STUDY AND EVALUATION SCHEME

B.Tech. Electronics Engineering, B.Tech. Electronics & Communication Engineering, B.Tech. Electronics & Telecommunication Engineering, B.Tech. Electronics & Instrumentation Engineering, B.Tech. Instrumentation & Control Engineering, B. Tech. Applied Electronics and Control Engineering, B. Tech. Biomedical Engineering

[Effective from Session 2014-15]

YEAR 2ND SEMESTER-III

S.No.	Subject Code	Name of Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	CT	TA	Total	ESC		
1.	NAS-301/ NOE-031-NOE-039	Engg. Mathematics-III/Science based Electives*	3	1	0	30	20	50	100	150	4
2.	NEC-301	Network Analysis & Synthesis	3	1	0	30	20	50	100	150	4
3.	NEC-302	Fundamental of Electronic Devices	3	1	0	30	20	50	100	150	4
4.	NEC-303	Signals and Systems	3	1	0	30	20	50	100	150	4
5.	NHU-301/ NHU-302	Industrial Psychology/Industrial Sociology	2	0	0	15	10	25	50	75	2
6.	NEC-304	Switching Theory & Logic Design	2	1	0	15	10	25	50	75	3
	AUC-001/ AUC-002	Human Values & Professional Ethics/Cyber Security	2	0	0	15	10	25	50	75**	--
PRACTICAL/DESIGN/DRAWING											
7.	NEC-351	Network Analysis & Synthesis Lab.	0	0	3	10	10	20	30	50	1
8.	NEC-352	Electronics Workshop & PCB Design	0	0	3	10	10	20	30	50	1
9.	NEC-353	Logic Design Lab.	0	0	2	10	10	20	30	50	1
10.	NEC-354	Electronic Device Lab.	0	0	2	10	10	20	30	50	1
11.	NGP-301	NGP						50		50	--
		Total	18	5	10					1000	25

Science Based Open Elective:

NOE031 Introduction to Soft Computing (Neural Network, Fuzzy Logic and Genetic Algorithm
NOE032 Nano Sciences
NOE033 Laser Systems and Applications
NOE034 Space Sciences
NOE035 Polymer Science & Technology
NOE036 Nuclear Science
NOE037 Material Science
NOE038 Discrete Mathematics
NOE039 Applied Linear Algebra

*Human values & Professional Ethics /Cyber Security will be offered as a compulsory audit course for which passing marks are 30% in End Semester Examination and 40% in aggregate.

STUDY AND EVALUATION SCHEME

B.Tech. Electronics Engineering, B.Tech. Electronics & Communication Engineering, B.Tech. Electronics & Telecommunication Engineering, B.Tech. Electronics & Instrumentation Engineering, B.Tech. Instrumentation & Control Engineering, B. Tech. Applied Electronics and Control Engineering, B. Tech. Biomedical Engineering

[Effective from Session 2014-15]

YEAR 2ND SEMESTER-IV

S.No.	Subject Code	Name of Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	CT	TA	Total	ESC		
1.	NOE-041-NOE-049/ NAS-401	Science based Elective/Engg. Mathematics-III	3	1	0	30	20	50	100	150	4
2.	NEC-401	Data Structure	3	1	0	30	20	50	100	150	4
3.	NEC-402	Electronic Circuits	3	1	0	30	20	50	100	150	4
4.	NEC-408	Electronic Measurements & Instrumentation	3	1	0	30	20	50	100	150	4
5.	NHU-401/ NHU-402	Industrial Sociology/ Industrial Psychology	2	0	0	15	10	25	50	75	2
6.	NEC-404	Electromagnetic Field Theory (EMFT)	2	1	0	15	10	25	50	75	3
7.	AUC-002/ AUC-001	Cyber Security/ Human Values & Professional Ethics	2	0	0	15	10	25	50	75**	--
PRACTICAL/DESIGN/DRAWING											
8.	NEC-451	Data Structure Lab.	0	0	3	10	10	20	30	50	1
9.	NEC-452	Electronic Circuits Lab.	0	0	3	10	10	20	30	50	1
10.	NEC-453	Digital Electronics Lab.	0	0	2	10	10	20	30	50	1
11.	NEC-454	Electronics Measurement Lab.	0	0	2	10	10	20	30	50	1
12.	NGP-401	NGP						50		50	--
		Total				40				1000	25

Science Based Open Elective:

NOE-041 Introduction to Soft Computing (Neural Network, Fuzzy Logic and Genetic Algorithm
NOE-042 Nano Sciences
NOE-043 Laser Systems and Applications
NoE-044 Space Sciences
NOE-045 Polymer Science & Technology
NOE-046 Nuclear Science
NOE-047 Material Science
NOE-048 Discrete Mathematics
NOE-049 Applied Linear Algebra

*Human values & Professional Ethics /Cyber Security will be offered as a compulsory audit course for which passing marks are 30% in End Semester Examination and 40% in aggregate.

Syllabus Third semester

THEORY SUBJECTS

NEC-301 NETWORK ANALYSIS & SYNTHESIS			3 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	Signal analysis, complex frequency, network analysis, network synthesis, General characteristics and descriptions of signals, step function and associated wave forms, The unit impulse Introduction to network analysis, network elements, initial and final conditions, step and impulse response, solution of network equations,	1.1 to 1.4 2.1 to 2.3 5.1 to 5.5	10
II.	Review of Laplace transforms, poles and zeroes, initial and final value theorems, The transform circuit, Thevenin's and Norton's theorems, the system function, step and impulse responses, the convolution integral. Amplitude and phase responses. Network functions, relation between port parameters, transfer functions using two port parameters, interconnection of two ports.	7.1 to 7.5 8.1 9.1 to 9.4	8
III.	Hurwitz polynomials, positive real functions. Properties of real immittance functions, synthesis of LC driving point immittances, properties of RC driving point impedances, synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances.	10.2,10.3 11.1 to 11.5	8
IV.	Properties of transfer functions, zeroes of transmission, synthesis of Y21 and Z21 with 1Ω terminations.	12.1 to 12.3	6
V.	Introduction to active network synthesis Active Network Synthesis	Material available on UPTU website & 8.7 (Text Book 2)	8

Text Book:

1. Franklin F. Kuo, "Network Analysis and synthesis", 2nd Edition, Wiley India Pvt Ltd.

2. Behrouz Peikari, "Fundamentals of Network Analysis & synthesis", Jaico Publishing House, 2006.

Reference Books: M. E. Van Valkenberg, "Network Analysis", 2nd Edition, Prentice Hall of India Ltd.
Ghosh-Network Theory: Analysis and Synthesis, PHI Learning Pvt. Ltd

NEC-302 FUNDAMENTAL OF ELECTRONIC DEVICES			3 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	Crystal Properties and charge Carriers in Semiconductors: Elemental and compound semiconductor materials, crystal lattice structure, Bonding forces and energy bands in solids, charge carriers in semiconductors, carrier concentrations, drift of carriers in electric and magnetic fields.	1.1 to 1.2 3.1 to 3.4	8
II.	Excess Carriers in Semiconductors: Optical absorption, luminescence, carrier life time and photo conductivity, diffusion of carriers.	4.1 to 4.3 and 4.4.1 to 4.4.4	8
III.	Junction Properties: Equilibrium conditions, biased junctions, steady state conditions, reverse bias break down, transient and AC conditions. Metal semiconductor junctions.	5.2 to 5.5 5.7	8
IV.	Transistors: Metal-semiconductor-field-effect-transistors (MESFET), Metal-insulator-semiconductor-field-effect-transistors (MISFET), Metal oxide semiconductor field effect transistor (MOSFET): Construction, Operation and characteristics of above devices. Bipolar junction transistors: Fundamentals of BJT operation, amplification with BJTs	6.3.1 to 6.3.2, 6.4.1 to 6.4.2, 6.5.1 to 6.5.2 7.1 to 7.2	8
V.	Some special devices: Photodiodes, photo detectors, solar cell, light emitting diodes, semi-conductor lasers, light emitting materials. Tunnel Diode: degenerate semiconductors, IMPATT diode; The transferred electron mechanism: The GUNN diode. P-N-P-N diode, semiconductor controlled rectifier (SCR), bilateral devices: DIAC, TRIAC, IGBT.	8.1, 8.2.1, 8.2.3, 8.3, 8.4; 10.1 10.2 10.3.1, 10.3.2 11.1 to 11.3	8
Text Book: B. G. Streetman and S. Banerjee "Solid state electronics devices", 5th Edition, PHI.			
Reference Books:1. Alok Dutta, "Semiconductor Devices and circuits", Oxford University Press. 2. Donald A Neaman, "Semiconductor Physics and Devices Basic Principles" 3rd Ed TMH India.			

NEC-303 SIGNALS AND SYSTEMS			3 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	**Signals**: Definition, types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one-dimensional/ multidimensional; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step, unit ramp (and their interrelationships), exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables).	1.1 to 1.5	6
II.	**Laplace-Transform (LT) and Z-transform (ZT):** (i) One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping	2.1 to 2.15	3+5
III.	**Fourier Transforms (FT):** (i) Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT (ii) Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT	4.1 4.11; 5.1 to 5.7	6+4
IV.	**Systems**: Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability. Convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density,	7.1 to 7.12; 9.2, 9.6 to 9.8	8
V.	**Time and frequency domain analysis of systems** Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter	8.1-8.6; 8.8	10

Text Book: P. Ramakrishna Rao, 'Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi

Reference Books:

Chi-Tsong Chen, 'Signals and Systems', 3rd Ed., Oxford University Press, 2004

V. Oppenheim, A.S. Willsky & S. Hamid Nawab, 'Signals & System', Pearson Education, 2nd Ed., 2003.

NEC-304 SWITCHING THEORY AND LOGIC DESIGN			2 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	Digital system and binary numbers: Signed binary numbers, binary codes. Gate-level minimization: The map method up to four variable, don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc-Clusky method (Tabular method).	1.6, 1.7, 7.4 3.1 to 3.7, 3.10	5
II.	Combinational Logic: Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decimal adder, binary multiplier, magnitude comparator, decoders, encoders, multiplexers	4.1 to 4.11	8
III.	Synchronous Sequential logic: Sequential circuits, storage elements: latches, flip flops, analysis of clocked sequential circuits, state reduction and assignments, design procedure. Asynchronous Sequential logic: Analysis procedure, circuit with latches, design procedure, reduction of state and flow table, race free state assignment, hazards.	5.1 to 5.5, 5.7 to 5.8 9.1 to 9.7	9
IV.	Registers and counters: Shift registers, ripple counter, synchronous Counter, other counters. Memory and programmable logic: RAM, ROM, PLA, PAL.	6.1 to 6.5 7.1 to 7.3, 7.5to 7.7	8
Text Book: M. Morris Mano and M. D. Ciletti, "Digital Design", 4th Edition, Pearson Education			
Reference Books: 1. Hill & Peterson, "Switching Circuit & Logic Design", Wiley. 2. Mohammad A. Karim and Xinghao Chen, "Digital Design-Basic concepts and Principles", CRC Press Taylor & Francis group, 2010.			

LABORATORY

NEC- 351 NETWORK ANALYSIS & SYNTHESIS LAB

1. Study and verification of network theorems with input signal of 1 kHz, 10kHz and 100kHz.
2. Verification of two port network parameters
3. Step and Ramp response of series and parallel RC circuits
4. Verification of properties of RC circuits
5. Verification of properties of RL circuits
6. Verification of properties of LC circuits
7. Verification of inverting, non-inverting and voltage follower VCVS circuits using 741 op-amp
8. Verification of inverting integrator using 741 op-amp
9. Design a finite gain differential amplifier with infinite input impedance and verify the output response.

NEC- 352 ELECTRONIC WORKSHOP & PCB LAB

Objective: To create interest in Hardware Technology.

1. Study of CRO, DMM & Function Generator
2. Identification of Active & Passive Components
3. Winding shop: Step down transformer winding of less than 5VA.
4. Soldering shop: Fabrication of DC regulated power supply
5. PCB Lab: (a) Artwork & printing of a simple PCB. (b) Etching & drilling of PCB.
6. Wiring & fitting shop: Fitting of power supply along with a meter in cabinet.
7. Testing of regulated power supply fabricated.

NEC- 353 LOGIC DESIGN LAB

Objective: To understand the digital logic and create various systems by using these logics.

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, Concept of V_{cc} and ground, verification of the truth tables of logic gates using TTL ICs.
2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
4. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
5. Implementation of 4x1 multiplexer using logic gates.
6. Implementation of 4-bit parallel adder using 7483 IC.
7. Design, and verify the 4-bit synchronous counter.
8. Design, and verify the 4-bit asynchronous counter.
9. Mini Project (Imp)

NEC- 354 ELECTRONIC DEVICES LAB.

Objective: To attain expertise in lab equipment handling and understanding the basic devices, their properties, Characteristics in detail. Along with their practical usage in the circuit

1. **Study of lab equipments and components:** CRO, Multimeter, Function Generator, Power supply- Active, Passive Components & Bread Board.
2. **P-N Junction Diode**: Characteristics of PN Junction diode-Static and dynamic resistance measurement from graph.
3. **Applications of PN junction diode**: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor-use of filter- ripple reduction (RC Filter)-Clipper & Clamper
4. **Properties of junctions** Zener diode characteristics. Heavy doping alters the reverse characteristics. Graphical measurement of forward and reverse resistance.
5. **Application of Zener diode:** Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
6. **Characteristic of BJT**: BJT in CB and CE configuration- Graphical measurement of h parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
7. **Characteristic of FET**: FET in common source configuration. Graphical measurement of its parameters gm, rd & m from input and output characteristics.
8. **Characteristic** of silicon-controlled rectifier.
9. **To plot** V-I Characteristics of DIAC.
10. **To draw** V-I characteristics of TRIAC for different values of Gate Currents.

Syllabus fourth semester

THEORY SUBJECTS

NEC-401 DATA STRUCTURE		3 1 0
Unit	Topic	Proposed number of Lectures
I.	Introduction: Basic Terminology, Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List	8
II.	Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.	8
III.	Trees: Basic terminology, Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: In order, Preorder and Post order, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.	8
IV.	Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal : Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transistive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm, Introduction to Activity Networks	8
V.	Searching : Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort	8

Text book:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI

References

1. Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publication
2. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill
3. R. Kruse etal, “Data Structures and Program Design in C”, Pearson Education
4. Lipschutz, “Data Structures” Schaum’s Outline Series, TMH
5. G A V Pai, “Data Structures and Algorithms”, TMH

NEC-402 ELECTRONIC CIRCUITS			3 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	**Operational Amplifier:** Inverting and non-inverting configurations, difference amplifier, Effect of finite open loop gain and bandwidth on circuit performance, Large signal operation of op-amp.	2.2 to 2.6	8
II.	**MOSFET:** Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier	4.3 to 4.9 and 4.11	8
III.	**BJT:** Review of device structure operation and V-I characteristics, BJT circuits at DC, BJT as amplifier and switch, biasing in BJT amplifier circuit, small-signal operation and models, single stage BJT amplifier, BJT internal capacitances and high frequency model, frequency response of CE amplifier.	5.3 to 5.9	8
IV.	**Differential Amplifier:** MOS differential pair, small signal operation of the MOS differential pair, BJT differential pair, other non-ideal characteristic of the Differential amplifier (DA), DA with active load.	7.1 to 7.5	9
V.	**Feedback:** The general feedback structure, properties of negative feed back, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt-series feedback amplifier. **Oscillators:** Basic principles of sinusoidal oscillators, op-amp RC oscillator circuits, LC oscillator.	8.1 to 8.6 13.1 to 13.3	7
Text Book: A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 5th Ed.			
Reference Books: Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Ed TMH			

NEC-403 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION			3 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, Other unit systems, dimension and standards. Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohm meter.	1.1 to 1.7 2.1 to 2.5 3.1 to 3.4	8
II.	Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multimeters, digital frequency meter system	4.1, 4.2, 4.4, 4.5, 4.7 6.1 to 6.3	8
III.	Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter	7.1, 7.3, 7.4,7.5 8.2 to 8.4, 8.9	8
IV.	CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications	9.1, 9.3, 9.4,9.5, 9.7, 9.9, 9.12,10.1, 10.3,10.4, 10.5	8
V.	Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters	12.1, 12.2 ,12.3, 13.2, 13.4	8

Text Book: David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI , New Delhi 2008.

Reference Books:

Oliver and Cage, "Electronic Measurements and Instrumentation", TMH, 2009.

Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann), 2008.

NEC-404 ELECTROMAGNETIC FIELD THEORY			2 1 0
Unit	Topic	Chapter/ Section	Proposed number of Lectures
I.	Coordinate systems and transformation: Cartesian coordinates, circular cylindrical coordinates, spherical coordinates Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stoke's theorem, Laplacian of a scalar.	2.1 to 2.4 3.1 to 3.8	6
II.	Electrostatics: Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields. Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constants, continuity equation and relaxation time, boundary condition. Electrostatic boundary value problems: Poission's and Laplace's equations, general procedures for soling Poission's or Laplace's equations, resistance and capacitance, method of images.	to 4.9 5.1 to 5.6, 5.8, 5.9 6.1, 6.2, 6.4 to 6.6	10
III.	Magnetostatics: Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, application of ampere's law, magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces, materials and devices: Forces due to magnetic field, magnetic torque and moment, a magnetic dipole, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy.	7.1 to 7.7 8.1 to 8.9	8
IV.	Waves and applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, displacement current, Maxwell's equation in final form. Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free space, plain waves in good conductors, power and the pointing vector, reflection of a plain wave in a normal incidence.	9.1 to 9.5 10.1, 10.3 to 10.8	8
Text Book: M. N. O. Sadiku, "Elements of Electromagnetics", 4th , Ed, Oxford University Press.			
Reference Books: W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7th Ed., TMH. Pramanik-Electromagnetism: Vol.1-Theory, PHI Learning Pvt. Ltd			

LABOROTARY

NEC- 451 DATA STRUCTURE LAB

Program in C or C++ for following:

1. To implement addition and multiplication of two 2D arrays.
2. To transpose a 2D array.
3. To implement stack using array.
4. To implement queue using array.
5. To implement circular queue using array.
6. To implement stack using linked list.
7. To implement queue using linked list.
8. To implement circular queue using linked list.
9. To implement binary tree using linked list.
10. To implement binary search tree using linked list.
11. To implement tree traversals using linked list.
12. To implement BFS using linked list.
13. To implement DFS using linked list.
14. To implement Linear Search.
15. To implement Binary Search.
16. To implement Bubble Sorting.
17. To implement Selection Sorting.
18. To implement Insertion Sorting.
19. To implement Merge Sorting.
20. To implement Heap Sorting.

NEC- 452 ELECTRONIC CIRCUITS LAB

Objective - To design and implement the circuits to gain knowledge on performance of the circuits and its applications.

Measurement of Operational Amplifier Parameters-Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.

Applications of Op-amp- Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator

Field Effect Transistors-Single stage Common source FET amplifier –plot of gain in dB Vs frequency, Measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier

Bipolar Transistors- Design of single stage RC coupled amplifier –design of DC biasing circuit using potential divider arrangement –Plot of frequency versus gain in dB. Measurement of bandwidth of an amplifier, input impedance and Maximum Signal Handling Capacity of an amplifier.

Two stage Amplifier. Plot of frequency Vs gain. Estimation of Q factor, bandwidth of an amplifier

Common Collector Configuration-Emitter Follower (using Darlington pair)-Gain and input impedance measurement of the circuit.

Power Amplifiers-Push pull amplifier in class B mode of operation –measurement of gain.

Differential Amplifier –Implementation of transistor differential amplifier .Non ideal characteristics of differential amplifier

Oscillators -Sinusoidal Oscillators- (a) Wein bridge oscillator (b) phase shift oscillator

Simulation of Amplifier circuits studied in the lab using any available simulation software and measurement of bandwidth and other parameters with the help of simulation software.

NEC- 453 DIGITAL ELECTRONIC LAB

1. TTL Transfer Characteristics and TTL IC Gates.
2. CMOS Gate Transfer Characteristics.
3. Implementation of a 3-bit SIPO and SISO shift registers using flip-flops.
4. Implementation of a 3-bit PIPO and PISO shift registers using flip-flops.
5. Design of Seven segment display driver for BCD codes.
6. BCD Adders & Subtractors
7. A L U
8. 8085 Assembly Language Programming

NEC- 454 ELECTRONIC MEASUREMENT LAB

1. Study of semiconductor diode voltmeter and its us as DC average responding AC voltmeter .
2. Study of L.C.R. bridge and determination of the value of the given components.
3. Study of distortion factor meter and determination of the % distortion of the given oscillator.
4. Study of the transistor tester and determination of the parameters of the given transistors.
5. Study of the following transducer (i) PT-100 trans (ii) J- type trans. (iii) K-type trans (iv) Presser trans
6. Measurement of phase difference and frequency using CRO (lissajous figure)
7. Measurement of low resistance Kelvin's double bridge.
8. Radio Receiver Measurements

SEMESTER - V

No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1	NEC 501	Integrated Circuits	3	1	0	30	20	50	100	150	4
2	NEC 502	Principles of Communication	3	1	0	30	20	50	100	150	4
3	NEC 503	Microprocessors	3	1	0	30	20	50	100	150	4
4	NIC 501	Control System – I	3	1	0	30	20	50	100	150	4
5	NEC 504	Antenna and Wave Propagation	2	1	0	15	10	25	50	75	3
6	NHU 501	Engineering Economics	2	0	0	15	10	25	50	75	2
PRACTICAL/ DESIGN/ DRAWING											
7	NEC 551	Integrated Circuits Lab	0	0	2	10	10	20	30	50	1
8	NIC 551	Control System Lab	0	0	2	10	10	20	30	50	1
9	NEC 552	Communication Lab – 1	0	0	2	10	10	20	30	50	1
10	NEC 553	Microprocessors Lab	0	0	2	10	10	20	30	50	1
11	NGP 501	GP						50		50	
		TOTAL	16	5	8					1000	25

SEMESTER - VI

No.	Subject Code	Name of the Subject	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Assessment			ESE		
						CT	TA	Total			
THEORY SUBJECTS											
1	NEC 601	Microwave Engineering	3	1	0	30	20	50	100	150	4
2	NEC 602	Digital Communication	3	1	0	30	20	50	100	150	4
3	NEC 603	Integrated Circuit Technology	3	1	0	30	20	50	100	150	4
4	NEC 0__	Departmental Elective – I	3	1	0	30	20	50	100	150	4
5	NEC 0__	Departmental Elective – II	2	1	0	15	10	25	50	75	3
6	NHU 601	Industrial Management	2	0	0	15	10	25	50	75	2
PRACTICAL/ DESIGN/ DRAWING											
7	NEC 651	Antenna and Microwave Lab	0	0	2	10	10	20	30	50	1
8	NEC 652	Communication Lab – II	0	0	2	10	10	20	30	50	1
9	NEC 653	CAD of Electronics Lab	0	0	2	10	10	20	30	50	1
10	NEC 654	Seminar	0	0	2	10	10	20	30	50	1
11	NGP 601	GP						50		50	
		TOTAL	16	5	8					1000	25

Departmental Elective – I

1. NEC 011 Digital Signal Processing
2. NEC 012 Computer Architecture and Organization
3. NEC 013 Artificial Neural Network
4. NEC 014 Advance Semiconductor Devices

Departmental Elective – II

1. NEC 021 Industrial Electronics
2. NEC 022 Microcontroller and its Applications
3. NEC 023 Analog Signal Processing
4. NEC 024 Advance Digital Design and Verilog

NEC 501 Integrated Circuits		
Unit	Topic	Proposed number of Lectures
I	**Analog Integrated circuit Design: an overview:** Current Mirrors using BJT and MOSFETs, Simple current Mirror, Base current compensated current Mirror, Wilson and Improved Wilson Current Mirrors, Widlar Current source and Cascode current Mirror **The 741 IC Op-Amp:** Bias circuit, short circuit protection circuitry, the input stage, the second stage, the output stage, and device parameters; D**C** Analysis of 741: Small Signal Analysis of input stage, the second stage, the output stage; Gain, Frequency Response of 741; a Simplified Model, Slew Rate, Relationship Between f_t and SR	10
II	**Linear Applications of IC op-amps:** An Overview of Op-Amp (ideal and non-ideal) based Circuits V-I and I-V converters, generalized Impedance converter, simulation of inductors **Filters:** First and second order LP, HP, BP BS and All pass active filters, KHN.	8
III	**Digital Integrated Circuit Design-An Overview**: CMOS Logic Gate Circuits**:** Basic Structure CMOS realization of Inverters, AND, OR, NAND and NOR Gates **Latches and Flip flops:**The Latch, The SR Flip-flop, CMOS Implementation of SR Flip-flops, A Simpler CMOS Implementation of the Clocked SR Flip-flop, D Flip-flop Circuits.	8
IV	**Non-Linear applications of IC Op-amps:** Log–Anti Log Amplifiers, Precision Rectifiers, Peak Detectors, Simple and Hold Circuits, Analog Multipliers and their applications. Op-amp as a comparator, Zero crossing detector, Schmitt Trigger, Astablemultivibrator, Monostablemultivibrator, Generation of Triangular Waveforms	7
V	**D/A and A/D converters** **Integrated Circuit Timer:** The 555 Circuit, Implementing a MonostableMultivibrator Using the 555 IC, AstableMultivibrator Using the 555 IC. **Phase locked loops (PLL):** Ex-OR Gates and multipliers as phase detectors**,** Block Diagram of IC PLL, Working of PLL and Applications of PLL.	7

Text Books:

1. Sedra and Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press.
2. Michael Jacob, "Applications and Design with Analog Integrated Circuits", PHI, 2nd Edition.

Reference Books:

1. Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Edition, Tata McGraw Hill.
2. BehzadRazavi, "Fundamentals of Microelectronics", 2nd Edition, Wiley.
3. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI.
4. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley.

NEC 502 Principles of Communication		
Unit	Topic	Proposed number of Lectures
I	Introduction:OverviewofCommunicationsystem,Communicationchannels,Needformodulation,BasebandandPass bandsignals,AmplitudeModulation: Doubleside bandwithCarrier(DSB-C),Doubleside bandwithoutCarrier, SingleSide BandModulation, DSB-SC,DSB-C,SSB Modulators and Demodulators,VestigialSideBand(VSB),Quadrature AmplitudeModulator, Radio Transmitterand Receiver.	10
II	Angle Modulation, Tone Modulated FM Signal, Arbitrary Modulated FM Signal, FM Modulators and Demodulators, Approximately Compatible SSB Systems,StereophonicFM Broadcasting, ExamplesBased onMat Lab.	8
III	PulseModulation,DigitalTransmissionofAnalogSignals:SamplingTheorem anditsapplications, Pulse AmplitudeModulation (PAM),Pulse Width Modulation, Pulse PositionModulation. Their generationandDemodulation, DigitalRepresentation ofAnalogSignals,PulseCodeModulation(PCM),PCM System,Issuesindigitaltransmission:Frequency DivisionMultiplexing,Time DivisionMultiplexing,LineCoding andtheir Power Spectral density, T1 Digital System, TDMHierarchy.	8
IV	Differential Pulse Code Modulation, Delta Modulation. Adaptive Delta Modulation,VoiceCoders,SourcesofNoises,Frequency domainrepresentation ofNoise, Super position ofNoises, Linearfilteringof Noises,Mathematical Representation of Noise.	7
V	NoiseinAmplitudeModulation:Analysis,SignaltoNoiseRatio,Figureof Merit.NoiseinFrequencyModulation:Preemphasis,DeEmphasisandSNR Improvement, PhaseLocked LoopsAnalog and Digital.	7

Text Book:

1. Herbert Taub and Donald L. Schilling, “Principles of Communication Systems”, Tata McGraw Hill.

Reference Books:

1. B.P.Lathi,“ModernDigitalandAnalogcommunicationSystems”,3rd Edition,OxfordUniversityPress.
2. SimonHaykin,“Communication Systems”,4thEdition,Wiley India.
3. H.P.Hsu&D.Mitra,“AnalogandDigitalCommunications”,2nd Edition,TataMcGraw-Hill.

NEC 503 MICROPROCESSORS		
Unit	**Topic**	**No. of Lectures**
1.	Evolution of microprocessors, Microprocessor architecture and its operations, 8085 pins description, programming model, basic interfacing concepts, input and output devices, logic devices and memory interfacing, addressing modes, Concept of instruction cycle, machine cycle and T-states, Concept of interrupts, Classification of 8085 instructions.	8
2.	8086 architecture-functional diagram, register organization, memory segmentation, programming model, memory address, physical memory organization, pins description, clock generator 8284A, maximum mode and minimum mode signal descriptions, timing diagrams, introduction to DOS and BIOS interrupts.	8
3.	Instruction formats, addressing modes, classification of instruction set, assembler directives (debug, TASM & MASM), macros, Programs techniques and assembly language programs: simple programs involves data transfer operation, arithmetic operation, logical operation, branch operation, machine control operation, string manipulations, stack and subroutine operations.	8
4.	8255 Programmable peripheral interfacing various mode of operation to 8086, interfacing keyboard and seven segment display, stepper motor interfacing, D/A and A/D converter, 8254 (8253) programmable interval timer, Direct Memory Access and 8237 DMA controller.	8
5.	Memory interfacing to 8086. Interrupt structure of 8086, interrupt handling, vector interrupt table and interrupt Service routine. Interfacing interrupt controller 8259 and DMA Controller 8257 to 8086. Serial communication standards, Serial data transfer schemes.	8

Text Book:

1. Ramesh Gaonkar, "Microprocessor architecture, programming and applications with the 8085", 5th Edition, Penram International Publication (India) Pvt. Ltd.
2. Douglas V. Hall, "Microprocessors and Interfacing", 2nd Edition, Tata McGraw Hill.

Reference Books:

1. Sivarama P. Dandamudi, "Introduction to Assembly Language Programing From 8086 to Pentium Processors", Springer.
2. Walter A. Triebel and Avtar Singh, "The 8088 and 8086 Microprocessors: Programming, Interfacing Software, Hardware and Applications", Pearson.
3. A. K. Ray and K. M. Bhurchandi, "Advance microprocessors and Peripherals" Tata McGraw Hill.
4. Lyla B. Das, "The X86 Microprocessors, Architecture, Programming and Interfacing (8086 to Pentium)", Pearson.

NIC 501 Control System – I		
Unit	Topic	Proposed number of Lectures
I	Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams Reduction and signal flow graphs, Modeling of Physical systems: electrical networks, mechanical systems elements, equations of mechanical systems, sensors and encoders in control systems, DC motors in control systems.	8
II	State-Variable Analysis: Vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability.	8
III	Time domain Analysis of Control Systems: Time response of continuous data systems, typical test signals for the time response of control systems, the unit step response and time-domain specifications, Steady-State error, time response of a first order system, transient response of a prototype second order system.	8
IV	Stability of Linear Control Systems: Bounded-input bounded-output stability continuous data systems, zero-input and asymptotic stability of continuous data systems, methods of determining stability, Routh Hurwitz criterion. Root-Locus Technique: Introduction, Properties of the Root Loci, Design aspects of the Root Loci	8
V	Frequency Domain Analysis: M_r (resonant peak) and ω_r (resonant frequency) and bandwidth of the prototype Second order system, effects of adding a zero to the forward path, effects of adding a pole to the forward path, Nyquist stability criterion, relative stability: gain margin and phase margin, stability analysis with The Bode plot.	8

Text Book:

1. B.C. Kuo&FaridGolnaraghi, "Automatic Control Systems", 8th Edition, John Wiley India.

Reference Books:

1. William A. Wolovich, "Automatic Control Systems", Oxford University Press.
2. Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Feedback and Control Systems" Schaums Outlines Series, 3rd Edition, Tata McGraw Hill.
3. I. J. Nagrath& M. Gopal, "Control System Engineering", New Age International Publishers.

NEC 504 Antenna and Wave Propagation		
Unit	Topic	Proposed number of Lectures
I	**Antennas Basics:** Introduction, Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle) ΩA, Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance.	8
II	**Point Sources and Their Arrays:** Introduction, Point Source ,Power Theorem and its Application to an Isotropic Source, Radiation Intensity, Arrays of Two Isotropic Point Sources, Non-isotropic but Similar Point Sources and the Principle of Pattern Multiplication, Pattern Synthesis by Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of Equal Amplitude and Spacing, Linear Broadside Arrays with Non- uniform Amplitude Distributions. General Considerations. **Electric Dipoles, Thin Liner Antennas and Arrays of Dipoles and Apertures**: The Short Electric Dipole, The Fields of a Short Dipole, Radiation Resistance of Short Electric Dipole, Thin Linear Antenna, Radiation Resistance of λ/2 Antenna, Array of Two Driven λ/2 Elements: Broadside Case and End-Fire Case, Horizontal Antennas Above a Plane Ground, Vertical Antennas Above a Plane Ground, Yagi-Uda Antenna Design, Long-Wire Antennas, folded Dipole Antennas.	8
III	**The Loop Antenna:** Design and its Characteristic Properties, Application of Loop Antennas, Far Field Patterns of Circular Loop Antennas with Uniform Current, Slot Antennas, Horn Antennas, Helical Antennas, The Log-Periodic Antenna, Micro strip Antennas. **Reflector Antennas:**Flat Sheet Reflectors, Corner Reflectors, The Parabola-General Properties, A Comparison Between Parabolic and Corner Reflectors, The Paraboloidal Reflector, Patterns of Large Circular Apertures with Uniform Illumination, Reflector Types (summarized), Feed Methods for Parabolic Reflectors.	8
IV	**Ground Wave Propagation:**Plane Earth Reflection, Space Wave and Surface Wave. **Space Wave Propagation:**Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth. **Sky wave Propagation:**Introduction structural Details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation, Wave Characteristics	8

Text Book:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", Fourth Edition, Tata McGraw Hill.

Reference Books:

1. A. R. Harish, M. Sachidananda, "Antennas and Wave Propogation", Oxford University Press.
2. Edward Conrad Jordan and Keith George Balmain, "Electromagnetic Waves and Radiating Systems", PHI.
3. A. Das, Sisir K. Das, "Microwave Engineering", Tata McGraw Hill.

LABOROTARY

NEC 551: Integrated Circuit Lab

Objective: - To design and implement the circuits to gain knowledge on performance of the circuit and its application. These circuits should also be simulated on Pspice.

1. Log and antilog amplifiers.
2. Voltage comparator and zero crossing detectors.
3. Second order filters using operational amplifier for–
    a. Low pass filter of cutoff frequency 1 KHz.
    b. High pass filter of frequency 12 KHz.
    c. Band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
4. Wien bridge oscillator using operational amplifier.
5. Determine capture range; lock in range and free running frequency of PLL.
6. Voltage regulator using operational amplifier to produce output of 12V with maximum load current of 50mA.
7. A/D and D/A convertor.
8. Voltage to current and current to voltage convertors.
9. Function generator using operational amplifier (sine, triangular & square wave)
10. Astable and monostablemultivibrator using IC 555.

NIC 551: Control System Lab

1. DifferentToolboxesinMATLAB,IntroductiontoControlSystemsToolbox.
2. Determinetranspose,inversevaluesofgivenmatrix.
3. Plotthepole-zeroconfigurationins-planeforthegiventransferfunction.
4. Determinethetransferfunctionforgivenclosedloopsysteminblockdiagramrepresentation.
5. Plotunitstepresponseofgiventransferfunctionandfindpeakovershoot,peaktime.
6. Plotunitstepresponseandtofindrisetimeanddelaytime.
7. Plotlocusofgiventransferfunction,locateclosedlooppolesfordifferentvaluesofk.
8. Plot root locusofgiventransferfunction and tofind outS,Wd,Wnatgivenroot &todiscuss stability.
9. Plotbodeplotofgiventransferfunction.
10. Plotbodeplotofgiventransferfunctionandfindgainandphasemargins
11. PlotNyquistplotforgiventransferfunctionandtocomparetheirrelativestability
12. PlottheNyquistplotforgiventransferfunctionandtodiscussclosedloopstability,gainand phasemargin.

Note:-Inaddition,Institutesmayincludemoreexperimentsbasedontheexpertise.

NEC 552: Communication Lab – 1

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2. To study amplitude demodulation by linear diode detector
3. To study frequency modulation and determine its modulation factor
4. To study PLL 565 as frequency demodulator.
5. To study sampling and reconstruction of Pulse Amplitude modulation system.
6. To study the Sensitivity, Selectivity, and Fidelity characteristics of super heterodyne receiver.

7. To study Pulse Amplitude Modulation
    a. using switching method
    b. by sample and hold circuit
8. To demodulate the obtained PAM signal by 2nd order LPF.
9. To study Pulse Width Modulation and Pulse Position Modulation.
10. To plot the radiation pattern of a Dipole, Yagi-uda and calculate its beam width.
11. To plot the radiation pattern of Horn, Parabolic & helical antenna. Also calculate beam width & element current.
12. Design and implement an FM radio receiver in 88-108 MHz.

NEC 553: Microprocessors Lab

1. Write a program using 8085/ 8086 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085/ 8086 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085/ 8086.
4. To find the largest and smallest number in an array of data using 8085/8086 instruction set.
5. To write a program to arrange an array of data in ascending and descending order using 8085/ 8086.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085/ 8086 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085/ 8086 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085/ 8086 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085/8086 through RS-232 C port.

Note:-In addition, Institutes may include two more experiments based on the expertise.

NEC 601 Microwave Engineering		
Unit	Topic	Proposed number of Lectures
I	RectangularWaveGuide:FieldComponents,TE,TMModes,Dominant TE_{10} mode, FieldDistribution,Power, Attenuation.Circular Waveguides: TE,TMmodes. Wave Velocities,MicrostripTransmissionline(TL), CoupledTL, StripTL,CoupledStripLine,CoplanarTL,Microwave Cavities,	8
II	Scattering Matrix, Passivemicrowave devices: MicrowaveHybrid Circuits, Terminations, Attenuators, Phase Shifters, Directional Couplers: TwoHole directional couplers,SMatrix ofa Directional coupler,HybridCouplers, MicrowavePropagationinferrites,Faraday Rotation,Isolators,Circulators.Sparameteranalysis ofallcomponents.	8
III	Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube,BackwardWave Oscillators:Their Schematic,Principle ofOperation, PerformanceCharacteristicandtheir applications.	8
IV	Solid state amplifiers and oscillators: Microwave Bipolar Transistor, Microwavetunnel diode,MicrowaveField-effectTransistor,Transferred electron devices,Avalanche Transit – time devices:IMPATT Diode, TRAPPATDiode,	8
V	MicrowaveMeasurements:Generalsetupofamicrowavetestbench, Slottedlinecarriage, VSWRMeter,microwave powermeasurements techniques,CrystalDetector,frequency measurement,wavelength measurements,Impedance andRefection coefficient, VSWR,Insertion andattenuationlossmeasurements, measurementofantenna characteristics, microwave linkdesign.	8

Text Book:

1. Samuel Y. Liao, "MicrowaveDevices and Circuits", 3rd Edition,PearsonEducation.

Reference Books:

1. R.E Collin, "Foundation forMicrowaveEngineering", 2nd Edition, JohnWiley India.
2. A. DasandS.K.Das,"MicrowaveEngineering",Tata McGraw Hill.

NEC 602 Digital Communication		
Unit	Topic	Proposed number of Lectures
I	DigitalDatatransmission, Linecoding review,Pulseshaping,Scrambling, Digitalreceivers,Eyediagram,Digitalcarriersystem,Methodofgeneration and detection of coherent &non-coherent binary ASK, FSK &PSK, Differentialphaseshiftkeying,quadraturemodulationtechniques.(QPSKand MSK),M-aryDigital carrierModulation.	8
II	Concept of Probability, Random variable, Statistical averages, Correlation, Sum ofRandom Variables,CentralLimitTheorem,Random Process, ClassificationofRandom Processes,Powerspectral density,Multiplerandom processes,	8
III	Performance Analysis of Digital communication system: Optimum linear Detector for Binary polar signaling, General Binary Signaling,Coherent Receivers for DigitalCarrierModulations, Signal Space Analysisof Optimum Detection, VectorDecompositionof WhiteNoiseRandom processes,General Expression forError Probability ofoptimumreceivers,	8
IV	Spread spectrum Communications: Frequency Hopping Spread Spectrum (FHSS)systems,DirectSequenceSpreadSpectrum,CodeDivision Multiple Access ofDSSS, Multiuser Detection,OFDM Communications	8
V	MeasureofInformation,SourceEncoding,ErrorFreeCommunicationovera NoisyChannelcapacity ofa discreteandContinuous Memorylesschannel ErrorCorrectingcodes:Hammingsphere,hamming distanceandHamming bound,relationbetweenminimum distanceanderror detectingandcorrecting capability,Linear blockcodes,encoding& syndrome decoding; Cycliccodes, encoderanddecodersforsystematiccyclecodes;convolutioncodes,codetree &Trellisdiagram, Viterbiandsequentialdecoding,bursterrorcorrection, Turbocodes.	8

Text Book:

1. B.P.Lathi,"ModernDigitalandAnalogcommunicationSystems",4th Edition,OxfordUniversityPress.

Reference Books:

1. H.Taub,D.L.Schilling,G.Saha,"PrinciplesofCommunication",3rd Edition,TataMcGraw-Hill.
2. John G.Proakis,"Digital Communications",4th Edition,McGraw-Hill International.
3. SimonHaykin,"Communication Systems",4th Edition,Wiley India.
4. H.P.HSUandD.Mitra,"AnalogandDigitalCommunications",2nd Edition,TataMcGraw-Hill.

NEC 603 Integrated Circuit Technology		
Unit	Topic	Proposed number of Lectures
I	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated CircuitsCrystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor –Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.	8
II	Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques andSystems, Oxides Properties. Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition:Deposition Processes, Polysilicon, Silicon Dioxide, Silicon Nitride.	8
III	Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, DiffusionEquations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid andGaseous Sources, Sheet Resistance and its Measurement. Ion-Implantation: Ion-Implantation Technique, Range Theory, ImplantationEquipment.	8
IV	Metallization: Metallization Application, Metallization Choices, PhysicalVapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging DesignConsideration, VLSI Assembly Technologies, Package FabricationTechnologies.	8
V	VLSI Process Integration: Fundamental Considerations For IC Processing,NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology,Monolithic and Hybrid Integrated Circuits, IC Fabrication	8

Text Books:

1. S. M. Sze, “VLSI Technology”, 2nd Edition, McGraw –Hill Publication.
2. S.K. Ghandhi, “VLSI Fabrication Principles”, 2nd Edition, Willy-India Pvt. Ltd.

Reference Books:

1. J. D. Plummer, M. D. Deal and Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, practice and modelling”, Pearson Education.
2. Stephen A. Campbell, “Fabrication Engineering at the micro and nano scale”, Oxford University Press.

Laboratory

NEC 651 Antenna and Microwave Lab

1. Study of Reflex Klystron Characteristics.
2. Measurement of guide wavelength and frequency of the signal in a rectangular Waveguide using slotted line carriage in a Micro wave Bench.
3. Measurement of impedance of an unknown load connected at the output end of the slotted line carriage in a Micro wave Bench.
4. Determine the S-parameter of any Three port Tee.
5. Determine the S-parameter of a Magic Tee.
6. Study various parameters of Isolator .
7. Measurement of attenuation of a attenuator and isolation, insertion loss, cross coupling of a circulator.
8. Determine coupling coefficient, Insertion loss, Directivity and Isolation coefficient of anty Multi-Hole directional coupler.
9. To study working of MIC Components like Micro strip Line, Filter, Directional Coupler,Wilkinson Power Divider, Ring resonator & coupler, antennas & amplifies.
10. Study of waveguide horn and its radiation pattern and determination of the beam width.
11. Study radiation pattern of any two types of linear antenna.

NEC 652 COMMUNICATION LAB – II

1. To construct a triangular wave with the help of Fundamental Frequency and its Harmonic component.
2. To construct a Square wave with the help of Fundamental Frequency and its Harmonic component.
3. Study of Pulse code modulation (PCM) and its demodulation using Bread Board.
4. Study of delta modulation and demodulation and observe effect of slope overload.
5. Study of pulse data coding techniques for NRZ formats.
6. Study of Data decoding techniques for NRZ formats.
7. Study of Manchester coding and Decoding.
8. Study of Amplitude shift keying modulator and demodulator.
9. Study of Frequency shift keying modulator and demodulator.
10. Study of Phase shift keying modulator and demodulator
11. Study of single bit error detection and correction using Hamming code.
12. Measuring the input impedance and Attenuation of a given Transmission Line

NEC-653 CAD OF ELECTRONICS LAB

PSPICE Experiments

1. (a)Transient Analysis of BJT inverter using step input.
   (b)DC Analysis (VTC) of BJT inverter with and without parameters.
2. (a)Transient Analysis of NMOS inverter using step input.
   (b)Transient Analysis of NMOS inverter using pulse input.
   (c)DC Analysis (VTC) of NMOS inverter with and without parameters.
3. (a)Analysis of CMOS inverter using step input.
   (b)Transient Analysis of CMOS inverter using step input with parameters.
   (c)Transient Analysis of CMOS inverter using pulse input.
   (d)Transient Analysis of CMOS inverter using pulse input with parameters.
   (e)DC Analysis (VTC) of CMOS inverter with and without parameters.

4. Transient &DC Analysis of NOR Gate inverter.
5. Transient & DC Analysis of NAND Gate.
6. VHDL Experiments
    a. Synthesis and simulation of Full Adder.
    b. Synthesis and Simulation of Full Subtractor.
    c. Synthesis and Simulation of 3 X 8 Decoder.
    d. Synthesis and Simulation of 8 X 1 Multiplexer.
    e. Synthesis and Simulation of 9 bit odd parity generator.
    f. Synthesis and Simulation of Flip Flop (D, and T).

Electives

NEC 011 Digital Signal Processing		
Unit	Topic	Proposed number of Lectures
I	**Realization of Digital Systems:** Introduction, direct form realization of IIR systems, cascade realization of an IIR systems, parallel form realization of an IIR systems, Ladder structures: continued fraction expansion of H (z), example of continued fraction, realization of a ladder structure, example of a ladder realization.	8
II	**Design of Infinite Impulse Response Digital Filters**: Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters.	8
III	**Finite Impulse Response Filter Design:** Windowing and the Rectangular Window, Other Commonly Used Windows, Examples of Filter Designs Using Windows, The Kaiser Window.	8
IV	**Discrete Fourier Transforms:** Definitions, Properties of the DFT, Circular Convolution, Linear Convolution.	8
V	**Fast Fourier Transform Algorithms:** Introduction, Decimation –In Time(DIT) Algorithm, Computational Efficiency, Decimation in Frequency (DIF) Algorithm.	8

Text Book:

1. Johnny R. Johnson, “Digital Signal Processing”, PHI.

Reference Books:

1. John G Prokias, Dimitris G Manolakis, “Digital Signal Processing”, Pearson Education.
2. Oppenheim & Schafer, “Digital Signal Processing” PHI.
3. Sanjit K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, 4thEdition, McGraw Hill.
4. Monson Hayes, “Digital Signal Processing”,2ndEdition, McGraw Hill Education

NEC 012 Computer Architecture and Organization		
Unit	Topic	Proposed number of Lectures
I	Introduction to Design Methodology: System Design – System representation, Design Process, the gate level (revision), the register level components and PLD (revision), register level design The Processor Level: Processor level components, Processor level design.	8
II	Processor basics: CPU organization- Fundamentals, Additional features Data Representation – Basic formats, Fixed point numbers, Floating point numbers. Instruction sets – Formats, Types, Programming considerations.	8
III	Datapath Design: Fixed point arithmetic – Addition and subtraction, Multiplication and Division, Floating point arithmetic, pipelining.	8
IV	Control Design: basic concepts – introduction, hardwired control, Micro programmed control –introduction, multiplier control unit, CPU control unit, Pipeline control- instruction pipelines, pipeline performance.	8
V	Memory organization: Multi level memories, Address translation, Memory allocation, Caches – Main features, Address mapping, structure vs performance, System Organisation: Communication methods- basic concepts, bus control. Introduction to VHDL.	8

TextBooks:

1. John P Hayes “Computer Architecture and Organisation”, 3rd Edition, McGraw Hill.

Reference Books:

1. M Morris Mano, “Computer System Architecture”,3rd Edition, Pearson.
2. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization and Embedded Systems”, McGraw Hill.
3. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier.

NEC 013 Artificial Neural Network		
Unit	Topic	Proposed number of Lectures
I	**Introduction to ANN** Features , structure and working of Biological Neural Network Trends in Computing Comparison of BNN and ANN. **Basics of Artificial Neural Networks -** History of neural network research, characteristics of neural networks terminology, models of neuron McCulloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture.	8
II	**Backpropagation networks** : (BPN) Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.	8
III	**Activation & Synaptic Dynamics** : Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks. **Basic functional units of ANN for pattern recognition tasks**: Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks.	8
IV	**a)Feedforward neural networks** – - Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods. **b)Feedback neural networks** Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning.	8
V	**Competitive learning neural networks :** Components of CL network pattern clustering and feature. Mapping network, ART networks, Features of ART models, character recognition using ART network**.** **Applications of ANN :** Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.	8

Text Book:

1. B. Yegnanarayana, “Artificial neural Networks”, PHI.

Reference Books:

1. S. Raj Sekaran ,VijayalakshmiPari,” Neural networks, Fuzzy logic and Genetic Algorithms”, PHI.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, TMH.

NEC 014 Advance Semiconductor Devices		
Unit	Topic	Proposed number of Lectures
I	**Physics and Properties of Semiconductors:** Introduction, Crystal Structure, Energy Bands and Energy Gap, Carrier Concentration at Thermal Equilibrium, Carrier-Transport Phenomena. Phonon, Optical, and Thermal Properties, Heterojunctions and Nanostructures, Basic Equations and Examples. *p-n* Junctions, Introduction, Depletion Region, Current-Voltage Characteristics, Junction Breakdown, Transient Behavior and Noise, Terminal Functions, Heterojunctions. Metal-Semiconductor Contacts, Metal-Insulator-Semiconductor Capacitors.	8
II	**Bipolar Transistors:** Static Characteristics, Microwave Characteristics, Related Device Structures, Heterojunction Bipolar Transistor. **MOSFETs:** Basic Device Characteristics, Nonuniform Doping and Buried-Channel Device, Device Scaling and Short-Channel Effects, MOSFET Structures, Circuit Applications, Nonvolatile Memory Devices, Single-Electron Transistor. JFETs, MESFETs, and MODFETs	8
III	**Tunnel Devices:** Tunnel Diode, Related Tunnel Devices, Resonant-Tunneling Diode. **IMPATT Diodes:** Static Characteristics, Dynamic Characteristics, Power and Efficiency, Noise Behavior, Device Design and Performance, BARITT Diode, TUNNETT Diode.	8
IV	Transferred-Electron and Real-Space-Transfer DevicesThyristors and Power Devices **Photonic Devices and Sensors:** Radiative Transitions, Light-Emitting Diode (LED), Laser Physics, Laser Operating Characteristics, Specialty Lasers.	8
V	**Photodetectors and Solar Cells:** Photoconductor, Photodiodes, Avalanche Photodiode, Phototransistor, Charge-Coupled Device (CCD), Metal-Semiconductor-Metal Photodetector, Quantum-Well Infrared Photodetector, Solar Cell. **Sensors:**Thermal Sensors, Mechanical Sensors, Magnetic Sensors, Chemical Sensors.	8

Text Book:

1. S. M. Sze, Kwok K. NG, “Physics of Semiconductor Devices”, 3rd Edition, Wiley Publication.

Reference Books:

1. J. P. Colinge and C. A. Colinge, "Physics Of Semiconductor Devices", Kluwer Academic Publishers

NEC 021 Industrial Electronics		
Unit	Topic	Proposed number of Lectures
I	**Power Semiconductor Devices:** Power semiconductor devices their symbols and static characteristics and specifications of switches, types of power electronic circuits Operation, steady state & switch characteristics & switching limits of Power Transistor Operation and steady state characteristics of Power MOSFET and IGBT Thyristor – Operation V- I characteristics, two transistor model, methods of turn-on Operation of GTO, MCT and TRIAC.	8
II	**Phase Controlled Rectifiers:** Phase Angle Control, Single-phase Half-wave Controlled Rectifier (One quadrant), Single-phase Full-wave Controlled Rectifier (Two quadrant Converters),Performance Factors of Line-commutated Converters, The Performance Measures of Two-pulse Converters, Three phase Controlled Converters **Inverters:** Introduction Thyristor Inverter Classification, Series Inverters, Parallel Inverter, Three-phase Bridge Inverters, Three-phase Bridge Inverter with Input-circuit Commutation.	8
III	**Choppers:** Introduction, Principle of Chopper Operation, Control Strategies, step-up/Down Chopper, Jones Chopper. Introduction to basic Cycloconverters. **Control of D.C. Drives:** Introduction, Basic Machine Equations, Breaking Modes, Schemes for D.C. Motor Speed Control, Single-phase Separately Excited Drives, Braking Operation of Rectifier Controlled Separately excited Motor, Single-phase Separately Excited Drives, Power Factor Improvement, Three-phase Separately Excited Drives, D.C. Chopper Drives	8
IV	**Control of A.C. Drives:** Introduction, basic Principle of Operation, Squirrel-cage Rotor Design, Speed Control of Induction Motors, stator Voltage Control, Variable Frequency control, Rotor Resistance Control, Slip Power Recovery Scheme, Synchronous Motor Drives	8

Text Books:

1. M. H. Rashid, “Power Electronics”, 3rd Edition, Pearson Education.

Reference Books:

1. M. D. Singh & K. Khanchandani, “Power Electronics”, Tata McGraw Hill.
2. V.R. Moorthy, “Power Electronics: Devices, Circuits and Industrial Applications”, Oxford University Press,2007.
3. M.S. JamilAsghar, “Power Electronics”,PHI.
4. Ned Mohan, T.M.Undeland and W.P.Robbins, “Power Electronics:Converters, Applications and Design”, Wiley India.

NEC 022 Microcontroller and it Applications		
Unit	Topic	Proposed number of Lectures
I	Introduction to microcontrollers and embedded systems, Von Neumann (Princetone) and Harvard architecture, RISC and CISC machine, overview of the 8051 family, general architecture (pins and signals, internal architecture, program memory and data memory organization, system clock, reset, programming technique), input/ output ports and special function registers, addressing mode.	8
II	Instruction groups of MCS-51: data transfer operation, arithmetic operations, branch operation, logical operation, Boolean variable manipulation, subroutine & stack operation and advance instructions. Assembler data type and directives, introduction to assembly programming and programming in C.	8
III	External interrupts and software interrupt, timer/ counter interrupt, interrupt service routine, programming 8051 timer, counter programming, Basic of serial communication, mode of serial communication, RS232, serial communication issue, serial port programming,	8
IV	Interfacing with 8051: external memory, 8255, keyboards, display devices, DAC/ADC, DC Motor, Stepper Motor, Servomotor, power management, Sensor interfacing and signal conditioning.	8

Text Book:

1. Mazidi Ali Muhammad, MazidiGillispie Janice, and McKinlayRolin D., "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson, 2nd Edition.
2. ChhabraBhupendra Singh, "Microcontrollers & its Applications" DhanpatRai Publishing Company, New Delhi

Reference Book:

1. Shah Satish, "8051 Microcontrollers MCS 51 Family and its variants", Oxford
2. SubrataGhoshal, "8051 Microcontroller Internals, Instructions, Programming and Interfacing" Pearson
3. V. Udayashankara, M.S. Mallikajunaswamy, "8051 Microcontroller Hardware, Software and Applications", McGraw-Hill.
4. DoganBrahim, "Microcontroller Projects in C for the 8051", Newnes
5. SubrataGhoshal,"Embedded System & Robots Projects using the 8051 Microcontroller", CengageLerning

NEC 023 Analog Signal Processing		
Unit	Topic	Proposed number of Lectures
I	Introduction to domains and the analogue/digital trade off, Introduction to basic building blocks: nullor, voltage feedback amplifier, operation transconductance amplifier, current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations. First-order and second-order filter realization, filter design parameters (Q and ω_0), frequency response,effect of finite gain of op-amp, realization of Single-Amplifier Biquad and General Impedance Convertor circuit.	8
II	Ideal low-pass filter, Buttreworth and Chebyshev magnitude response, pole locations, low-pass filter specifications.	8
III	Delay equalization: equalization procedures, equalization with first-order and second-order modules, strategies for equalization design. Definition of Bode sensitivity.	8
IV	Properties of Lossless ladders, the general impedance convertor (GIC), optimal design of the GIC, realization of simple ladders, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique, creating negative components.	8

Text Books:

1. R.Schaumann and M.E.Valkenberg,"Designof AnalogCircuits", Oxford University Press.

NEC 024 Advanced Digital Design and Verilog		
Unit	Topic	Proposed number of Lectures
I	Introduction to Mixed Logic, Logic Representation and Minimization with cost, Multiple output minimization, Entered Variable K- Map including don't care handling, XOR-Pattern Handling.	8
II	Combinational Circuit Design, Multiplexers, Decoders, Encoders, Code Comparators, Adders, Subtractors, Multipliers, Timing Analysis, Hazard Detection and Elimination.	8
III	Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi level minimization and optimization.	8
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis in combinational and sequential systems, Path Sensitization method, Boolean Difference Method, Initial State Method.	8
V	Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures, Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.	8

Text Books:

1. Richard F. Tinder, "Engineering Digital Design", Academic Press.
2. Parag K. Lala, "Digital system Design Using PLDs", PHI India Ltd.

Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication.
2. Eugene Fabricius, "Modern Digital Design and Switching Theory", CRC Press.
3. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
4. Alexander Miczo, "Digital Logic Testing and Simulation",Wiley Interscience.
5. Stephen Brown and ZvonkoVranesiv, "Fundamental of Digital Logic with Verilog Design", Tata McGraw Hill.

G.B. TECHNICAL UNIVERSITY, LUCKNOW
Study and Evaluation Scheme B. Tech. in Electronics Engg/ Electronics & Communication Engg/ Electronics & Telecomm Engg
[Effective from the session 2011-12]

YEAR 4th, SEMESTER-VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY SUBJECTS											
1.	EOE 07*	Open Elective-I**	3	1	0	30	20	50	100	150	4
2.	EOE 02*	Departmental Elective-II	3	1	0	30	20	50	100	150	4
3.	EEC 701	Optical Communication	3	1	0	30	20	50	100	150	4
4.	EEC 702	Data Communication Networks	3	1	0	30	20	50	100	150	4
5.	EEC 703	VLSI Design	3	1	0	30	20	50	100	150	4
6.	AUC 001	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	-
PRACTICAL/DESIGN/DRAWING											
7.	EEC 751	Microwave & Fiber Optic Lab	0	0	2	-	20	20	30	50	1
8.	EEC 752	Electronics Circuit Design Lab	0	0	3	-	20	20	30	50	2
9.	EEC 753	Industrial Training Viva-Voce	0	0	2	-	50	50	0	50	1
10.	EEC 754	Project	0	0	2	-	50	50	-	50	1
11.	GP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**15**	**5**	**9**	**150**	**210**	**410**	**590**	**1000**	**26**

**** Open Electives-I**

EOE-071	Entrepreneurship Development
EOE-072	Quality Management
EOE-073	Operation Research
EOE-074	Introduction to Biotechnology
EOE-075/EIC-034	Micro and smart systems

G.B. TECHNICAL UNIVERSITY, LUCKNOW
Study and Evaluation Scheme B. Tech. in Electronics Engg/ Electronics & Communication Engg/ Electronics & Telecomm Engg
[Effective from the session 2011-12]

YEAR 4th, SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY SUBJECTS											
1.	EOE 08*	Open Elective-II**	3	1	0	30	20	50	100	150	4
2.	EEC 03*	Departmental Elective-III	3	1	0	30	20	50	100	150	4
3.	EEC 801	Wireless & Mobile Communication	3	1	0	30	20	50	100	150	4
4.	EEC 802	Electronics Switching	3	1	0	30	20	50	100	150	3
5.	AUC 001	*Human Values & Professional Ethics	2	0	0	15	10	25	50	75	-
PRACTICAL/DESIGN/DRAWING											
6.	EEC 851	Project	0	0	12	-	100	100	250	350	8
7.	GP 801	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**12**	**4**	**12**	**120**	**180**	**350**	**650**	**1000**	**24**

**** Open Electives-II**

EOE-081 Non Conventional Energy Resources
EOE-082 Nonlinear Dynamic system
EOE-083 Product Development
EOE-084 Automation and Robotics

LIST OF ELECTIVES:

Elective – I

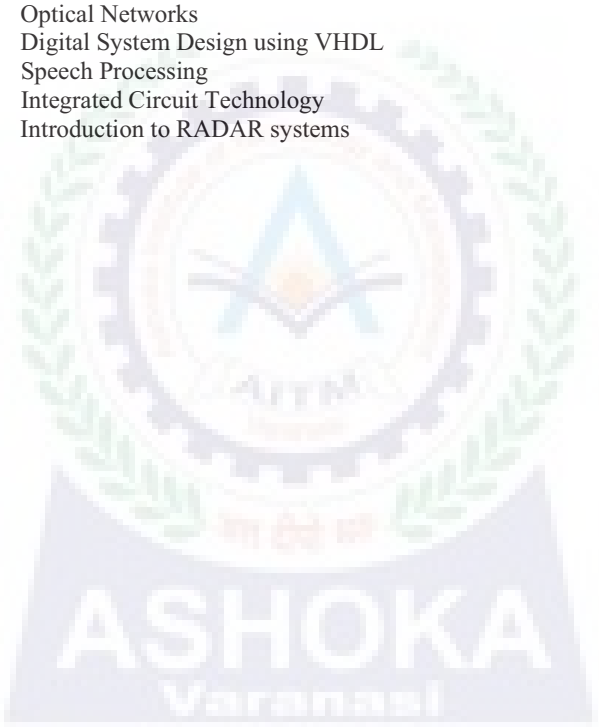
1. EEC 011 Analog Signal Processing
2. EEC 012 Data Structure
3. EEC 013 Advance Semiconductor Devices
4. EEC 014 Microcontrollers

Elective – II

1. EEC 021 Satellite Communication
2. EEC 022 Digital Image Processing
3. EEC 023 ANN
4. EEC 024 Filter Design

Elective – III

1. EEC 031 Optical Networks
2. EEC 032 Digital System Design using VHDL
3. EEC 033 Speech Processing
4. EEC 034 Integrated Circuit Technology
5. EEC 035 Introduction to RADAR systems



SYLLABUS

EEC 701 OPTICAL COMMUNICATION		3 1 0
UNIT	TOPICS	LECTURES
I	Overview of optical fiber communication- The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index. Fiber Material and its Fabrication Techniques	8
II	Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Attenuation Measurements Techniques, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion. Pulse broadening. Overall fiber dispersion in Multi mode and Single mode fibers, Fiber dispersion measurement techniques, Non linear effects. Optical fiber Connectors: Joints, Couplers and Isolators.	8
III	Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser: Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, resonant frequencies, reliability of LED & ILD	8
IV	Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling. Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers	8
V	Link Design: Point to Point Links, Power Penalities, Error control,Multichannel Transmission Techniques, WDM concepts and component overview, OTDR and optical Power meter	8

TEXT BOOKS:

1. John M. Senior, "Optical Fiber Communications", PEARSON, 3rd Edition, 2010.
2. Gerd Keiser, "Optical Fiber Communications", TMH, 4th Edition, 2008.

REFERENCE BOOKS

1. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd Edition, 2004.
2. Joseph C. Plais, "Fiber Optic Communication", Pearson Education, 4th Ed, 2004.

EEC 702 DATA COMMUNICATION NETWORKS		3 1 0
Unit	**Topic**	**Lectures**
I	Introduction to Networks & Data Communications The Internet, Protocols & Standards, Layered Tasks, OSI Model, TCP / IP, Addressing, Line Coding Review, Transmission Media: Guided and unguided Media Review.	8
II	Switching: Datagram Networks, Virtual Circuit Networks, Structure of a switch ,Ethernet Physical Layer, Data Link Layer: Error detection and Correction Data Link Control: Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol	8
III	Multiple Access : RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16	8
IV	Network Layer : Design Issues. Routing Algorithms. Congestion control Algorithms.IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses, Internet Protocol, Hardware Addressing versus IP Addressing, IP Data Gram	8
V	Transport Layer Protocol : UDP and TCP, ATM ATM, Cryptography, Network Security	8

Text Books:

1. B. A. Forouzan, “Data Communications and Networking”, MGH, 4th ed. 2007

Reference Books:

1. A. S. Tanenbaum, “Computer Networks”, PHI.
2. W. Stallings, “Data and Computer Communication”, PHI.

EEC 703 VLSI DESIGN		3 1 0
Unit	Topic	Lectures
I	Introduction: Overview of VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality. MOSFET Fabrication: Fabrication process flow, NMOS and CMOS fabrication, layout design rules, stick diagram and mask layout design. MOS Transistor : MOS Structure, The MOS System under external bias, Operation of MOSFET, MOSFET - Current /Voltage Characteristics, Scaling and Small geometry effects and capacitances	8
II	MOS Inverters: Introduction, Resistive Load Inverter, Inverters with n-type MOSFET load, CMOS Inverter. MOS Inverters - Switching Characteristics: Introduction, Delay – Time Definitions, Calculation of Delay Times, and Inverter Design with Delay Constraints.	8
III	Combinational MOS Logic Circuits: Introduction, MOS logic circuits with depletion NMOS Loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates) Sequential MOS Logic Circuits: Introduction, behaviour bistable elements, SR latch circuits, clocked latch and FF circuits, CMOS D latch and edge triggered FF.	8
IV	Dynamic logic circuits: Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, domino CMOS logic. Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.	8
V	Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits. Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques	8

Text Book:

1. Sung-Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis & Design", TMH, 3rd Edition.

Reference Books:

2. D. A. Pucknell and K. Eshraghian, "Basic VLSI Design: Systems and Circuits", PHI, 3rd Ed., 1994.
3. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

ELECTIVES II

EEC 021 SATELLITE COMMUNICATIONS		3 1 0
Unit	**Topic**	**Lectures**
I	Elements of Satellite Communication. Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.	8
II	Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna Satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.	8
III	Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc. Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary,	8
IV	Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing accuracy, GPS Receiver Operation	8
V	Global Mobile Satellite Systems, Antenna System for mobile satellite applications, Evolution, Antenna Requirement and Technical Characteristics, Classification of Mobile Satellite Antenna(MSA), Low gain omni directional Antenna, Medium gain Directional Antenna, High gain Directional Aperture Antenna, Wire Quadrifilar Helix Antenna(WQHA) for Hand held Terminals, Antenna Systems for Mobile Satellite Broadcasting.	8

Text/ Reference Books:

1. B. Pratt, A. Bostian, "Satellite Communications", Wiley India.
2. D. Roddy, "Satellite Communications", TMH, 4th Ed.
3. S. D. Ilcev, "Global Mobile Satellite Communication", Springer
4. R. Pandya, "Mobile and Personal Communication Systems and Services ", PHI.

EEC 022 DIGITAL IMAGE PROCESSING		3 1 0
Unit	**Topic**	**Lectures**
I & II	Introduction: Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model. Image Transforms: One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar, and Slant & KL transforms. Image Enhancement: Introduction, point operations, histogram modelling, spatial operations, Transform operations.	8
III	Image Restoration: Introduction, image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.	8
IV	Image Compression: Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding	8
V	Image Segmentation: Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.	8

Text Books:

1. Rafael C. Gonzalez Richard E Woods, "Digital Image Processing", Pearson, 3rd Ed. 2009.
2. Anil K Jain, "Fundamentals of Digital Image Processing", PHI.

EEC 023 Artificial Neural Networks		3 1 0
Unit	Topic	Lectures
I	Introduction: Introduction and history, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge representation, Artificial intelligence and neural networks. Learning Process: Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation.	4 4
II	Artificial neurons, Neural networks and architectures Introduction, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture. Geometry of Binary threshold neurons and their networks Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non linear separable problems, capacity of TLN, XOR solution.	2 3
III	Perceptrons and LMS Learning objective of TLN, pattern space & weight space, perceptron learning algorithm, perceptron convergence theorem, pocket algorithm, α – LMS learning, MSE error surface, steepest descent search, μ – LMS and application. Back propagation and other learning algorithms Multilayered architecture, back propagation learning algorithm, practical considerations, structure growing algorithms, applications of feed forward neural networks, reinforcement learning	5
IV	Statistical Pattern Recognition Bayes' theorem, classical decisions with Bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems. RBF Networks Regularization networks, generalized RBF networks, RBF network for solving XOR problem, comparison of RBF networks & multilayer perceptrons. Stochastic Machines Statistical mechanics, simulated annealing, Boltzmann machine.	4 2 2
V	Adaptive Resonance Theory Building blocks of adaptive resonance, Adaptive Resonance Theory 1. Self Organizing Feature MAP Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, Mexican hat networks.	8

Text Books:

1. Kumar Satish, "Neural Networks", TMH
2. Simon Haykin, "Neural Networks", PHI
3. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishers, 3rd Ed.

EEC 024 FILTER DESIGN		3 1 0
Unit	Topic	Lectures
I	Review of op-amps circuits, Categorization of filters-Low-pass filter, High-pass filter, band-pass filter, band-reject filter, Gain equalizers, and Delay equalizers.	8
II	Approximation Theory: Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Basic of sensitivity, Frequency Transformations.	8
III	Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR. Active ladder filters. Active R filters.	10
IV	Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.	8
V	Switched capacitor filters: The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation based SC filter design.	6

Text Book:

[1] Gobind Daryanani, "Principles of active network synthesis and design",John Wiley & Sons.

[2] R. Schaumann, M. E. Van Valkenburg, "Design of analog filters", Oxford University Press.

EEC 751 Microwave and Optical Communication Lab

Minimum Ten Experiments to be conducted:

Part – A (Any 6 Experiments):

1. Study of Reflex Klystron Characteristics.
2. Measurement of guide wavelength and frequency of the signal in a rectangular Waveguide using slotted line carriage in a Micro wave Bench.
3. Measurement of impedance of an unknown load connected at the output end of the slotted line carriage in a Micro wave Bench
4. Determine the S-parameter of any Three port Tee.
5. Determine the S-parameter of a Magic Tee.
6. Study various parameters of Isolator .
7. Measurement of attenuation of a attenuator and isolation, insertion loss, cross coupling of a circulator.
8. Determine coupling coefficient, Insertion loss, Directivity and Isolation coefficient of anty Multi-Hole directional coupler.
9. To study working of MIC Components like Micro strip Line, Filter, Directional Coupler, Wilkinson Power Divider, Ring resonator & coupler, antennas & amplifies.
10. Study of waveguide horn and its radiation pattern and determination of the beam width.
11. Study radiation pattern of any two types of linear antenna.

Part – B (Any 4 Experiments):

1. To setting up fiber optic analog link.
2. Study and measurement of losses in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Study and perform time division multiplexing (digital).
5. Study of framing in time division multiplexing.
6. Study of Manchester coding and decoding.
7. Study of voice coding and codec chip.
8. Study and measure characteristics of fiber optic LED's and photo detector.

EEC 752 Electronic Circuit Design

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/ digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad
2. Universal OTA biquad
3. Amplitude control or stabilization applied to any sinusoidal oscillators
4. Op-amp/ OTA based function generator
5. Any application of log/antilog circuits
6. Any applications of analog multiplier/ divider
7. Any digital system design and its hardware implementation using TTL/ CMOS ICs
8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any other ICs

The above must include

1. Design the circuit.
2. Make a hardware and measure various parameters.
3. Simulation in Spice of the designed circuit.
4. Comparison of measured and simulated results.
5. A report is to be made for evaluation.

EEC 801 Mobile and Wireless Communication		3 1 0
Unit	Topic	Lectures
I	Evolution of mobile radio communication fundamentals. Large scale path loss: propagation models, reflection, diffraction, scattering, practical link budget design using path loss model. Small scale fading & multipath propagation and measurements, impulse response model and parameters of multipath channels. Small scale Multipath Measurements, Parameters of Mobile Multipath Channels types of small scale fading.	8
II	Fundamentals of equalisation, Equalisers in communication receiver, Survey of equalisation techniques, linear equaliser, Algorithms for Adaptive Equalization, Diversity techniques, RAKE receiver. Characteristics of speech signals, quantisation techniques, vocoders, linear predictive coders, Multiple Access techniques for Wireless Communications.	8
III	Cellular concepts, Frequency reuse, channel assignment strategies, handoff strategies, interference and system capacity, improving coverage and capacity in cellular systems.	8
IV	GSM system for mobile: Services and features, System Architecture, Radio Sub system Channel types, Frame Structure. CDMA Digital Cellular Standard (IS 95): Frequency and Channel specifications, Forward CDMA channel and reverse CDMA channel	8
V	Introduction to Mobile Adhoc Networks, Mobile data networks, wireless standards IMT2000, Introduction to 4G and concept of NGN.	8

Text Book:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson, Second Edition.
2. T L Singal ,"Wireless Communications ",McGraw Hill Publications.
3. R. Pandya, " Mobile and personal communication system", PHI.

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University press.
2. Andreas F. Molisch, "Wireless Communications", Wiley Student Edition.
3. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.

EEC 802 ELECTRONIC SWITCHING			3 1 0
Unit	Topic	Text Book/ Chapter	Lectures
I	Evolution of Switching systems: Introduction: Message switching, circuits switching, functions of a switching system, register-translator-senders, distribution frames, crossbar switch, a general trunking, electronic switching, Reed electronic system, digital switching systems.	2/3	8
II	Digital switching: Switching functions, space division switching, Time division switching, two dimensional switching, Digital cross connect systems, digital switching in analog environment.	3/5	8
III	Telecom Traffic Engineering: Network traffic load and parameters, grade of service and blocking probability, modelling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, Delay systems.	1/8	8
IV	Control of Switching Systems: Introduction, Call processing functions; common control, Reliability availability and security; Stored program control. Signalling: Introduction, Customer line signalling, AF junctions and trunk circuits, FDM carrier systems, PCM and inter register signalling, Common channel signalling principles, CCITT signalling system No. 6 and 7, Digital customer line signalling.	2/7 2/8	8
V	Packet Switching: Packets formats, statistical multiplexing, routing control, dynamic, virtual path circuit and fixed path routing, flow control, X.25 protocol, frame relay, TCP/IP, ATM cell, ATM service categories, ATM switching, ATM memory switch, space memory switch, memory-space, memory-space-memory switch, Banyan network switch.	3/10	8

Text Books:

1. Thiagarajan Viswanathan, "Telecommunication switching System and networks", PHI.
2. J.E. Flood, "Telecommunication switching, Traffic and Networks", Pearson education.
3. J.C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed.

ELECTIVE III

EEC 031 OPTICAL NETWORKS		3 1 0
Unit	Topic	Lectures
I	Introduction to Optical Networks- Principles and Challenges and its Generation, Characteristics of Optical Fiber in non linear region ,Optical Packet Switching, Transmission Basics, Multiplexers & Filters,	8
II	Optical Amplifiers ,Tunable Lasers, Switches, Wavelength Converters. Sub-Carrier Modulation and Multiplexing,Spectral efficiency,Crosstalk,Introduction of Soliton systems.	8
III	SONET/SDH: Multiplexing, SONET/ SDH Layers, Frame Structure, Physical Layer, Elements of a SONET/SDH Infrastructure, Ethernet. Optical Transport Network, Generic framing Procedure, IP routing and forwarding and QOS. WDM Network Elements Optical Line Terminals, Optical Line Amplifiers, Optical Add/ Drop Multiplexers, Optical Cross Connects.	8
IV	WDM Network Design Cost Trade-offs, Light path Topology Design, and Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Different Schemes, Interworking between Layers Access Networks Network Architecture Overview, Enhanced HFC, FTTC, PON evolution	8
V	Optical Switching OTDM, Synchronization, Header Processing, Buffering, Burst Switching. Deployment Considerations- SONET/SDH core Network	

Text Books:

1. R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practical perspective", Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, "Optical Networks: Third Generation Transport Systems"/ Pearson Educations

Reference Books:

1. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006.

EEC 032 DIGITAL SYSTEM DESIGN USING VHDL		3 1 0
Unit	Topic	Lectures
I	Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.	8
II	Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL. RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding Alternatives, Association methods, generic Parameters, Design Configuration	8
III	Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure, Packaging Utilities and Components, Sequential Statements. VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE – related issues, Predefined Attributes	8
IV	VHDL Signal Model – Characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution	8
V	Hardware Cores and Models - Synthesis rules and styles, Memory and Queue Structures, Arithmetic Cores, Components with Separate Control and Data parts. Core Design Test and Testability - Issues Related to Design Test, Simple Test benches.	8

TEXT BOOKS:

1. Z. Navabi, “VHDL-Modular Design and Synthesis of cores and Systems”, TMH – 3rd Edition.
2. R.D.M. Hunter, T. T. Johnson, “Introduction to VHDL” Spriger Publication, 2010.

REFERENCE BOOKS:

3. C. H. Roth, “Digital System Design using VHDL”, PWS Publishing
4. Douglas Perry, “VHDL- Programming by examples”, MGH

EEC 033 SPEECH PROCESSING		3 1 0
Unit	Topic	Lectures
I	Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.	10
II	Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech& silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function.	10
III	Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.	10
IV	Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder.	6
V	Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.	10

Text / Reference Books:

1. R. L. Rabiner & R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.
2. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition, 2006.

EEC 034 INTEGRATED CIRCUIT TECHNOLOGY		3 1 0
Unit	Topic	Lectures
I	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Epitaxy: Vapor –Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.	8
II	Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties. Lithography: Optical Lithography. Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes, Polysilicon , Silicon Dioxide, Silicon Nitride.	8
III	Diffusion: Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources , Sheet Resistance and its Measurement. Ion-Implantation: Ion-Implantation Technique, Range Theory, Implantation Equipment.	8
IV	Metallization: :Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies.	8
V	VLSI Process Integration: Fundamental Considerations For IC Processing, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, Monolithic and Hybrid Integrated Circuits, IC Fabrication	8

Text Book:

1. S. M. Sze, “VLSI Technology”, 2nd Edition, McGraw –Hill Publication.

Reference Books:

1. S.K. Ghandhi, “VLSI Fabrication Principles”, 2nd Edition,. Willy-India Pvt. Ltd.
2. J. D. Plummer, M. D. Deal and Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, practice and modelling”, Pearson Education.
3. Stephen A. Campbell, “Fabrication Engineering at the micro and nano scale”, Oxford Univ Press.

EEC 035 INTRODUCTION TO RADAR SYSTEMS		3 1 0
Unit	Topic	Lectures
I	Introduction to Radar: Basic Radar, The Simply Form of the Radar Equations, Radar Block Diagram, Radar Frequencies, Applications of Radar. The Radar Equation: Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar Cross-Section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses, Problems	8
II	MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line Cancelers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.	8
III	Tracking Radar: Tracking with Radar, Mono pulse Tracking, Conical Scan and Sequential Lobing, Limitations to tracking Accuracy, Low-Angle Tracking, Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars(ADT)	8
IV	Detection of Signals in Noise: Introduction, Detection Criteria, Detectors, Automatic Detection, Integrators, Constant-False-Alarm Rate Receivers.	8
V	Information from Radar Signals: Basic Radar Measurements, Theoretical Accuracy of Radar Measurements, Ambiguity Diagram, Pulse Compression, Target Recognition, Land Clutter, Sea Clutter, Weather Clutter	8

Text/ Reference Books:

1. Merrill I. Skolnik " Introduction to Radar Systems" Third Edition.
2. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

EIC-034/EOE-075 MICRO AND SMART SYSTEMS		3 1 0
UNIT	TOPICS	LECTURES
I	Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems,.	5
II	Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezoresistive pressure sensor, conductometric gas sensor, an electrostatic combo-drive, a magnetic microrelay, portable blood analyzer, piezoelectric inkjet print head, micromirror array for video projection, smart materials and systems.	8
III	Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.	8
IV	Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses. Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electro-mechanics.	8
V	Integration of micro and smart systems: integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.	

Text book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, “Micro and smart systems”, Wiley India, 2010.