Semester-wise proposed curriculum of B. Tech programme of ECE

Semester-I

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	CH103	Chemistry	3	0	1	4	5
2.	MS104	Mathematics-I	3	1	0	4	4
3.	EE103	Basic Electrical Engineering	3	0	0	3	3
4.	EE104	Basic Electrical Engineering Lab	0	0	1	1	2
5.	PH103	Physics-I	2	0	1	3	4
6	EF103	English	2	0	1	3	4
7.	SE100	Induction Program	-	-	-	-	8
		Total-	13	1	4	**18**	30

Semester-II

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	PH104	Physics-II	2	0	0	2	2
2.	MS105	Mathematics-II	3	1	0	4	4
3.	EC102	Basic Electronics	2	1	1	4	5
4.	ME103	Workshop Practice	0	0	2	2	4
5.	CO103	Introductory Computing	3	0	0	3	3
6.	CO104	Computing Lab	0	0	2	2	4
7.	ME102	Engineering Mechanics	3	1	0	4	4
8.	CE103	Engineering Graphics	1	0	2	3	5
		Total-	14	3	7	**24**	31

Semester-III

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	EC201	Electronics Devices	3	0	0	3	3
2.	EC202	Electronics Devices Lab	0	0	1	1	2
3.	EC203	Digital System Design	3	0	0	3	3
4.	EC204	Digital System Design Lab	0	0	1	1	2
5.	EC205	Signals and Systems	3	0	0	3	3
6.	EC206	Network Theory	3	0	0	3	3
7.	MS205	Mathematics-III	3	0	0	3	3
8.	BA302	Economics	3	0	0	3	3
9.	ES201	Environmental Science	1	0	1	0	3
		Total-	19	0	3	**20**	25

Semester-IV

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	EC207	Analog & Digital Communication	3	0	0	3	3
2.	EC208	Analog & Digital Communication Lab	0	0	1	1	2
3.	EC209	Analog Circuits	3	0	0	3	3
4.	EC210	Analog Circuits Lab	0	0	1	1	2
5.	EC211	Microcontroller and Microprocessor	3	0	0	3	3
6.	EC212	Microcontroller Lab	0	0	1	1	2
7	BT201	Biology	3	0	0	3	3
8.	CS201	Data Structure & Operating System	2	0	1	3	4
		Total	14	0	4	**18**	22

Semester-V

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	EC301	Electromagnetic Waves	3	0	0	3	3
2.	EC302	Electromagnetic Waves Lab	0	0	1	1	2
3.	EC303	Computer Architecture	3	0	0	3	3
4.	EC304	Probability Theory & Stochastic Process	3	0	0	3	3
5.	EC305	Digital Signal Processing	3	0	0	3	3
6.	EC306	Digital Signal Processing Lab	0	0	1	1	2
7.		ECE Elective-I(any one from the subjects below)	3	0	0	3	3
	EC307	• *Mobile communication& Networks*					
	EC308	• *Electrical machines and power protection*					
	EC309	• *Intelligent instrumentation*					
	EC310	• *CMOS design*					
	EC322	• *Fundamentals of Machine Learning and Deep Learning with Applications*					
8.		Open Elective-I	3	0	0	3	3
9.	LW301	Indian constitution (MC- Non Credit)	1	0	0	0	1
		Total	19	0	2	**20**	22

Semester-VI

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.	EC311	Control System	3	0	0	3	3
2.	EC312	Computer Network	3	0	0	3	3
3.	EC313	Computer Network Lab	0	0	2	2	4
4.	EC314	Electronic Measurement Lab	0	0	1	1	2
5.	EC315	Mini Project	0	0	2	2	4
6.		ECE Elective-II(any one from the subjects below)	3	0	0	3	3
	EC316	• *Microwave techniques*					
	EC317	• *Speech and Audio processing*					
	EC318	• *Digital image and video processing*					
	EC319	• *VLSI Design*					
7.		Open Elective-II	3	0	0	3	3
8.	IC361	Accounting & Financial Management	3	0	0	3	3
		Total	15	0	5	**20**	25

Students will undergo a summer training of 4 weeks after 6th semester during summer vacation and submit the report and the certificate of completion in the department in the beginning of 7th semester.

Semester-VII

Sl. No.	Course Type Code	Course Name	L	T	P	CR	CH
1.		ECE Elective –III(any one from the subjects below)	3	0	0	3	3
	EC401	• Information Theory & Coding					
	EC402	• Embedded systems					
	EC403	• Satellite communication					
	EC404	• Digital systems and VHDL					
2.		ECE Elective-IV(any one from the subjects below)	3	0	0	3	3
	EC405	• Computer Vision					
	EC406	• Biomedical Signal Processing					
	EC407	• Antenna and propagation					
	EC408	• Digital control system					
3.		ECE Elective-V(any one from the subjects below)	3	0	0	3	3
	EC409	• Introduction to MEMS					
	EC410	• Biomedical electronics					
	EC411	• Fibre optic communication					
	EC412	• Nano-electronics					
4.		ECE Elective-VII(any one from the subjects below)	3	0	0	3	3
	EC413	• Fuzzy Logic and Neural network					
	EC414	• Bioneuro engineering					
	EC415	• Digital signal processor					
	EC416	• Electronics design automation					
5.		Open Elective -III	3	0	0	3	3
6.	EC417	Project- Stage I	0	0	6	6	12
7.	XXxxx	* HSS/Management Elective	3	0	0	3	3
8.	CT465	Essence of Indian Traditional Knowledge (MC- Non Credit)	1	0	0	0	1
		Total	19	0	6	**24**	31

Semester-VIII

Sl. No.	Course Code	Course Name	L	T	P	CR	CH
1.		ECE Elective-VI(any one from the subjects below)	3	0	0	3	3
	EC418	• Power electronics					
	EC419	• Mixed signal design					
	EC420	• High speed electronics					
2.		Open Elective-IV	3	0	0	3	3
3.	EC421	Project- Stage II	0	0	10	10	20
		Total	9	0	10	**16**	26

Semester-wise Break-up:

Semester	Category-wise Credit Distribution							Total Credits
	HSMC	**BSC**	**ESC**	**PCC**	**PEC**	**OEC**	**PCE**	
I	3	11	4	0	0	0	0	18
II	0	6	18	0	0	0	0	24
III	3	3	0	14	0	0	0	20
IV	0	3	3	12	0	0	0	18
V	0	0	0	14	3	3	0	20
VI	3	0	0	9	3	3	2	20
VII	3	0	0	0	12	3	6	24
VIII	0	0	0	0	3	3	10	16
Total-	12	23	25	49	21	12	18	**160**

Semester-III

EC 201: Electronics devices (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ. Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to
1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems

EC 202 : Electronic Devices Lab (L0:T0:P1: CH2: CR 1)

Experiments using bipolar junction transistor (BJT) and Field effect transistor: Single and Multistage amplifier's frequency response, JFET's characteristics, MOSFET's characteristics, differential amplifier's frequency response, simulation using SPICE.

EC 203 : Digital System Design (L3:T0:P0: CH3: CR 3)

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan'sTheorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, CodeConversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half andFull Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Rippleand Synchronous counters, Shift registers, Finite state machines, Design of synchronous

FSM,Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, PseudoRandom Binary Sequence generator, Clock generation

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Conceptof Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data typesand objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

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

Course outcomes:

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

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits

Use HDL & appropriate EDA tools for digital logic design and simulation

EC 204 : Digital System Design Lab (L0:T0:P1: CH2: CR1)

Experiments using SSI and MSI digital integrated circuits: logic gates, Staircase switch, majority detector, quality detector, flip-flops, non overlapping pulse generator, ripple counter, synchronous counter, pulse generator, multiplexers, demultiplexers, shift registers, seven – segment decoders, monostable multivibrators, latches, memories, TTL; some examples of the experiments: arbitrary wave form generator, stop watch, logic probe, time clock.

EC 205 : Signals and Systems (L3:T0:P0: CH3: CR 3)

Signals and systems as seen in everydaylife, and in various branches of engineering and science.

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

Periodic and semi-periodic inputs to an LSI system, the notion of a frequencyresponse and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.The idea of signal space and orthogonal bases,

The Laplace Transform, notion ofeigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

Course outcomes:

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

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

EC 206 : Network Theory (L3:T0:P0: CH3: CR 3)

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Text/Reference Books

1. Van, Valkenburg.; "Network analysis"; Prentice hall of India, 2000
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education

Course Outcomes:

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

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.
5. Appreciate the frequency domain techniques.

MS205: Mathematics III (L3 - T0 - P0) 3 Credits: 3 Hours

Unit 1: Basic Probability (10 lectures)
Probability spaces, conditional probability, Discrete random variables, Independent random variables, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, infinite sequences of Bernoulli trials, Probability distributions: Binomial, Poisson - evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution.

Unit 2: Continuous Probability Distributions (5 lectures)
Continuous random variables and their properties, distribution functions and densities, normal, exponential, and gamma densities.

Unit 3: Applied Statistics (11 lectures)
Moments, Skewness, Kurtosis, Chebyshev's Inequality, Correlation and regression, method of least squares. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 4: Curve fitting (4 lectures)
Curve fitting - fitting of straight lines, second degree parabolas and more general curves. Splines fitting.

Unit 5: Partial differential equations (15 lectures)
Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Second-order linear equations and their classification. Method of separation of variables.

Textbook(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, (John Wiley & Sons, 9th Edition), 2006.
2. Thomas and Finney, Calculus and Analytic Geometry, (Pearson Education, Eleventh (Indian) Edition), 1998.
3. Feller, W. An Introduction to Probability Theory and its Applications, Vol. 1, (Wiley), 1968.

Reference book(s)

1. Jain, R. K. and Iyengar, S. R. K. Advanced Engineering Mathematics, Third Edition, (Narosa publishing house, India), 2009.
2. Veerarajan T., Engineering Mathematics for first year, (Tata McGraw-Hill, New Delhi), 2008.
3. Ramana, B. V. Higher Engineering Mathematics, (McGraw Hill, India), 2010.
4. Hoel P. G., Port S. C. and Stone C. J., Introduction to Probability Theory, (Universal Book Stall, New Delhi), 2003.
5. Ross, S., A First Course in Probability, (Pearson Education, India), 2002.

BA302: **Economics** **<u>(L3:T0:P0: CH3: CR 3)</u>**

Module 1:

Basic Principles and Methodology in Economics.Demand and Supply analysis; Elasticity measurement.

Theory of the Firm and Market Structure-Perfect Competition, Monopoly, Monopolistic Competition, Duopoly, and Oligopoly.

Basic Macroeconomics- National income, (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, inflationary growth and Phillips Curve.

Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Public utilities, public and private expenditure, and public income. Taxation.

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows).

Business Forecasting – Elementary techniques.

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity.

Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization.

Employment–Informal, Organized, Unorganized, Public, Private.

Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

Module 5:Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.

Books / References

1. Salvadore, Dominik. (2009). *Microeconomics:Theory and Applications.* OxfordUniversity Press.
2. D. N. Dwivedi. (2011). Microeconomics. Pearson Education.
3. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
4. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
5. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
6. Acts Related to Minimum Wages, Workmen’s Compensation, Contract, and Arbitration

Semester-IV

EC 207: Analog and Digital Communication (L: 3 T 0 P 0 CH 3 CR 3)

Review of signals and systems, Frequency domain representation of signals, Principles of AmplitudeModulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Review of probability and random process. Gaussian and white noise characteristics,Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations. BasebandPulse Transmission- Inter symbol Interference and Nyquist criterion.Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'',John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

Course Outcomes:

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

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

EC 208: Analog and Digital Communication Lab (L:0 T:0 P 1 CH 2CR 1)

Generation, testing and verification of AM,FM,PM, DSBSC, SSB &SSBSC wave,
Transmitter & receiver, Line codes, phase detection using PLL, PCM Codec. PN sequence generator, PWM, ASK , FSK, PSK, Modulation and demodulation, Spread spectrum signalling, numerical aperture of an Optical Fiber, Power Loss in Optical Fibers.

EC 209: Analog Circuits (L: 3 T 0 P 0 CH 3 CR 3)

Diode Circuits, Amplifiermodels: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

High frequency transistor models, frequency response of single stage andmultistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Current mirror: Basic topology and its variants, V-I characteristics, outputresistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

OP-AMP applications: review of inverting and non-inverting amplifiers, integratorand differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistorstring etc. Analog- to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Text/Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
5. Publishing, Edition IV
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Course Outcomes:

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

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits
5. Design ADC and DAC

EC 210: Analog Circuits Lab (L: 0 T 0 P 1 CH 2 CR 1)

Op-Amps and other integrated circuits: Precision rectifier, Active filters, Voltage regulators, Wave form generators, Phase Locked Loop

EC 211: Microcontroller and Microprocessor (L: 3 T 0 P 0 CH 3 CR 3)

Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access, instruction sets of microprocessors (with examples of 8085 and 8086);

Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design;

Concepts of virtual memory, Cache memory, Advanced co-processor Architectures- 286, 486, Pentium; Microcontrollers: 8051 systems,

Introduction to RISC processors; ARM microcontrollers interface designs.

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

Course Outcomes:

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

1. Do assembly language programming
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
3. Develop systems using different microcontrollers
4. Understand RSIC processors and design ARM microcontroller based systems

EC 212: Microcontroller Lab (L: 0 T 0 P 1 CH 2 CR 1)

Assembly language programming for 8085/8086: interfacing of 8085/8086: memory interfacing. Design of I/O modules and interfacing of different peripherals, parallel interfacing using A/D and D/A converters; 8051 based control of stepper motor.

Programming in Ardino UNO, peak and arm processor

BT 201: Elements of Modern Biology **<u>(L: 3 T 0 P 0 CH 3 CR 3)</u>**

Biological Structures and Organization:
- Biological macromolecules, cellular organization, cell types, membrane structures and functions.
- Cellular energetics: Structure of Mitochondria, Energy transduction; Structure of Plastids (chloroplast), Photosynthetic light and dark reaction.

Biological systems:
- Muscular skeletal system, Nervous system (overview of the major human sensory organs and their (functioning), Cardiovascular system.

Biological Information:
- DNA : Structure, Genetic code, Central dogma in Molecular Biology.
- Protein synthesis
- Biological data and Bioinformatics.
- Signal transduction in plants and animals
– Basic concepts.

Text/Reference:

1. N Hopkins, J W Roberts, J A Steitz and A M Weiner, "Molecular Biology of the Gene", J Watson, 4th Ed. Benjamin Cummings, Singapor, 1987.

2. J L Tymoczko, L Stryer, " Biochemistry", J M Berg, 5th Ed. W H Freeman & Co, New York, 2002

3. Dr. C CChatterjee, "Human Physiology", 11th Ed., Vol I & II, Medical Allied Agency, Kolkata, 1987
4. Guyton, "Human Physiology".

<u>Semester-V</u>

<u>EC 301: Electromagnetic Waves (L: 3 T 0 P 0 CH 3 CR 3)</u>

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Maxwell's Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna,

Text/Reference Books:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
4. David Cheng, Electromagnetics, Prentice Hall

Course Outcomes:

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

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

EC 302: Electromagnetic Waves Lab (L: 0 T 0 P 1 CH 2 CR 1)

Experiment related to Microwave and Optical Fibre Communication: Reflex Klysbon tube, Gunn diode, Antenna radiation pattern, Frequency chart, Rectangular wave guide on TE_{10} mode

EC 303: Computer Architecture (L: 3 T 0 P 0 CH 3 CR 3)

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.

Processor organization, Information representation, number formats.

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats

Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Micro-programmed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Micro-programmed computers - CPU control unit

Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network

Text/Reference Books:

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M.M.Mano, "Computer System Architecture", Edition
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
6. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

Course Outcomes

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

1. learn how computers work
2. know basic principles of computer's working
3. analyze the performance of computers
4. know how computers are designed and built
5. Understand issues affecting modern processors (caches, pipelines etc.).

EC 304: Probability Theory & Stochastic Process (L: 3 T 0 P 0 CH 3 CR 3)

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds;

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Text/Reference Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing,'' Third Edition, Pearson Education
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes,'' Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International

4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course Outcomes:

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

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

EC 305: Digital Signal Processing (L: 3 T 0 P 0 CH 3 CR 3)

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT),Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

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

Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multirate signal processing.

Application of DSP.

Text/Reference Books:

1. S.K.Mitra, Digital Signal Processing: A computer based approach. TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Course Outcomes:

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

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

EC 306: Digital Signal Processing Lab (L:0 T 0 P 1 CH 2 CR1)

Experiment related to Digital Signal Processing using MATLAB.

Programming in DSP Kits

EC 307: Mobile Communication and Network (L:3 T 0 P 0 CH 3 CR3)

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Signal propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Capacity of flat and frequency selective channels. Antennas- Antennas for mobile terminal-monopole antennas, PIFA, base station antennas and arrays.

Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Outcomes:

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

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance

EC 308: Electrical Machines and power protection (L: 3 T 0 P 0 CH 3 CR 3)

Electrical machines: Principles of electromechanical energy conversion, DC generator and DC motor. ,

AC machines: synchronous machines, synchronous condensers, three phase and single phase induction motors, applications of special types of motors (linear stepper, reluctance).

Transformers: Single phase and three phase transformers, parallel operations, autotransformers.

Power transmission and distribution: High-voltage AC (HV AC) and high-voltage DC (HVDC) transmissions, industrial and domestic loads, power factor improvement, safety and protection-fuses, circuit breakers, earthing, lighting rods, earth leakage detectors.

Power electronic devices: Thyristors, electronic control of motors.

Texts/References

1. Cotton,H., "Advanced Electrical Technology", CBS Publishers and Distributors, New Delhi, 1984.
2. Nagrath I.J. and Kothari, D.P., "Electrical Machines", TMH, New Delhi, 2001.
3. Hambley, A.R., Electrical Engineering: Principles and Applications, 2nd Edition, Prentice Hall, 2002.
4. Yamayee,Z.A and Bala, JL, Electromechanical Energy Devices an Power Systems, John Wiley & Sons Inc., 1994

5. Mohan, N., Power Electronics: Converters, Applications & Design, John Wiley and Sons, 2003

EC 309: Intelligent Instrumentation (L: 3 T 0 P 0 CH 3 CR 3)

Intelligent sensors: Definitions- Classical sensors and transducers, Smart sensors, Cogent sensors, Self adaptive sensors, VLSI-ANN sensors, MEMs , Computational sensors, Integrated intelligent sensors (ISS), Passive and active elements, AD and DA conversions, Micromachining sensors, Thermocouple and RTD signal processing-Cold junction compensation, Integrated compensating ADC, Realization of differential temperature, Temperature compensation in Resistive strain gauge sensors- Integrated compensating DAC, Calibration of IC thermal sensors- Integrated calibration and compensation in pressure sensors, Integrated offset, gain and nonliterary compensation

Sensor Intelligence: Metrological intelligence-Linearization techniques, Look up table, Piece-wise linearization, Interpolation, Progressive polynomial, LMS curve fitting, PWM, ANN , Auto calibration- autozero and autorange, Offset nullification, Error and drift compensation , Ambient errors , Circuit compensation- Dummy circuit, Mathematical compensation- Intelligent compensation, Electrical/Electronics errors, Mechanical errors, Computational errors.

Transmission intelligence- Sampling ,Digitization and AD conversion, Signal conversion, Voltage to frequency conversion, Voltage to current conversion, 4-20mA transmitter, Capacitance/Inductance to duty cycle, Modulation, FM, PWM

Signal manipulation intelligence- Semantic transformation, Data validation, Missing data and data restoration, Decision making, Derived information

Artificial and adaptive Intelligence- Human intelligence, Array based sensors, Basic Sensor Metrics, Signal and image features, Prognostics diagnostics and predictive, Tracking, classification and discrimination, Adaptive least square models

Other Intelligences- Power saving, Voltage and current regulation, Reliability, Failure detection

Intelligent Sensor Standards and Protocols : IEEE 1451.1, Network communication models, STIM, Lon Talk TM Protocol, Integrated SAE JI850, MI bus, FieldBus,

BOOK SUGGESTED

1. Intelligent Sensors (Handbook of Sensors and Actuators) by H. Yamasaki (Hardcover - Mar 1, 1996).

2. Smart Sensors and MEMS by Sergey Y. Yurish, Maria T. S. R. Gomes, and Maria Teresa S.R. Gomes (Paperback - May 22, 2006)

3. Data Acquisition and Signal Processing for Smart Sensors by Nikolay V. Kirianaki, Sergey Y. Yurish, Nestor O. Shpak, and Vadim P. Deynega(Hardcover - April 11, 2002)

4. Understanding Smart Sensors (Artech House Sensors Library) by Randy Frank (Hardcover - April 2000)

5. Microsensors, MEMS and Smart Devices by Julian W. Gardner, Vijay Varadan, and Osama O. Awadelkarim(Hardcover - Dec 15, 2001)

EC 310: CMOS Design (L: 3 T 0 P 0 CH 3 CR 3)

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor. Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Text/Reference Books:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4thEdition, Pearson Education India, 2011.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Course Outcomes:

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

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.

LW 301 Indian constitution (MC-Non Credit) L 1 T 0 P 0 CR 0 CH 1

Unit I : Introduction :

Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

Unit II : Union Government and its Administration Structure of the Indian Union:

Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

Unit III : State Government and its Administration Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Unit IV: Local Administration District's Administration head:

Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit V Election Commission Election Commission:

Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Books Recommended:

1. Laxmikanth 'Indian Polity' McGraw Hill India Pvt Ltd, 5th Edition N. Delhi, 2014.

2. D. D. Bas, Indian Constitution' Lewis Nexis, Nagpur, 20th Edition, 2011

Semester-VI

EC 311: Control System (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to control problem- Industrial Control examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Feedback control systems- Stability, steady-state accuracy,transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

State variable Analysis- Concepts of state, state variable, state model, state modelsfor linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, treking problem. Nonlinear system – Basic concept & analysis.

Text/Reference Books:

1. Gopal. M., “Control Systems: Principles and Design”, Tata McGraw-Hill, 1997.
2. Kuo, B.C., “Automatic Control System”, Prentice Hall, sixth edition, 1993.
3. Ogata, K., “Modern Control Engineering”, Prentice Hall, second edition, 1991.
4. Nagrath & Gopal, “Modern Control Engineering”, New Age International, New Delhi

Course Outcomes:

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

1. Characterize a system and find its study state behavior
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve liner, non-liner and optimal control problems

EC 312: Computer Network (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical

Multiplexing. Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines,

TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

Text Reference books:

1. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall
4. S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education
5. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, "Computer networks", Prentice Hall
7. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall
8. William Stallings, "Data and computer communications", Prentice Hall

Course Outcomes:

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

1. Understand the concepts of networking thoroughly.
2. Design a network for a particular application.
3. Analyze the performance of the network.

EC 313: Computer Network Lab (L: 0 T 0 P 2 CH 4 CR 2)

HDLC Frame making in Computer networks , Routing algorithms in Computer networks etc.

EC 314: Electronic Measurement Lab (L: 0 T 0 P1 CH 2 CR 1)

Study of Thermistor characteristics, Study the characteristics of photovoltaic cell., To design an Instrumentation amplifier, Study of the characteristics of Pressure Transducer, Study of Semiconductor Thermal sensor, Study of an Analog to Digital Converter (ADC-0808/0809) circuit, Study of Input-Output characteristics of LVDT., Study of the characteristics of Capacitive Transducer. Study of ON/OFF Controller in maintaining water level, Study of thermocouple, Study of strain gauge based load cell., To study Mini Process Control Demonstrator Trainer Kit, Study of Optical RPM sensor.

EC 315: Mini project (L: 0 T 0 P 2 CH 4 CR 2)

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.

2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

EC 316: Microwave Techniques (L: 3 T 0 P 0 CH 3 CR 3)

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

Mathematical Model of Microwave Transmission-Concept of Mode, Features ofTEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangularwaveguide, Circular waveguide, Strip line, Micro strip line.

Microwave Network Analysis- Equivalent voltages and currents for non-TEMlines, Network parameters for microwave circuits, Scattering Parameters.

Passive and Active Microwave Devices- Microwave passive components:Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

Microwave Design Principles- Impedance transformation, Impedance Matching,Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

Microwave Measurements- Power, Frequency and impedance measurement atmicrowave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Text/Reference Books:

1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Course Outcomes:

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

1. Understand various microwave system components their properties.
2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.
3. Design microwave systems for different practical application.

EC 317: Speech and Audio Processing (L: 3 T 0 P 0 CH 3 CR 3)

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Text/Reference Books:

1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students *Edition), 2004.*
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

Course Outcomes:

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

1. Mathematically model the speech signal
2. Analyze the quality and properties of speech signal.
3. Modify and enhance the speech and audio signals.

EC 318: Digital Image and Video Processing (L: 3 T 0 P 0 CH 3 CR 3)

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Text/Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Course Outcomes:

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

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

<u>EC 319: VLSI Design (L: 3 T 0 P 0 CH 3 CR 3)</u>

Issues of digital IC design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles; MOSFET fabrication: basic steps fabrication, CMOS p-well and n-well processes, layout design rules, Bi-CMOS fabrication processes; basic electrical properties of MOS and BiCMOS circuits: MOS transistor operation in linear and saturated regions, MOS transistor threshold voltage, MOS switch and inverter, Bi- CMOS inverter, latch-up in CMOS inverter, inverter properties (robustness, dynamic performance, regenerative property, inverter delay times, switching power dissipation), MOSFET scaling (constant voltage and constant field scaling);logic design with MOSFETs: switch logic (networks derived from canonical form and Shannon expression theorem, universal logic modules, networks derived from iterative structure), gate restoring) logic, programmable logic array (PLAs), finite state machine (FSM) as a PLA, personality matrix of a PLA, PLA folding, pseudo-nmos logic; basic circuit concepts: sheet resistance and area capacitances of layers, driving large capacitive loads, supper-buffers, propagation delay models of cascaded pass transistors, wiring capacitances; dynamic CMOS design: steady state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic problems in single phase clocking, two phase non overlapping clocking scheme; low power CMOS logic gates: low power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits: subsystem design: design of arithmetic building blocks like adders (static, dynamic, Manchester carrychain, look ahead, linear and square root carry select, carry bypass and pipelined adders) and multipliers (serial-parallel, Braun, Baugh-Wooley and systolic array multipliers), barrel and logarithmic shifters, area time tradeoff, power consumption issues; Semiconductor memories: Dynamic random access memories (DRAM), static RAM, non volatile memories, flash memories; bipolar ECL inverter: Features of ECL gate, robustness and noise immunity, logic design in ECL, signal ended and differential ECL; physical design: brief ideas on partitioning, placement, routing and compaction, Kernighan-Lin and FiducciaMattheyses partitioning algorithms, area routing and channel routing algorithms; testability of VLSI: Fault types and models, stuck-at fault models, scan based techniques, built-in self test (BIST) techniques, Boolean differences, PLA testability.

Books:

1. D.A. Pucknell and K.Eshraghian, Basic VLSI Design, PHI, 1995
2. Fabricius, Introduction to VLSI design, McGraw Hill,1991

IC361 Accounting and Financial management (L 3-T 0-P 0 - CH 3 - CR 3)

Unit 1: Introduction of Accounting

Meaning and Scope of accounting; Objectives, nature and functions of accounting; Advantages and limitations of accounting;Accounting as a measurement and valuation principle; Accounting Principles; Accounting as an Information System;Basis of Accounting – Cash and accrual system of Accounting; Branches of accounting; Accounting and management control.

Unit 2: Basic Accounting Process

Accounting process from recording of transactions till preparation of Trial Balance-Concept of assets, liabilities, capital, income and expenses; Balance Sheet equation; Classification of receipts/income and payments/expenditure into capital and revenue; Rules for Debit and credit; recording of transactions; The Journal and subsidiary books, ledger accounts- posting of transactions; Adjusting entry; Bank Reconciliation Statement.

Unit 3: Trial Balance and Final Accounts

Trial Balance – meaning and importance, adjusted trial balance, Difference in Trial Balance; Errors and rectification entries thereof.
Need for measurement of income, Realization principle vs. Accrual principle; accounting period, Matching revenue and expenses.
Manufacturing Account, Trading Account, Concept of Gross profit and Net profit,, Need and meaning of Profit and Loss Account, Forms and contents of Profit and Loss Account, Concept of Balance Sheet, Classification of items in a balance sheet; Format of Company Balance Sheet, Preparation of Final Accounts; Cash Flow statement.
Accounting for depreciation; method of inventory valuation

Unit 4: Accounting Standards and emerging concepts in Accounting

Introduction to Accounting Standards and IFRS converged Ind AS, Human Resource Accounting, Corporate Social Accounting etc.; computerized Accounting System and accounting software,

Unit 5: Study of Annual Reports of Companies; Analysis, interpretation and Judgment building

(Assignment based)

Text Books:

1. Ramachandran, N. and Kakani, R.K. Financial Accounting for Management. 3/e, TATA McGraw-Hill Education Pvt. Ltd: Noida, 2011.
2. BhattacharjeeAshis K. Financial Accounting for Business Management. Prentice Hall India: New Delhi, 2006.

Reference Books:

1. Anthony Robert N., Hawkins David, Merchant Kenneth A. ,Financial Accounting-Text and Cases, McGraw-Hill Higher Education; 13 edition (1 June 2010)

Semester-VII

EC 401: Information Theory & Coding (L: 3 T 0 P 0 CH 3 CR 3)

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.

Text/Reference Books:

1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Course Outcomes:

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

1. Understand the concept of information and entropy
2. Understand Shannon's theorem for coding
3. Calculation of channel capacity
4. Apply coding techniques

EC 402: Embedded Systems (L: 3 T 0 P 0 CH 3 CR 3)

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems, Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. sub-

system interfacing, interfacing with external systems, user interfacing. Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Course Outcomes:

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

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

EC 403: Satellite Communication (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Satellite link budget

Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Text /Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Course Outcomes:

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

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

EC 404: Digital Systems and VHDL (L: 3 T 0 P 0 CH 3 CR 3)

Modeling digital systems, modeling languages, VHDL modeling concepts, Design of digital circuits using Verilog or VHDL, Computer architecture and organization: control design hardwired control, micro- programmed control; CPU design- complex instruction set computer (CISC), reduced instruction set computer (RISC); memory organization- virtual memory, high speed memory; input-output systems and communication. Programmable logic devices: programmable logic design techniques, modular designs and hierarchy, field programmable gate arrays (FPGAs) and complex programmable logic devices (CPLDs). Hardware structures for digital signal processing (DSP): computer arithmetic- number representations, CORDIC method for computing elementary and special functions; measures for enhancing performance-parallel processing and pipelining; array processor architectures algorithmic representation, linear mapping method, systolic arrays; digital filter structures.

Books:

1. J.Hayes: Computer Architecture and Organization; McGraw-Hill, 1998,3/e.
2. J.H.Jenkins: Designing with FPGAs and CPLDs; PHI, 1994

EC 405: Computer Vision (L: 3 T 0 P 0 CH 3 CR 3)

Image formation and image models; image filtering; lines, blobs, edges and boundary detection; representation of 2-D and 3-D structures; Bayes decision theory for pattern recognition; supervised and unsupervised classifications; parametric and non- parametric schemes; clustering for knowledge representation; application of neural networks and fuzzy logic in pattern recognition; feature extraction in images; texture analysis and classification; image segmentation; optical character recognition; 2-D and 3-D object recognition; surface extraction from monocular images; stereo image pair analysis; optical flow and 3-D motion analysis.

Books:

1. D.H. Ballard and C.M. Brown: Computer Vision; PHI, 1982
2. R.C. Gonzalez and R.E. Woods: Digital Image Processing, Pearson Education, 2001

EC 406: Biomedical Signal Processing (L: 3 T 0 P 0 CH 3 CR 3)

Biomedical signals: Genesis of bioelectric potential, ECG, EEG, EMG and their monitoring and measurement; overview of analog signal analysis: time – and frequency- domain representation of signal, Fourier series and Fourier transform, linear system, correlation, convolution and filtering; random signal – correlation and spectral representation. Digitization of signal: sampling theorem and A/D Conversion; quantizing effects; aliasing artifacts in biomedical signals. Discrete transforms: Discrete – time Fourier theorem, DFT and FFT; z-transform and properties.

Digital filters: FIR and IIR filter, biomedical applications of digital filtering- removal power line interference from ECG data, reducing ECG artifact from EMG data. ECG Pre-processing, wave form recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory, ECG compression, Evoked potential estimation. EEG: evoked responses, averaging techniques, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages, epilepsy detection, EMG: wave pattern studies, biofeedback

Text/ Reference Books:

1. Biomedical Signal Processing and Signal Modeling Author: E.N. Bruce, Publisher: John Wiley and Sons.

2. Nonlinear Biomedical Signal Processing Dynamics, Analysis and Modeling; Author: Metin Akay; Publisher: John Wiley and Sons.
3. Nonlinear Biomedical Signal Processing, Fuzzy Logic, Neural Networks and New algorithms; Author: Metin Akay: Publisher: John Wiley and Sons.
4. Biomedical Digital Signal Processing: C language examples and Laboratory Experiments for IBM PC; Author: W. J Tompkms; Publisher: Prentice Hall.
5. Digital Signal Processing A Computer base Approach; Author: S.K. Mitra Publisher: Mc.Graw Hill, 2nd Edition ,2001
6. Digital Signal Processing: Principles, Algorithms and Application; Author: John G. Proakis, Dimitria G. Manolakis Publisher: 3 rd Edition, Prentice Hall, 1995.
7. Biomedical Engineering Handbook, Author: J.D. Bronzino, Publisher: CRC press.
8. Textbook of Medical Physiology; Author: A C Guyton; Publisher: Prism Books (PVT) Ltd.
9. Fundamentals of Anatomy and Physiology, Author: F.H.Martini, Publisher: Prentice Hall

<u>**EC 407: Antenna and Propagation (L: 3 T 0 P 0 CH 3 CR 3)**</u>

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

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.

Different modes of Radio Wave propagation used in current practice.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Course Outcomes:

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

1. Understand the properties and various types of antennas.
2. Analyze the properties of different types of antennas and their design.
3. Operate antenna design software tools and come up with the design of the antenna of required specifications.

EC 409: Introduction to MEMS (L: 3 T 0 P 0 CH 3 CR 3)

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk

Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear

Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Text/Reference Book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

Course Outcomes:

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

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

EC 410: Biomedical Electronics (L: 3 T 0 P 0 CH 3 CR 3)

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic, X-ray and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Text/Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Course Outcomes:

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

1. Understand the application of the electronic systems in biological and medical applications.
2. Understand the practical limitations on the electronic components while handling bio-substances.
3. Understand and analyze the biological processes like other electronic processes.

EC 411: Fibre Optic Communication (L: 3 T 0 P 0 CH 3 CR 3)

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

Different types of optical fibers, Modal analysis of a step index fiber.

Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

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

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

Optical amplifiers - EDFA, Raman amplifier.

WDM and DWDM systems. Principles of WDM networks.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication.

Text/Reference Books

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Course Outcomes:

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

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers

EC 412: Nano-electronics (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/ Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Course Outcomes:

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

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and theprocesses involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

EC413: Fuzzy Logic and Neural Networks (L: 3 T 0 P 0 CH 3 CR 3)

Introduction to Fuzzy sets, Fuzzy relation, Approximate reasoning, Rules. Fuzzy control design parameters, Rule base, database, and choice of fuzzification procedure, choice of defuzzification procedure. Nonlinear fuzzy control, adaptive fuzzy control.

Introduction to neural networks, biological neurons, artificial neurons, artificial neural networks-various structures, learning strategies, applications.

Books:

1. D. Driankov, H. Hans, R. Michael: An Introduction to Fuzzy Control; SpringerVerlag,1993
2. R.Beale, T. Jackson: Neural Computing-An Introduction; Adam Hilger, 1990

EC414: Bio-neuro Engineering (L: 3 T 0 P 0 CH 3 CR 3)

Biology of the neuron, biophysical description of the action potential, synapses, neuron as a threshold device, networks, neuro-electronic junctions, silicon neurons, SPICE modeling of Silicon neurons, Neural coding, models and methods, goal functions and time dependent learning rules, neural interfaces, EEG recording for brain computer interface applications, coding and decoding of neural information in bi-directional neural interfaces, Neuro-engineering of mind : neural models of higher functions, large scale brain models, neural modeling and neural coding in the brain.

Text/ Reference Books:

1. Bioelectronics Handbook, MOSFETs, Biosensors & Neurons, Author: Massimo Grattarola, Giuseppe Massobrio, Publisher: Mc Graw Hill.
2. From Neuron to Brain ; Author: J C Nicholls, A R Martin, B G Wallace; Sunderland ,Mass, Publisher: Sinauer Associates
3. Analog VLSI and neural systems; Author: C Mead; Publisher: Addison Wesley.
4. Neural Engineering (Vol 1-6); Author: Metin Akay; Publisher: Wiley /IEEE Press.

EC415: Digital Signal Processor (L: 3 T 0 P 0 CH 3 CR 3)

Computational characteristics of DSP algorithms: basic DSP operations, a genetic instruction-set architechture for DSPs, architectural requirement of DSPs, high throughput, enhanching computational throughput, multiple on chip memories and buses, on chip peripherals, control unit of DSPs

Books

1. P.Pirsch, Architectures for Digital Signal Processing,John Wiley, 1999
2. R.J.Hggins, Digital Signal Processing in VLSI, Prentice-Hall,1990

EC417: Project Stage I (L: 0 T 0 P 6 CH 12 CR 6)

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

BM 301 Social Responsibility and Professional Ethics in Engineering **(L: 3 T 0 P 0 CH 3 CR 3)**

Engineering and Society: What is Engineering? The Engineering view, The Engineering Image; The Engineer's Challenge: Cost, Deadline and Safety

Moral Dilemmas in Engineering: Engineering and Business.

Frameworks for Engineering ethics: Moral Thinking and moral theories, codes of Engineering ethics, support for ethical engineers.

Engineering ethics and public policy: Risk Assessment and Communication, product liability, engineering and sustainable development.

Intellectual property: Foundations of intellectual property, copyrights, patents, and trade secrets, software piracy, software patents, transnational issues concerning intellectual property. Entrepreneurship: prospects and pitfalls, Monopolies and their economic implications, Effect of skilled labor, supply and demand of the quality computing products, pricing strategies.

Case studies in Engineering ethics: Challenger Disaster, Hyatt Regence Walkway collapse, The Pfizer Heart Valve Case, The Therac-25 case etc.

Reference:

1. Computers, Ethics and Social Values, Johnson &Nissenbaum, Prentice Hall
2. Social Issues in Computing: Putting Computing in Place, Huff &Finholt, McGraw Hill.
3. A Gift of Fire: Social, Legal and Ethical Issues in Computing, Prentice Hall.
4. Cyber Ethics: Morality and Law in Cyber Space, Jones & Bartlett.

CT465: Essence of Traditional Indian Knowledge **(L: 1 T 0 P 0 CH 1 CR 0)**

This course will introduce Indian thought and culture from a historical perspective. The aim will be to introduce students to important concepts from the diverse intellectual traditions of India to encourage critical appreciation of these concepts.

UNIT I	Plurality of Indian culture/Indus valley culture/Dravidian culture and Vedic culture/Cultural separatism and cultural unity
UNIT II	The goals of traditional Indian Education/Introduction to Indian Philosophy: Vedic thought, Cārvāka Darśana, Jaina Darśana, Bauddha Darśana

Text books:

Chatterjee, Satishchandra and Dhirendramohan Datta. (2007) *Introduction to Indian Philosophy.* Rupa Publications, New Delhi.

Husain,S. Abid. (2003). *The National Culture of India*. National Book Trust, New Delhi.

Reference Books:

Dasgupta, Surendranath. (1922).A History of Indian Philosophy (5 vols.). Motilal Banrasidass, New Delhi.

Kuiper, Kathleen. (2011). The Culture of India. Encyclopaedia Britannica, New York.

Semester-VIII

EC 418: Power Electronics (L: 3 T 0 P 0 CH 3 CR 3)

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT-Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Text /Reference Books:

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V.R.Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers”, New Age International Publishers. SCR manual from GE, USA.

Course Outcomes:

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

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

EC 419: Mixed Signal Design (L: 3 T 0 P 0 CH 3 CR 3)

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signalling and data transmission; Current-mode signaling and data transmission.

Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

Text/Reference Books:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008.
4. Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

Course Outcomes:

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

1. Understand the practical situations where mixed signal analysis is required.
2. Analyze and handle the inter-conversions between signals.
3. Design systems involving mixed signals

EC 420: High Speed Electronics (L: 3 T 0 P 0 CH 3 CR 3)

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise; Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Inter-modulation,Cross-modulation, Dynamic range

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs high frequency)

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Text/Reference Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", CambridgeUniversity Press, 2004, ISBN 0521835399.
3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
4. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
5. Kai Chang, "RF and Microwave Wireless systems", Wiley.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Course Outcomes:

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

1. Understand significance and the areas of application of high-speed electronics circuits.
2. Understand the properties of various components used in high speed electronics
3. Design High-speed electronic system using appropriate components.

EC421: Project Stage II <u>(L: 0 T 0 P 10 CH 20 CR 10)</u>

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.