prentice Hall (India)

16. INDUSTRIAL ELECTRONICS

Power semiconductor devices:

Thyristor, Thyristor characteristics, Thyristor turn-on methods, Thyristor protection, Series and parallel operation of thyristors, Thyristor commutation; Characteristics of Diac and Triac; Power diode; Power transistor; Power MOSFET; IGBT.

Phase controlled converters:

Principle of phase control, Single-phase half-wave circuit with different types of load, Singleasefull-wave mid-point converter, Single-phase full-wave bridge converters, Single-phase miconverter, Three-phase thyristor converters, Single-phase and three-phase dual converters.

DC choppers:

Principle of chopper operation and control strategies, Step-up and step-down choppers, Typesof chopper circuits, Voltage-commutated chopper, Current-commutated chopper, Load-commutated chopper.

Inverters:

Single-phase voltage source inverters, Modified McMurray half-bridge and full-bridge inverter, McMurray-Bedford half-bridge and full-bridge inverter, Pulse-width modulated inverters, current source inverters, Series inverters, Parallel inverter.

Applications of industrial electronics:

Switched mode power supply (SMPS), Uninterruptible power supplies, Solid state relays.

Suggested Text Books & References:

1. Power Electronics: Circuits, Devices and Applications by Muhammad H. Rashid; Pearson / PHI Publication
2. Power Electronics by Dr. P. S. Bimbhra; Khanna Publishers
3. Power Electronics by P. C. Sen; Tata McGraw Hill Publication
4. Power Electronics by C. W. Lander; McGraw Hill Publication

LIST OF SUBJECTS FOR
OPEN ELECTIVE – I & OPEN ELECTIVE – II

1. **SOFT COMPUTING**
2. **IMAGE PROCESSING**
3. **ROBOTICS**
4. **CRYPTOGRAPHY AND SECURITY**
5. **COMPUTER ARCHITECTURE & ORGANISATION**
6. **OPERATING SYSTEM**
7. **ELECTIVE OFFERED BY OTHER DEPARTMENTS**

1. SOFT COMPUTING

Neural Networks-1(Introduction & Architecture):
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

Neural Networks-II (Back propagation networks):
Architecture: perception model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting back propagation training, applications.

Fuzzy Logic-I (Introduction):
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Fuzzy Logic –II (Fuzzy Membership, Rules):
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzy fications & Defuzzifications, Fuzzy Controller,

Evolutionary Computation:
Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities.
Introduction to swarm intelligence.

Suggested Text Books & References:

1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing home, 2002.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', 2nd John Wiley (India), 1997.
3. A. Konar, Computational Intelligence: Principles, Techniques and Applications, CRC press.
4. S N Sivanandam, S N Deepa – Principles of Soft Computing, Wiley Publications

2. IMAGE PROCESSING

Digital image fundamentals:

Fundamental Steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception. Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

Image Transform:

Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform. Discrete cosine transform, sine transform, Hadamard transform, Haar transform, Slant transform, KL transform.

Image Enhancement:

Image Enhancement in Spatial domain, Some Basic Gray Level Trans - formations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations.

Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, homomorphic filtering.

Image Restoration:

Model of image degradation/restoration process, noise models, Restoration in the Presence of Noise, Only-Spatial Filtering Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) Filtering,

Color image processing:

Color Fundamentals, Color Models, Pseudo color Image Processing., processing basics of full color image processing

Suggested Text Books & References:

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, etl, TMH,
2. Fundamentals of Digital Image Processing Anil K. Jain, Pearson Education,
3. Digital Image Processing and Analysis, B. Chanda and D. DuttaMajumdar, PHI,

3. ROBOTICS

Introduction:

Definition and Need for Robots, Robot Anatomy, Co-ordinate Systems, Work Envelope, types and classification, Specifications, Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load, Robot Parts and Their Functions, Different Applications

Sensors:

Principles and Applications and need of a sensor, Principles, Position of sensors, Piezo-Electric
Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors, Range Sensors, Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters, Proximity Sensors, Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors, Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors

Drive Systems & Grippers for Robot:

Drives systems (Mechanical, Electrical, Pneumatic Drives, Hydraulic), D.C. Servo Motors, Stepper Motor, A.C. Servo Motors, Comparison of all Drives, End Effectors, Grippers (Mechanical, Pneumatic, Hydraulic, Magnetic, Vacuum Grippers), Two Fingered and Three Fingered Grippers, Internal Grippers and External Grippers, Selection and Design Considerations

Machine Vision:

Camera, Frame Grabber, Sensing and Digitizing Image Data, Signal Conversion, Image Storage,
Lighting Techniques, Image Processing and Analysis, Data Reduction, Edge detection, Segmentation Feature Extraction, Object Recognition, Other Algorithms, Applications, Inspection, Identification, Visual Serving and Navigation.

Robot Kinematics & Programming:

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2-Dimensional), Four Degrees of Freedom (In 3 Dimensional), Deviations and Problems Teach Pendant Programming, Lead through programming, Robot programming Languages, VAL Programming, Motion Commands, Sensor Commands, End effecter commands.

Suggested Text Books & References:

1. M.P.Groover, ―Industrial Robotics – Technology, Programming and Applications, McGraw-Hill, 2001.
2. Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.
3. Yoram Koren, Robotics for Engineers‖, McGraw-Hill Book Co., 1992.
4. Fu, K., Gonzalez, R. and Lee, C.S. G., Robotics: Control, Sensing, Vision and Intelligence¸ McGraw Hill, 1987.
5. Robin R Murphy, AI robotics, PHI, 2000.

4. CRYPTOGRAPHY AND SECURITY

Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.
Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET).
System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Suggested Text Books & References:

1. William Stallings, “Cryptography and Network Security: Principals and Practice”, Prentice Hall, New Jersy.
2. Johannes A. Buchmann, “Introduction to Cryptography”, Springer-Verlag.
3. Bruce Schiener, “Applied Cryptography”.

5. COMPUTER ORGANISATION AND ARCHITECTURE

Introduction:
Organization and Architecture, Structure and Function, Brief History of Computers, Designing for Performance, Performance metrics; MIPS, MFLOPS, Computer Components and Functions, Interconnection Structures, Bus Interconnection, Point-To-Point Interconnect, PCI Express, Flynn’s classification of computers (SISD, MISD, MIMD.

Internal and Cache Memory:
Computer Memory System Overview, Cache Memory Principles, Elements of Cache Design, Semiconductor Main Memory, Advanced Dram Organization.

Basic non pipelined CPU Architecture and Operating System:
CPU Architecture types (accumulator, register, stack, memory/register) detailed data path of a typical register based CPU, Fetch-Decode-Execute cycle (typically 3 to 5 stage), microinstruction sequencing, implementation of control unit, Enhancing performance with pipelining. Operating System

Overview, Scheduling, Memory Management, Pentium Memory Management.

Parallel Processing and Multi-core Computer:
Multiple Processor Organizations, Symmetric Multiprocessors, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Clusters, Non-uniform Memory Access, Vector Computation, Multi-core Computers, Hardware and Software Performance Issues, Multi-core Organization, Intel x86 Multi-core Organization.

Suggested Text Books & References:

1. William Stallings, Computer Organization and Architecture, 9/E, Pearson, Delhi.
2. Computer Architecture and Organization, 3rd Edi, by John P. Hayes, TMH.
3. Chaudhuri P. Pal, Computer Organisation &Design, PHI,
4. Mano, M.M., Computer System Architecture, PHI.

6. OPERATING SYSTEM

Introduction and Overview of Operating Systems:
Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, User interface related functions, Classes of operating systems, O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems.

Structure of the Operating Systems:
Operation of an O.S, Structure of the supervisor, Configuring and installing of the supervisor, Operating system with monolithic structure, layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems.

Process Management:
Process concept, Programmer view of processes, OS view of processes, Interacting processes, Threads, Processes in UNIX, Threads in Solaris.

Memory Management:
Memory allocation to programs, Memory allocation preliminaries, Contiguous and non-contiguous allocation to programs, Memory allocation for program controlled data, kernel memory allocation.

Virtual Memory:
Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing, UNIX virtual memory.

File Systems:
File system and IOCS, Files and directories, Overview of I/O organization, Fundamental file organizations, Interface between file system and IOCS, Allocation of disk space, Implementing file access, UNIX file system.

Scheduling:
Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Process scheduling in UNIX.

Message Passing:
Implementing message passing, Mailboxes, Inter process communication in UNIX.

Suggested Text Books & References:

1. "Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH,
2. Operating Systems Concepts, Silberschatz and Galvin, John Wiley India Pvt. Ltd,
3. Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education,
4. Design of Operating Systems, Tannenbhaum, TMH,

NC 481 SOFT SKILL – II

L	T	P	C	
3	0	0	0	**Full Marks: 50 (Sessional – Non Credit)**

Numbers:
Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

Arithmetic – I :
Percentages, Profit & Loss, Simple Interest & Compound Interest, Clocks & Calendars

Algebra – I :
Logarithms, Problems on ages

Modern Mathematics – I :
Permutations, Combinations, Probability

Reasoning:
Logical Reasoning, Analytical Reasoning

Assessment:
1. Objective type – Paper based / Online – Time based test

Suggested Text Books & References:

1. Agarwal. R.S– Quantitative Aptitude for Competitive Examinations, S. Chand Limited 2011
2. AbhijitGuha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 3rd Edition, 2011
3. Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition, 2012