MANIPUR UNIVERSITY
CANCHIPUR, IMPHAL

CURRICULUM & SYLLABUS

BACHELOR OF ENGINEERING
(Effective from the Academic Session 2020-2021)

IN

ELECTRONICS & COMMUNICATION ENGINEERING
(Second Year to Fourth Year)

CONTENTS

VISION OF THE INSTITUTE

Excellence in engineering and technology education with good leadership in Human Resource Development.

MISSION OF THE INSTITUTE

- To produce technically strong, innovative, research oriented, all round developed engineers capable to solve modern challenges by adopting student centric teaching learning methods.
- To impart engineering and technology education for all round development.
- To produce good engineering professionals with social commitment.

ABOUT THE DEPARTMENT

The department presently offers the following programmes**:**

- **B.E in Electronics and Communication Engineering.**
- **M.Tech. in the following specialization:**
  1. Microelectronics and VLSI specialization
  2. Communication Engineering& Signal Processing specialization
- **Ph.D in Electronics and Communication Engineering**

VISION OF THE DEPARTMENT

- Impart quality education to create good technocrats and entrepreneurs with new ideas and innovations to meet industry expectations through advance research.

MISSION OF THE DEPARTMENT

- To develop and deliver quality academic programs in emerging and innovative field of engineering to empower the student to meet industry standard.
- To build student community with high ethical standards to undertake R&D in thrust areas of national and international needs.
- To create centre of excellence by establishing the incubation centres to meet latest research challenges.

Programme Educational Objectives (PEOs)

PEO1: To produce graduates with a solid foundation in mathematical, scientific, computing and engineering fundamentals and working knowledge of managerial skills.

PEO2: To produce graduates with sound theoretical and practical knowledge in Electronics and Communication Engineering.

PEO3: To impart quality education to the students to become professionally, ethically and socially responsible and acquire skills for effective communication and team work in multidisciplinary environment.

PEO4: To inculcate the spirit of enquiry, creativity, collaboration and adaptability through the habit of problem solving and self-learning to keep the graduates motivated for higher studies, research and professional services.

Programme Specific Outcomes (PSOs)

At the time of graduation, the students would be able to:

PSO 1: Design Electronics and Communication systems including electronic circuits and devices, software and hardware using analytical knowledge in Core Electronics, IC Design, Robotics, Embedded Systems and Analog and Digital Communications.

PSO 2: Analyze specific engineering problems relevant to Electronics and Communication Engineering by applying the core knowledge of circuit design, signal processing, communication systems and networks, computing and control systems supported by the concepts of basic sciences and mathematics.

PSO 3: Apply the contextual knowledge of Electronics and Communication Engineering to address professional, societal and environmental issues with work ethics and function effectively as a team member.

PSO 4: Get acquainted with the usage of DSP and Communication boards, EDA tools, Microprocessors and Microcontrollers, Microwave benches and various simulation tools for analyzing and design of practical systems and processes.

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: The problems: that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution that require consideration of appropriate constraints/requirements not explicitly given in the problem statement which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER-WISE STRUCTURE OF CURRICULUM
(L= Lectures, T = Tutorials, P = Practicals & C = Credits)

THIRD SEMESTER (SECOND YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 231	Electronic Devices	3	0	0	70	30	-	100	3
2	EC 232	Digital System Design	3	0	0	70	30	-	100	3
3	EC 233	Electromagnetic Waves	3	0	0	70	30	-	100	3
4	EC 234	Network Theory	3	0	0	70	30	-	100	3
5	MA 231	Mathematics-III	3	1	0	70	30	-	100	4
6	HU 231	Economics for Engineers	2	0	0	35	15	-	50	2
		Sub Total	***17***	***1***	***0***				***550***	***18***
		Practical/Design								
7	EC 231P	Electronics Devices Lab	0	0	4	-	30	70	100	2
8	EC 232P	Digital System Design Lab	0	0	4	-	30	70	100	2
9	EC 235P	Simulation Lab.	0	0	2	-	15	35	50	1
10	EC 236P	Internship	-	-	-	-	100	-	100	1
		Sub Total	***0***	***0***	***10***				***350***	***6***
		Mandatory Course								
11	NC 231	Constitution of India/ Essence of Indian Traditional Knowledge	3	0	0	-	*50			
		Total	**20**	**1**	**10**				**900**	**24**

Total Credits - 24

FOURTH SEMESTER (SECOND YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 241	Analog and Digital Communication	3	0	0	70	30	-	100	3
2	EC 242	Analog Circuits	3	0	0	70	30	-	100	3
3	EC 243	Signals and Systems	3	0	0	70	30	-	100	3
4	MA 241	Numerical Methods and Computation	3	0	0	70	30	-	100	3
5	MA 242	Probability theory and Stochastic Processes	3	0	0	70	30	-	100	3
6	HU 241	Universal Human Values-II	2	1	0	70	30	-	100	3
		Sub Total	***17***	***1***	***0***				***600***	***18***
		Practical/Design								
7	EC 241P	Analog and Digital Communication Lab	0	0	4	-	30	70	100	2
8	EC 242P	Analog Circuits Lab	0	0	4	-	30	70	100	2
		Sub Total	***0***	***0***	***8***				***200***	***4***
		MANDATORY COURSE								
9	NC 241	Environmental Science	2	0	0	-	*50			
		Total	**19**	**1**	**8**				**800**	**22**

Total credit - 22

FIFTH SEMESTER (THIRD YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 351	Introduction to VLSI Design	3	0	0	70	30	-	100	3
2	EC 352	Computer Architecture	3	0	0	70	30	-	100	3
3	EC 353	Digital Signal Processing	3	0	0	70	30	-	100	3
4	EC 354	Microcontrollers	3	0	0	70	30	-	100	3
5	EC 355	Program Elective – 1	3	0	0	70	30	-	100	3
6	EC 356	Open Elective-1	3	0	0	70	30	-	100	3
		Sub Total	***18***	***0***	***0***				***600***	***18***
		Practical/Design								
7	EC 353P	Digital Signal Processing Lab	0	0	4	-	30	70	100	2
8	EC 354P	Microcontrollers Lab	0	0	2	-	30	70	100	1
9	EC 357P	Internship	-	-	-	-	100	-	100	1
		Sub Total	***0***	***0***	***6***				***300***	***4***
		Mandatory Course								
10	NC 351	Organizational Behaviors	3	0	0	-	*50	-		
		Total	**21**	**0**	**6**				**900**	**22**

Total Credits - 22

SIXTH SEMESTER (THIRD YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 361	Control Systems	3	0	0	70	30	-	100	3
2	EC 362	Computer Network	3	0	0	70	30	-	100	3
3	EC 363	Microwave Engineering	3	1	0	70	30	-	100	4
4	EC 364	Program Elective – 2	3	0	0	70	30	-	100	3
5	EC 365	Open Elective-2	3	0	0	70	30	-	100	3
		Sub Total	***15***	***1***	***0***				***500***	***16***
		PRACTICAL/DESIGN								
6	EC 363P	Microwave Engineering Lab	0	0	3	-	30	70	100	1.5
7	EC 366P	Mini Project/ Electronic Design workshop	0	0	4	-	50	100	150	2
		Sub Total	***0***	***0***	***7***				***250***	***3.5***
		TOTAL	**15**	**1**	**7**				**750**	**19.5**

Total Credits – 19.5

SEVENTH SEMESTER (FOURTH YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 471	Program Elective -3	3	0	0	70	30	-	100	3
2	EC 472	Program Elective -4	3	0	0	70	30	-	100	3
3	EC 473	Program Elective -5	3	0	0	70	30	-	100	3
4	EC 474	Open Eelective-3	3	0	0	70	30	-	100	3
		Sub Total	***12***	***0***	***0***				***400***	***12***
		PRACTICAL/DESIGN								
5	EC 475P	Logic Design using HDL	1	1	2	-	30	70	100	3
6	EC 476P	Project Stage-I	0	0	6	-	100	100	200	3
7	EC 477P	Internship	-	-	-	-	100	-	100	1
		Sub Total	***1***	***1***	***8***				***400***	***7***
		TOTAL	**13**	**1**	**8**				**800**	**19**

Total Credits - 19

EIGHTH SEMESTER (FOURTH YEAR)

Sl. No.	Subject Code	Subject	Hours/week			Marks				Credits
			L	T	P	Theory	Sess.	Pract.	Total	
1	EC 481	Program Elective -6	3	0	0	70	30	-	100	3
2	EC 482	Program Elective -7	3	0	0	70	30	-	100	3
3	EC 483	OE-4	3	0	0	70	30	-	100	3
4	EC 484	OE-5	3	0	0	70	30	-	100	3
		Sub Total	***12***	***0***	***0***				***400***	***12***
		Practical/Design								
5	EC 485P	Project Stage-II & Dissertation	0	0	1 2	-	120	280	400	6
		Sub Total	***0***	***0***	***12***				***400***	***6***
		TOTAL	**12**	**0**	**12**				**800**	**18**

Total Credits - 18

SUMMARY	
TOTAL SUBJECTS	**51**
THEORY	**36 [32 + 4(NC)]**
LABORATORY	**15 [9 + 1(Mini Project) + 2(Main Project) + 3 (Internship)]**
CREDITS	**163 [125 (CORE BRANCH) + 17.5(Sem-I) + 21(Sem-II)]**
TOTAL MARKS	**900 + 800 + 900 + 800 + 900 + 800 = 5050**

DETAILED SYLLABUS - THIRD SEMESTER

EC 231	Electronic Devices	3L:0T:0P	3 Credits

Course Objectives: The main objective of this course is to provide

1. To introduce the concepts and physics behind semiconductors.
2. To teach diodes, their working and different types.
3. To bring the different applications of diode to understanding.
4. To teach the concept of Bipolar Junction Transistor.
5. To teach the concept of Field Effect Transistor.
6. To understand the necessity of transistor biasing and study and analyse small signal low frequency transistor amplifier circuits.

Module 1: 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.

Module 2: Generation and recombination of carriers

Poisson and continuity equation P-N junction characteristics, I-V characteristics, piece-wise linear diode model and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode, LED, photodiode and solar cell.

Module 3: Bipolar Junction Transistor (BJT)

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, small signal models of transistor .

Module 4: Field Effect transistors

MOS capacitor, CV characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor.

Module 5: Integrated circuit fabrication process

Oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Text /Reference Books:

1. MG. 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.
3. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
4. 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 junction and MOS transistors for circuits and systems.

EC 232	Digital System Design	3L:0T:0P	3 credits

Objectives:

1. Conversion of number systems between different number systems.
2. To teach principles of digital system
3. To teach codes as BCD and Gray code.
4. To teach error detection and correction code.
5. To teach topics including Boolean algebra, basic gates, logic circuits, arithmetic circuits.
6. Using K-map and Quine-McCluskey tabular simplification of logic circuit.
7. To teach different types of flip-flops, registers, counters and computer memory.
8. To teach state machine diagram

Module 1; Fundamentals of Digital Systems. (8 Hours)
Digital signals, number systems, digital circuits, Boolean Algebra and De- Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps representation, Binary codes, Code Conversion.

Module 2: Combinational Digital Circuits: (8 Hours)
SI devices like Comparators, Multiplexers, De-multiplexers, Encoder, Decoder, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU, parity checker/generator.

Module 3; Sequential Logic Design (10 Hours)
Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

Module 4: Logic Families and Semiconductor Memories (7 Hours)
TTL gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Module 5: VLSI Design flow (7 Hours)
Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and 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

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

EC 233	Electromagnetic Waves	3L:0T:0P	3 credits

Course Objective:

1. To analyze fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications to describe the relationship between Electromagnetic Theory and circuit theory.
2. Formulate the basic laws of static electricity and magnetism and extend them to time varying fields to define the Maxwell's equations in differential and integral form.
3. Derive the wave equations for conducting and dielectric mediums to analyze the wave propagation characteristics of Uniform Plane Waves (UPW).
4. Analyze fundamental concepts of Transmission lines and to formulate the basic relationship between distortion less transmission lines & applications.

Module I : Electrostatics

Review of coordinate systems. Coulomb's Law, Electric field due to various charge distributions, Electric flux density. Gauss's Law and its applications. Divergence Theorem, Maxwell's Two equations of Electrostatics Fields, Electric potential& Potential difference, The dipole. Current and Current density, Laplace and Poisson's equations, Dielectrics : linear, isotropic, homogeneous.

Module II : Magnetostatics

Biot-Savart's law, Ampere's law and its applications, Stoke's theorem, Magnetic flux and magnetic flux density. Scalar and vector magnetic potentials, Maxwell's two equations of magnetostatics.

Module III : Maxwell's Equations (Time Varying Fields)

Faraday's law, displacement current & displacement current density, Maxwell's Equations in different forms, Boundary conditions at Media Interface, Wave equation.

Module IV : Uniform plane waves

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

Module V : Transmission Lines

Types of transmission line, Equations of Voltage and Current on TX line, Propagation constant, Characteristic impedance and reflection coefficient, Impedance Transformation, Impedance matching, VSWR, Smith Chart and its applications.

Text/Reference Books*:*

1. Engineering Electromagnetics H Hayt, J A Buck, M Jaleel Akhtar Tata McGraw-Hill, 8th Edition, 2014.
2. Mathew N. O. Sadiku ―Elements of Electromagnetic, Oxford University Publication 2014
3. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999.
4. Field and wave electromagnetic‖, David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint–2001
5. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
6. David Cheng, Electromagnetics, Prentice Hall

Course Outcomes :

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

1. Understand the different coordinate systems, vector calculus, Coulomb's law and Gauss's law for finding electric fields due to different charges.
2. Learn basic magneto-statics concepts and laws such as Biot-Savart's law and Ampere's law, their application in finding magnetic field intensity.
3. Distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell’s Equations and Boundary Condit ions, and use them for solving engineering problems.
4. Analyse the wave equations for dielectric and good conductor and evaluate the UPW characteristics for several practical media of interest.
5. Determine the Transmission Line parameters to characterize the distortions and estimate the characteristics for different lines.

EC234	**Network Theory**	**3L:0T:0P**	**3 Credits**

Course Objectives: The main objective of this course is to provide:

1. Understand basic concepts of DC and AC circuit behaviour.
2. Understand and analyse the application of Kirchhoff’s voltage and current laws and Ohm’s law to linear circuits.
3. Perform node and loop analysis.
4. Learn the concepts of two-port network theory.
5. Learn the network analysis methods through the use of graph theory.

Module 1: Network theorems (10 Hours)

Node and Mesh Analysis. Superposition, Reciprocity, Thevenin’s, Norton’s, Maximum power Transfer, Compensation and Tallegen’s theorem as applied to AC circuits. Concepts of duality and dual networks.

Module 2: Trigonometric and exponential Fourier series (10 Hours)

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.

Module 3:Electric Circuit Analysis using Laplace transforms (10 Hours)

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.

Module 4: Two port network and network functions (10 Hours)

Two port network, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnection of two port networks. 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.

MA 231	Engineering Mathematics-III	3L:1T:0P	4 credits

Course Objectives:
The objective of this course is to familiarize with basics of Fourier series, Boundary value problems, calculus of complex variable, basics of probability and statistics.

Module 1: Fourier Series (6 lectures)
Derichlet's condition-General Fourier series- odd and even functions, Half range-sine and cosine series-complex form of Fourier series, Practical Harmonic analysis.

Module 2: Boundary Value Problems (6 lectures)
Classification of second order quasi linear partial differential equations- solution of one dimensional wave equation, one dimensional heat equation- steady state solution of two dimensional heat equation(insulated edges exclude)-Solution by separation of variables.

Module 3: Complex Analysis (10 lectures)
Analytic function-properties, Cauchy-Riemann equations, construction of analytic function, determination of conjugate harmonic functions, application to two dimensional potential problems. Conformal transformations, Bilinear Transformation. Cauchy's Integral theorem and Cauchy's integral formula (statement only), Taylor's and Laurent's expansions, isolated singularities, residues-Cauchy's residues theorem (statement only), contour integration-over unit circle and semi- circle(excluding poles on real axis).

Module 4: Basic Probability (10 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 5: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Suggested Text & Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Plublication,41 Edition, New Delhi
2. Erwin Kreyszig, Advance Engineering Mathematics, 9th Edition, John wiley & Sons, 2006
3. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
4. N. O. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
6. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
7. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1 Wiley, 1968.

Course Outcomes:

The students will learn:

1. The methods to expand a function in Fourier series.
2. The methods to solve partial differential equations that are arising in engineering problems.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. The basics of probability and statistics that are essential in most branches of engineering.

HU 231	Economics for Engineers	2L:0T:0P	2 credits

Course objectives:

1. To impart knowledge, with respect to concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions
2. To explain engineering economics decision making process, state and explain the law of demand and supply, law of diminishing returns and solve problems on interest factors.
3. To explain the various cost concepts, cost estimation methods
4. To familiarise Monetary policy and banking system

Module 1: Introduction to Economics (5 Hrs)

Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; meaning, determinants, law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity

Module 2: Theory of production, Cost and Break even analysis (5 Hrs)

production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical

Module 3: Markets (5 Hrs)

Meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income.

Module 4: Basic economic problems (5 Hrs)

Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control

Module 5: Money and Banking (5 Hrs)

Money; meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR.

Text Books/ References:

1. James L Riggs, Engineering Economy, McGraw Hill, 2002.
2. Gerald J Thuesen, Engineering economy, Prentice-Hall-India, Pvt Ltd, 2002.
3. Engineering Economics, R.Paneerselvam, PHI publication
4. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
5. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

Course Outcomes:

At the end of this course, students will learn

1. Basic understanding of Economics such as concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions
2. Understand the monetary policy, banking system and markets characteristics

NC 231	Constitution of India / Essence of Indian Traditional Knowledge	3L:0T:0P	0 credits

Constitution of India – Basic features and fundamental principles The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments.

The Constitution of India Reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 2

PRACTICAL / DESIGN

EC 231P	**Electronics Devices Lab.**	**0L:0T:4P**	**2 credits**

Course Objectives:

1. To expose the students to various electronic components and devices.
2. To implement theoretical concepts of diode, Zener diode in a breadboard and obtain their corresponding results.
3. To derive BJT and FET characteristics

LIST OF EXPERIMENTS

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

Course outcomes:

Students completing the course will be able to-

1. Identify and test different R, L, C components
2. Identify and test different active components such as diodes, BJTs, MOSFETs, JFETs, LEDs
3. Operate Multimeter, Function Generator, Power Supply, CRO and DSO
4. Use soldering iron.
5. Understand the characteristics of diode, LED, Zener diodes, BJT and JFET.

EC 232P	Digital System Design Lab.	0L:0T:4P	2 credits

Course Objectives:
1. Learn and understand the basics of digital electronics.
2. Understand of Boolean algebra and able to design the simple logic circuits.
3. Test/ verify the functionality of the logic circuits.

LISTOFEXPERIMENTS:

1. Familiarization of different logic gates.
2. Design of different logic gates using universal logic gates.
3. Design of Half adder, Full adder, Half Subtractor and full Subtractor.
4. Design of BCD to Gray code and Gray to BCD code converter circuit.
5. Design of Multiplexer and Demultiplexer using logic gates.
6. Design of Comparator circuit.
7. Familiarization of different types of flip flop.
8. Design of binary Counter using flip flop.

Course Outcomes: At the end of the course the student will be able to:
1. Distinguish between analog and digital systems.
2. Identify the various digital I.C.s and understand their operation.
3. Apply Boolean laws and K-map to simplify the digital circuits.
4. Understand the function of elementary digital circuits under real and simulated environment.
5. Prepare a report on basis of digital electronics and handling of I.C.s.

DETAILED SYLLABUS - FOURTH SEMESTER

EC 241	Analog and Digital Communication	3L:0T:0P	3 credits

Course objectives:

This course will enable students to: ·

1. Design simple systems for generating and demodulating AM, DSB, SSB and VSB signals.
2. Understand the concepts in Angle modulation for the design of communication systems.
3. Evaluate the performance of the analog communication system in presence of noise.
4. Understand the basic structures and fundamental principles of modern digital communication systems.
5. Provides an understanding of the generation and detection of different digital modulation techniques such as ASK, FSK, PSK.
6. Analyze the advantages of spread spectrum techniques and performance of spread spectrum, PN codes etc.

Module 1 : Modulation (10 lectures)

Amplitude Modulation: Principles of Amplitude Modulation Systems, Time & Frequency – Domain description, Generation of AM signal, Demodulation of AM signal. Different type of modulator circuits, DSB, SSB and VSB modulations, Coherent detection.

Angle Modulation: Basic definitions, Representation of FM and PM signals, Relationship between frequency and phase modulations, Spectrum of FM signal, Narrow Band and Wide Band FM, Spectral characteristics of angle modulated signals, Comparison of FM and AM.

Module 2 : Noise in Analog Communication System (6 lectures)

The Superheterodyne Receiver, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De- emphasis, Threshold effect in angle modulation.

Module 3 : Pulse Modulation (8 lectures)

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

Module 4 : Digital Modulation Techniques (10 lectures)

Line codes, Digital Modulation schemes- Amplitude Shift Keying, Phase Shift Keying, generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM, Frequency Shift Keying, BFSK generation, detection and error probability, Continuous Phase Modulation and Minimum Shift Keying.

Module 5 : Principles of Spread Spectrum Communication Systems (6 lectures)

Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum.

Text/ Reference Books:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014.
2. B.P.Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 4th Edition, 2010.
3. John G.Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education.
4. Digital and Analog Communication Systems – Sam Shanmugam, John Wiley, 2005.
5. Electronics & Communication System – George Kennedy and Bernard Davis , TMH 2004.
6. Principles of Communication Systems - Herbert Taub, Donald L Schilling, Goutam Saha, 3rd Edition, Mc Graw-Hill, 2008.
7. Digital Communication- Theory, Techniques, and Applications _ R. N. Mutagi, 2nd Ed. 2013.

Course Outcomes:

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

1. Understand the fundamental concepts of the analog communication systems.
2. Design various pulse modulation techniques such as PCM, DPCM, DM.
3. Explain the basic components of digital communication systems.
4. Understand the generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of different digital modulation techniques.
5. Analyze the performance of various spread spectrum communication systems.

EC 242	**Analog circuits**	**3L:0T:0P**	**3 credits**

Module 1: Diode Circuits

P-N junction diode, V-I characteristics of a diode; review of half-wave and full wave rectifiers, Zener diodes, clamping and clipping circuits .

Module 2: Biasing schemes for BJT and FET amplifiers: bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features

Module3: Small signal operation and models: 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.

Module4: High frequency transistor models: frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues.

Module5: 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.

Module5: Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Module6: Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.

Module7: 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, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Module8: Converters: Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog- to-digital converters (ADC): Single slope, dual slope, successive approximation, flash 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

EC 243	Signals and Systems	3L:0T:0P	3 Credits

Course Objectives :

1 Analyze basic concepts related to signals and systems. Familiarize with basic operations on signals.

2 Define convolution, correlation operations on continuous and discrete time signals of LTI systems.

3 Analyze mathematical representation of a periodic signals using Fourier and Laplace transform.

4 Describe the concept of Z- Transform and its properties and illustrate their applications to analyze systems.

Module I : Introduction to signals and systems

Definition of signal and systems; Classification of signals : continuous-time(CT) and discrete-time(DT) signals; Classification of CT and DT signals : periodic & aperiodic, random & deterministic, even &odd, energy & power signals; Elementary signals : step, ramp, impulse, exponential, sinusoidal signal ; Basic operations on signals : scaling, reflection, shifting; System classification and properties : linear-nonlinear, static-dynamic , causal - non causal, time variant-invariant, stable - unstable.

Module II : Time-domain representation of LTI System
Impulse response; Convolution sum and convolution integral; Different methods of computing convolution sum and integral; Properties of LTI systems : memory, causality, stability; System representation through differential equations and difference equations.

Module III : Fourier representation of signals
Fourier series representation: continuous time (CTFS) and discrete time Fourier series (DTFS), basic problems. Fourier transform: CTFT, DTFT, properties of Fourier transform, system analysis using Fourier transform.
Sampling Theorem and Nyquist rate, Aliasing.

Module IV : Laplace Transform
The Laplace Transform and its properties, Region of convergence (ROC), poles and zeros of system, Unilateral Laplace transform, Laplace domain analysis, solution to differential equations and system behavior.

Module V : Z-Transform
The z-Transform and its properties, Region of convergence (ROC) and its properties, Inversion of z-transform, Transform analysis of LTI systems, Unilateral z-transform and its applications.

Text/Reference books:

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, ―Signals and Systems‖ Pearson Education Asia/PHI, 2nd edition, 1997, Indian Reprint 2002.
2. H.P Hsu, R. Ranjan, ―Signals and Systems‖, Scham' soutlines, TMH, 2006
3. B.P. Lathi, ―Linear Systems and Signals‖, Oxford University Press, 2005
4. Ganesh Rao and Satish Tunga, ―Signals and Systems‖, Sanguine Technical Publishers, 2004
5. Simon Haykin, Barry van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India.
6. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
7. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
8. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Course outcomes:
At the end of this course, students will be able to demonstrate
1. Define and differentiate types of signals and systems in continuous and discrete time.
2. Obtain Linear Convolution and Correlation of discrete time signals of LTI systems.
3. Apply the properties of Fourier transform for continuous time signals
4. Relate Laplace transforms to solve differential equations and to determine the response the Continuous Time Linear Time Invariant Systems to known inputs.
5. Apply Z-transforms for discrete time signals to solve Difference equations.

MA 241	Numerical methods & Computation	3L:0T:0P	3 Credits

Course Objectives:

The main objective of this course is:

1. Introduction to Computer arithmetic and errors.
2. Introduction to solution of Algebraic and Transcendental equation, Linear System of equations and differential equations.
3. Introduction to Eigen values and Eigen vectors.

Module 1: Accuracy and Errors in Computation:

Basic concepts on accuracy of numbers, significant figures, rounding of numbers, Errors representation-Inherent and truncation, Absolute and relative errors, errors in the approximation and series approximation of functions.

Module 2: Solution of Algebraic and Transcendental Equations:

Bisection, Regula-Falsi method, Newton-Raphson and iterative methods with their convergence conditions, Generalizations of Newton-Raphson and iterative methods to simultaneous non-linear equations.

Module 3: Solution of Linear System of Equations:

Gaussian elimination method with partial pivoting, Factorization method, Matrix Inverse method, Gauss-Jacobi and Gauss-Siedel iterative methods, Fitting of curve by method of least square.

Module 4: Numerical solution of Differential Equations:

Picard's and Taylor series, Euler's method and its modified form, Runge-Kutta methods, Solution of two-point boundary value problems using finite difference: One dimensional parabolic equations-Schmidt method, Crank-Nicolson method; Elliptic equations-Solution of Laplace equation-Jacobi's and Guass-Siedel methods; Hyperbolic Equations: Solution of wave equation.

Module 5: Eigen values and Eigen-vectors problems:

Gershgorin's theorem (without proof) with simple problems, Power method for dominant Eigen-values, Jacobi and Given methods for symmetric matrices.

Suggested Text Books & References:

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

Course outcomes:

Students completing the course will be able to

1. Understand fundamental arithmetic operations and Errors Estimation.
2. Solve algebraic and transcendental equations.
3. Solve the system of linear equations of various methods.
4. Solve the differential equations.
5. Determine the Eigen values and Eigen vectors.

MA 242	Probability theory and Stochastic Processes	3L:0T:0P	3 credits

Module 1:(6 Hours)
Sets and set operations; Probability space; Conditional probability and Bayes theorem, Independent events. Combinatorial probability and sampling models.

Module 2: (10 Hours)
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.

Module 3: (10 Hours)
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.

Module 4: (8 Hours)
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.

Module 5: (6 Hours)
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.

HU 241	Universal Human Values-II	2L:1T:0P	3 credits

Course objectives:
The objectives of the course are:
1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being,family, society and nature/existence
3. Strengthening of self-reflection
4. Development of commitment and courage to act

Contents:
The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correctpriority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of thecurrent scenario
6. Method to fulfill the above human aspirations: understanding and living inharmony at various levels.

\# Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physicalfacility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

\# Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life; Differentiate between prosperity and accumulation; Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention andcompetence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

\# Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships; Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role oftechnology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and HumanisticUniversal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT (2L: 1T:0P 3 credits)
Lectures hours are to be used for interactive discussion, placing the proposal about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements. In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and workin real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in theform of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor	: 10 marks
Self-assessment	: 10 marks
Assessment by peers	: 10 marks
Socially relevant project/Group Activities/Assignments	: 20 marks
Semester End Examination	: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OUTCOME OF THE COURSE:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would becomemore responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow itup by

a) Faculty-student or mentor-mentee programs throughout their time with the institution

b) Higher level courses on human values in every aspect of living. E.g. as a professional

PRACTICAL/DESIGN

EC 241P	**Analog and Digital Communication Lab.**	**0L:0T:4P**	**2 Credits**

Course objectives: This course familiarizes the students with

1. Basic analog and digital communication systems.
2. Integrate theory with experiments to appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation, pulse modulation etc.
3. Implement it practically in the laboratory.
4. Enriches the students in latest advancements in analog and digital communication.

List of Experiments

1. Amplitude modulator and demodulator.
2. DSB-SC modulator & demodulator.
3. SSB-SC modulator & demodulator.
4. Operation of Automatic Gain Control (AGC).
5. Frequency modulator and demodulator.
8. Sampling and reconstruction of sinewave.
9. Pulse Amplitude Modulator & demodulator.
10. Pulse Width Modulator & demodulator.
11. Pulse Position Modulator & demodulator.
12. Generation of Unipolar NRZ, Polar NRZ, Unipolar RZ and Polar RZ line code.
13. ASK modulator and demodulator.
14. FSK modulator and demodulator.
15. Phase Shift Keying (PSK) modulator and demodulator.

Course Outcomes:

After studying this course, the students shall be able to:

1. Design analog modulation circuits such as amplitude and frequency modulation.
2. Design analog demodulation circuits such as amplitude demodulation.
3. Design and generate various pulse modulation techniques as PAM, PPM, PWM.
4. Understand the basic concept of Sampling and reconstruction of the signal.
5. Design and implement different digital modulation and demodulation techniques with desired specifications.

EC 242P	**Analog Circuits Lab.**	**0L:0T:4P**	**2 credits**

Course Objectives:

1. Understand the working of different amplifier circuit.
2. Understand the working of different oscillator.
3. Design of Power and tuned amplifiers.
4. Study basic function of I.C.741, 555, 566.
5. Study the different application of I.C. 741, 555,566.
6. Study the different types filter circuit.
7. Simulation of the above circuits using SPICE or Equivalent software.

List of Experiments:

1. Single stage BJT amplifier
2. Two stage BJT amplifier
3. FET amplifier
4. Differential amplifier
5. Design of negative feedback amplifier
6. RC phase shift oscillator
7. Wien bridge oscillator
8. Study of ICs: OP-AMP 741, 555 Timer, 566 PLL.
9. OP-AMP applications: Adder, Subtractor, comparators, Integrator, differentiator and Instrumentation amplifier using IC 741.

Course outcomes:

After the completion of this course, students will be:

1. Design single stage BJT, FET and differential amplifier.
2. Design negative feedback amplifier.
3. Able to generate waveforms with various oscillators.
4. Design power amplifiers and tuned amplifier with capacitor coupled load.
5. To design Op – Amp for ADDER, SUBTRACTOR, INTEGRATOR and DIFFERENTIATOR.
6. To design high pass and low pass filter for various inputs.
7. To design astable, monostable with IC 555 circuits.
8. To design various voltage regulators.

NC 241	Technical English	3L:0T:0P	0 credit

Module 1: Style and organization in technical communication:
Listening, speaking, reading and writing as skills; Objectivity, clarity, precision as defining features of technical communication; Various types of business writing: Letters, reports, notes, memos; Language and format of various types of business letters; Language and style of reports; Report writing strategies; Analysis of a sample report.

Module 2: Oral Presentation and professional speaking:
Basics of English pronunciation; Elements of effective presentation; Body Language and use of voice during presentation; Connecting with the audience during presentation; Projecting a positive image while speaking; Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Basics of public speaking; Preparing for a speech.

Module 3: Career Oriental Communication:
covering, Resume and bio-data: Design & style; Applying for a job: Language and format of job application. Job Interviews: purpose and process; How to prepare for interviews; Language and style to be used in interview; Types of interview questions and how to answer them; Group Discussion: structure and dynamics; Techniques of effective participation in group discussion; Preparing for group discussion;

Module 4: Language Practice:
Emphasizing Listening and comprehension skills; Reading Skills; Sound Structure of English and intonation patterns; training in speaking skills covering oral presentations.

Suggested Text Books & References:

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

DETAILED SYLLABUS - FIFTH SEMESTER

EC 351	**Introduction to VLSI Design**	**3L:0T:0P**	**3 credits**

Course Objectives:
1. To learn the basic MOS Circuits.
2. To learn the CMOS Process Technology.
3. To understand the operation of MOS devices and express the Layout of simple MOS circuit using Stick diagram and Lambda based design rules.
4. To impart in-depth knowledge about analog and digital CMOS circuits.

Module 1: VLSI Technology
Introduction to VLSI technology, VLSI design flow, Digital Design Cycle, Physical Design Cycle.

Module 2: MOS Transistor Theory
MOS fundamentals, Device Structure and Physical Operation, Current-Voltage Characteristics, channel length modulation, body effect, biasing of MOSFETs, capacitances in MOS, VLSI circuit and system representation.

Module 3: CMOS Circuit Concepts
Logic gate characteristics, Design of MOS inverter with different loads, Determination of pull up and pull down ratio for an NMOS inverter driven by another n MOS inverter, Design of W/L, power dissipation, propagation delay, and noise margin analysis

Module 4: CMOS Logic Structures and Design
CMOS inverter, static and dynamic characteristics of CMOS inverter, DC Characteristics: NAND and NOR Gates, NAND and NOR transient response, Scaling models and factors. Limits on scaling. System design using HDL

Module 5: Circuit Design Processes
MOS layers. Stick diagrams. Design rules and layout – lambda-based design and other rules. Examples. Layout diagrams. Symbolic diagrams. Tutorial exercises. Basic Physical Design of Simple logic gates.

Text Books
1. Sung-Mo Kang, Yusuf Leblebici : CMOS Digital Integrated Circuits Analysis and Design", Tata McGraw-Hill Edition 2003
2. Adel S. Sedra, Kenneth C. Smith : Microelectronics Circuits, 5th Ed., Oxford University Press, 2004
3. John P. Uyemura : Introduction to VLSI Circuits and Systems, John Wiley & Sons, Inc, 2002

Reference Books
1. Neil Weste and David Harris, "CMOS VLSI Design", 4th Ed., Addison Wesley, 2011.
2. Douglas A Pucknell et al, "Basic VLSI Design", 3rd Ed., Prenctice Hall, 2004

Course Outcomes:
1. Understand the fabrication process of IC technology.
2. Analysis of the operation of MOS transistor.
3. Analysis of the physical design process of VLSI design flow.
4. Analysis of the design rules and layout diagram.
5. Design of Adders, Multipliers and memories etc.
6. Making sense of the ASICs and Getting the idea of design approach.

EC 352	Computer Architecture	3L:0T:0P	3 credits

Module 1: Introduction to computer organization (10 Hours)
Architecture and 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. Arithmetic- Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.

Module 2: Memory System (6 Hours)
Memory organizations, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

Module 3: Input-Output Organization (8 Hours)
Accessing I/O devices, Direct Memory Access and DMA Controller, Interrupts and, Interrupt controllers, Arbitration, Multilevel Bus Architecture, Interface circuits- parallel and serial port. Features of PCI and PCI Express bus.

Module 4: Control Design (8 Hours)
Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit.

Module 5: Microprogrammed Control (4 Hours)
Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit.

Module 6:Different Architectures (4 Hours)
VLIW Architectures, DSP Architectures, SoC Architectures and MIPS Processor.

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. Understand the concepts of microprocessors, their principles and practice.
2. Write efficient programs in assembly language of the 8086 family of microprocessors.
3. Organize a modern computer system and be able to relate it to real examples.
4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
5. Implement embedded applications using ATOM processor.

EC 353	Digital Signal Processing	3L:0T:0P	3 Credits

Course objectives:
1. To understand the frequency domain sampling and reconstruction of discrete time signals.
2. To learn efficient algorithms for the computation of DFT.
3. To realize FIR and IIR filters in different structural forms.
4. To design IIR and FIR filters.

Module 1: Discrete Fourier Transform (DFT) (8 lectures)
Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs –the circular convolution. Additional DFT properties, use of DFT in linear filtering, overlap-save and overlap-add method.

Module 2: Fast Fourier Transform (FFT) algorithms (12 lectures)
Direct computation of DFT, need for efficient computation of DFT, Radix-2 FFT algorithm for the computation of DFT and IDFT – decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm and Chirp-Z transform.

Module 3: Structure for IIR systems (10 lectures)
Direct form, Cascade form, Parallel form structures.
IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.

Module 4: Structure for FIR systems (10 lectures)
Direct form, Linear phase, Frequency sampling structure, lattice structure.
FIR filter design: Introduction to FIR filters, design of FIR filters using Rectangular, Hamming, Hanning and Barlett windows.

Text/References 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, Algorithm 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 and W.S. Hodgkiss, Digital Signal Processing, John Wiley & Sons, 1988.
7. P. Ramesh Babu, Digital Signal Processing, Scitech Publications (India) Pvt Ltd, 2011.

Course outcomes:
At the end of this course, students will be able to:
1. Determine response of LTI systems using time domain and DFT techniques.
2. Compute DFT of real and complex discrete time signals.
3. Computation of DFT using FFT algorithm and linear filtering approach.
4. Solve problems on digital filter design and realize using digital computations.

EC 354	**Microcontrollers**	**3L:0T:0P**	**3 credits**

Module 1:
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);

Module 2:
Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters; Arithmetic Coprocessors; System level interfacing design;

Module 3:
Concepts of virtual memory, Cache memory, Advanced coprocessor Architectures 286, 486, Pentium; Microcontrollers: 8051 systems.

Module 4:
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 microcontro
4. Understand RSIC processors and design ARM microcontroller based systems

PRACTICAL/DESIGN

EC 355	**Program Elective-I**	**3L:0T:0P**	**3 credits**

EC 356	**Open Elective-1**	**3L:0T:0P**	**3 credits**

EC 353P	Digital Signal Processing Lab.	0L:0T:4P	2 credits

Course Objectives:
The main objective of this course is
1. To implement Linear and Circular Convolution
2. To implement FIR and IIR filters.

List of experiments using MATLAB / SCILAB / OCTAVE:
1. To develop elementary signal for unit sample, unit step, exponential sinusoidal and unit ramp sequences.
2. Write a program in MATLAB to generate standard sequences.
3. Write a program in MATLAB to compute power density spectrum of a sequence.
4. To develop program based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.
5. Write a program in MATLAB to verify linear convolution.
6. Write a program in MATLAB to verify circular convolution.
7. To develop program for finding magnitude and phase response of LTI system.
8. To develop program for finding response of the LTI system described by the difference equation.
9. To develop program for computing inverse Z-transform.
10. To develop program for computing DFT and IDFT.
11. To write a MATLAB programs for pole-zero plot, amplitude, phase response and impulse response from the given transfer function of CTS and DTS.
12. Write a program in MATLAB to find frequency response of different types of analog filters.
13. Write a program in MATLAB to design FIR filter (LP/HP) through Window techniques.

Course Outcomes:
At the end of this course, students will be able to:
1. Experiment concepts of DSP and its applications using MATLAB
2. Understand the basic signal generation
3. Learn Fourier Transform Concepts
4. Verify Linear and Circular convolution
5. Compute DFT and IDFT
6. Design FIR and IIR filters.

EC 354P	Microcontroller Lab	0L:0T:2P	1 Credits

Course Objectives:
1. Introduces the assembly language programming of the 8085 and 8051 microcontroller.
2. It gives a practical training of interfacing the peripheral devices with the 8085 microprocessor as well as a microcontroller.
3. To familiarize with embedded c programming for 8051 microcontrollers.

Experiments based on the contents covered in EC243.

Course outcomes:

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

1. Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.
2. Demonstrate arithmetic and logical operations in 8085 assembly language using trainer boards.
3. Design and implement interfacing devices with 8085.
4. Running embedded c programs for 8051 using Keil micro vision.
5. Design and implement a complete system using 8051 microcontroller.

DETAILED SYLLABUS - SIXTH SEMESTER

EC 361	Control Systems	3L:0T:0P	3 credits

Course Objectives:

The students should be able to learn:

1. Types of system, dynamics of physical systems, classification of control systems, analysis and design objective.
2. How to represent system by transfer function and block diagram reduction method.
3. Time response analysis and demonstrate their knowledge to frequency response.
4. Stability analysis of system using Root locus, bode plot, polar plot and Nyquist plot.

Module 1: Introduction to control problem - (4 Hours)

Industrial Control examples. Mathematical model of physical systems Control hardware and their models. Transfer function models of linear time invarient system. Feedback control systems- open loop and closed loop systems Benefits of feedback. Block diagram algebra.

Module 2: Time Response Analysis - (10 Hours)

Standard Test signals. Time response of first and second-order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second order system based on the time response. Concept of stability, Routh Hurwitz criteria, Relative Stability analysis, Root Locus technique, Construction of Root Loci.

Module 3: Frequency-response analysis - (6 Hours)

Relationship between time and frequency response, Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency domain. Relative stability using Nyquist Criterion-gain and phase margin, Closed loop frequency response.

Module 4: Introduction to controller Design - (10 Hours)

Stability, steady state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control system, Root Loci method of feedback controller design, Design specification in frequency domain, Frequency- domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation in design, and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

Module 5: State variable Analysis - (5 Hours)

Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Module 6: Introduction to Optimal control & Nonlinear control - (5 Hours)

Optimal Control problem, Regulator problem, Output regulator, tracking 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 362	Computer Network	3L:0T:0P	3 credits

Module 1: 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.

Module 2: 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

Module 3: Multiplexing. Transport layer:

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

Module 4: Transport layer:

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

Module 5: Congestion Control and Resource Allocation:

Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Module 6: Network layer:

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

Module 7: 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 363	**Program Elective-2**	**3L:0T:0P**	**3 credits**

EC 364	**Open Elective-2**	**3L:0T:0P**	**3 credits**

EC 365	**Instrumentation & Measurement**	**2L:0T:0P**	**2 credits**

Module 1:

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

Module 2:

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

Module 3:

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

Module 4:

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

Module 5:

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

Module 6:

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

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

Suggested Text Books & References:

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

PRACTICAL/DESIGN

EC 365P	**Electronic Measurement Lab.**	**0L:0T:2P**	**1 credit**

Experiments based on the contents covered in EC 365.

EC 366P	**Simulation Lab.**	**0L:0T:4P**	**2 credits**

Course Objectives:
1. To impart the fundamental knowledge on using various analytical tools like MATLAB, SPICE, or equivalent circuit Simulation software.
2. To know various fields of engineering where these tools can be effectively used to improve the output of a product.
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

List of experiments:
1. Simulation Lab Using MATLAB.
2. Circuit Simulation using Spice or Equivalent Circuit.

Course Outcome: At the end of this course, student should be able to:
1. The student will be able to appreciate the utility of the tools like MATLAB, SPICE, or equivalent circuit simulation software in solving real time problems and day to day problems.
2. Use of these tools for any engineering and real time applications.

EC 367P	**Mini Project / Electronic Design workshop**	**0L:0T:4P**	**2 credits**

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 I.Cs, 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 objective of mini project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronics circuit/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product and guidelines for documentation / report writing.

Course Outcome:
At the end of the course students will demonstrate the ability to:
1. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
2. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
3. Write comprehensive report on mini project work.

DETAILED SYLLABUS - SEVENTH SEMESTER

HU 471	Principles of Management	3L:0T:0P	3 credits

Course Objectives:
To understand the principles of management and their application to the functioning of an organization.

Module 1: **Overview of Management**
Definition - Management - Role of managers-Evolution of Management thought-Organization and the environmental factors–Trends and Challenges of Management in Global Scenario.

Module 2: Planning
Nature and purpose of planning-Planning process-Types of plans–Objectives -Managing by objective (MBO) Strategies -Types of strategies -Policies -Decision Making -Types of decision -Decision Making Process –Rational Decision Making.

Module 3: Organising
Nature and purpose of organizing-Organization structure-Formal and informal groups organization - Line and Staff authority - Departmentation -Span of control-Centralization and Decentralization- Delegation of authority-Staffing - Selection and Recruitment - Orientation - Career Development –Career stages–Training-Performance Appraisal.

Module 4: Directing
Creativity and Innovation - Motivation and Satisfaction -Motivation Theories-Leadership Styles-Leadership theories-Communication-Barriers to effective communication-Organization Culture-Elements and types of culture-Managing cultural diversity.

Module5**: Controlling**
Process of controlling-Types of control-Budgetary and non-budgetary control Q techniques – Managing Productivity-Cost Control-Purchase Control– Maintenance Control –Quality Control-Planning operations.

Suggested Text Book & References:

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

Course outcomes:
Upon completion of this course, the student will get a clear understanding of management functions in an organization.

EC 471	**Program Elective- 3**	**3L:0T:0P**	**3 credits**

EC 472	**Program Elective- 4**	**3L:0T:0P**	**3 credits**

EC 473	**Program Elective- 5**	**3L:0T:0P**	**3 credits**

EC 474	**Open Elective-3**	**3L:0T:0P**	**3 credits**

PRACTICAL/DESIGN

EC 475P	**Logic Design Using HDL**	**1L:0T:2P**	**2 credits**

Course Objectives:
1. To design combinational, sequential circuits using Verilog HDL./VHDL
2. To understand behavioural and RTL modelling of digital circuits
3. To verify that a design meets its timing constraints, both manually and through the use of computer aided design tools
4. To verify and design the digital circuit by means of Computer Aided Engineering tools which involves in programming with the help of Verilog HDL/VHDL.

List of Experiments:
1. Write structural and data flow HDL models for
2. 4-bit ripple carry adder.
3. 4-bit carry Adder –cum Subtractor.
4. 2-digit BCD adder/subtractor.
5. 4-bit carry looka head adder
6. 8-bit comparator
7. Write a HDL program in structural model for
8. 16:1 mux realization
9. 3:8 decoder realization through 2:4 decoder
10. Write a HDL program in behavioral model for
11. 16:1 mux
12. 3:8 decoder
13. 8:3 encoder
14. 8 bit parity generator and checker
15. Write a HDL program in structural and behavioral models for
16. 8 bit a synchronous up-down counter
17. 8 bit synchronous up-down counter
18. Write a HDL program for 4 bit sequence detector through Mealy and Moore state machines.
19. Write a HDL program for traffic light controller realization through state machine.
20. Write a HDL program for vending machine on troller through state machine.
21. Write a HDL program in behavioral model for 8 bit booth’s multiplier.
22. Write a HDL program in behavioral model for 8 bit shift and add multiplier.
23. Write a HDL program in structural model for 8 bit Universal Shift Register.
24. Write a HDL program for implementation of data path and controller units
25. Serial Adder
26. Shift and add multiplier
27. Booth’s multiplier
28. ALU
29. MIPS processor.

Course outcomes:
Upon the successful completion of the course, students will be able to:
1. Understand the basic concepts of HDL.
2. Model digital systems in Verilog HDL at different levels of abstraction.
3. Know the simulation techniques and test bench creation.
4. Understand the design flow from simulation to synthesizable version.
5. Get an idea of the process of synthesis and post-synthesis.

EC 476P	**Project Stage-I**	**0L:0T:6P**	**3 credits**

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

DETAILED SYLLABUS - EIGHTH SEMESTER

EC 481	**Program Elective-6**	**3L:0T:0P**	**3 credits**

EC 482	**Program Elective-7**	**3L:0T:0P**	**3 credits**

EC 483	**Open Elective-4**	**3L:0T:0P**	**3 credits**

EC 484	**Open Elective-5**	**3L:0T:0P**	**3 credits**

PRACTICAL/DESIGN

EC 485P	**Project Stage-II & Dissertation**	**0L:0T:12P**	**6 credits**

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.

Program Elective Course

Sr. No.	Course Code	Course Title	Hrs. / Week L: T: P	Credits	Preferred Semester
1	ECEL1	Microwave Theory and Techniques	3:0:0	3	VII/VIII
2	ECEL2	Fiber Optic Communications	3:0:0	3	VII/VIII
3	ECEL3	Information Theory and Coding	3:0:0	3	V/VI
4	ECEL4	Speech and Audio Processing	3:0:0	3	V/VI
5	ECEL5	Introduction to MEMS	3:0:0	3	V/VI
6	ECEL6	Adaptive Signal Processing	3:0:0	3	VII/VIII
7	ECEL7	Antennas and Propagation	3:0:0	3	VII/VIII
8	ECEL8	Bio-Medical Electronics	3:0:0	3	V/VI
9	ECEL9	Mobile Communication and Networks	3:0:0	3	VII/VIII
10	ECEL10	Digital Image & Video Processing	3:0:0	3	VII/VIII
11	ECEL11	Mixed Signal Design	3:0:0	3	VII/VIII
12	ECEL12	Wireless Sensor Networks	3:0:0	3	VII/VIII
13	ECEL13	CMOS Design	3:0:0	3	V/VI
14	ECEL14	Power Electronics	3:0:0	3	V/VI
15	ECEL15	Satellite Communication	3:0:0	3	VII/VIII
16	ECEL16	High Speed Electronics	3:0:0	3	VII/VIII
17	ECEL17	Wavelets	3:0:0	3	VII/VIII
18	ECEL18	Embedded systems	3:0:0	3	VII/VIII
19	ECEL19	Nano electronics	3:0:0	3	V/VI
20	ECEL20	Error correcting codes	3:0:0	3	VII/VIII
21	ECEL21	Scientific computing	3:0:0	3	V/VI

1	Microwave Theory and Techniques	3L:0T:0P	3 credits

Course objectives:
The course will enable students to:
1. Describe the microwave properties and its transmission media.
2. Understand the microwave waveguides, passive and active devices, tubes and network analysis.
3. Design microwave matching networks.
4. Deal with the issues in the design of microwave amplifiers and oscillators.
5. Perform microwave measurements.
6. Describe microwave devices and system for several applications.

Module 1: Introduction to Microwaves - (9 lectures)
History of Microwaves, Microwave Frequency bands, Applications of Microwaves-Civil and Military, Medical, EMI/EMC.

Mathematical Model of Microwave Transmission: Concept of Mode, Features of TEM, TE and TM Modes, Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide. Introduction to planar transmission line: Strip line, Microstrip line.

Module 2: Microwave Network - (7 lectures)
N-port microwave networks, impedance, admittance, transmission and scattering matrix representations, reciprocal and losses networks, network matrices transformations.

Microwave passive components: Waveguide Tees, Directional Coupler, Power Divider, Magic Tee, Attenuator, Isolator, Resonator.

Module 3: Microwave active components - (7 lectures)

Microwave active components: Diodes and Transistors.

Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. **Microwaves tubes**: Klystron, TWT, Magnetron.

Module 4: Microwave Design Principles - (7 lectures)
Impedance matching, Microwave Filter, Microwave Amplifier, Microwave Oscillator, Microwave Mixer.

Module 5 : Microwave measurements - (5 lectures)
Power, Frequency and Impedance measurement at microwave frequency, Network analyzer and measurement of scattering parameters, Spectrum analyzer and measurement of spectrum of microwave signal, Measurement of noise figure.

Module 6: Introduction to Microwave system - (5 lectures)
Radar, Terrestrial and satellite communication, Radiometer system, Microwave heating, Biological effects and safety, Electromagnetic Interference and Electromagnetic Compatibility (EMI & EMC), RFID,GPS, Monolithic Microwave ICs, RF MEMS for microwave components, Microwave Imaging.

Text/References Books:

1. David M. Pozar, Microwave Engineering, 3rd Edition,John Willey & Sons Inc.,1989
2. Robert E. Collin, Foundations for Microwave Engineering, 2nd Edition, McGraw Hill, Inc.,1992
3. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech House
4. Samuel Y. Liao, Microwave Devices and Circuits, 3rd Edition, Pearson Education, Inc., 2003
5. Matthew N.O. Sadiku, Principles of Electromagnetics, Oxford
6. K.C. Gupta, Microwaves, New Age International Pvt, 2013

Course Outcomes:
At the end of this course, students will be able to:
1. Explain different types of microwave transmission lines and their modes of propagation.
2. Formulate S-parameters for two port and RF networks.
3. Explain the working of microwave passive circuits such as isolator, directional coupler, attenuator etc.
4. Describe and explain working of microwave solid state devices and tubes.
5. Design microwave amplifiers, oscillators, filters.
6. Set up a microwave bench for measuring microwave parameters.

EC EL02	Fiber Optic Communication	3L:0T:0P	3 credits

Module 1: Overview of optical fiber communication - (7 Hours)
Introduction, Historical development, general system, advantages, disadvantages and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber(no derivations in article 2.4.4), single mode fiber, cutoff wavelength, mode filed diameter. Optical fibers: fiber materials, photonic crystal, fiber optic cables specialty fibers.

Module 2: Transmission characteristics of optical fibers - (6 Hours)
Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion.

Module 3: Optical sources and detectors - (6 Hours)
Introduction, LED's, LASER diodes Photo detectors, Photo detector noise, Response time, double heterojunction structure, Photo diodes, comparison of Photo detectors.

Module 4: Fiber couplers and connectors - (6 Hours)
Introduction, fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers.

Module 5: Optical receiver - (6 Hours)
Introduction, Optical receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst mode receiver, operation, analog receivers.

Module 6: Analog and digital links - (6 Hours)
Analog links-Introduction, CNR, multichannel transmission techniques, RF over fiber, key link parameters. Digital links- Introduction, point -to-point links, System considerations, link power Budget, resistive budget, short wave length band, Power penalties, nodal noise and chirping.

Module 7: WDM concepts and components - (3 Hours)
WDM concepts WDM and DWDM systems. Principles of WDM networks

Text/Reference Books

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5^{th} 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, 2^{nd} 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

ECEL03	Information Theory and Coding	3L:0T:0P	3 credits

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

ECEL04	Speech and Audio Processing	3L:0T:0P	3 credits

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; Linear Prediction 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 on reflection 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.

Text/Reference Books:

1. "Digital Speech" by A.M. Kondoz, Second Edition (Wiley Students *Edition)* Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729 standards *2004.*
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, Wiley Inter 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 EL05	Introduction to MEMS	3L:0T:0P	3 credits

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 Micro engineering (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.

ECEL06	Adaptive Signal Processing	3L:0T:0P	3 credits

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram- Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice. Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Text/Reference Books:

1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Course Outcomes:

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

1. Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
2. Mathematically represent the „adaptability requirement".
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

ECEL07	**Antennas and Propagation**	**3L:0T:0P**	**3 credits**

Course objectives:

1. To understand the concept of antennas and antennas parameters.
2. To understand the mechanism of radiation.
3. To have knowledge on antennas operations and types as well as their usage in real time field.
4. To have knowledge of wave propagation at different frequencies through different layers of atmosphere.

Module 1: Antenna fundamentals - (10 lectures)

Physical concept of radiation, radiation pattern, near and far field region, directivity and gain, aperture, front to back ratio, beam width, bandwidth, polarization, input impedance, efficiency, Friss transmission equation. Concept of retarded potentials. Radiation from infinitesimal dipole, linear elements near conductors, finite-length dipole, dipoles for mobile communication, small circular loop.

Module 2 : Antenna Arrays - (7 lectures)

Arrays of two point sources, linear arrays of n-point sources, pattern multiplication, analysis of uniform linear array. Broadside and Endfire arrays. Synthesis of antenna arrays using Schelkunoff polynomial method, Woodward- Lawson method.

Module 3: VHF, UHF and Microwave Antennas-I - (8 lectures)

Folded Dipoles and their characteristics, Arrays with parasitic elements, Yagi-Uda antennas, Log-periodic antennas, Helical antennas- Helical geometry, helix modes and practical design consideration, Horn antennas- types, optimum horns and design considerations.

Module 4 : VHF, UHF and Microwave Antennas- I - (8 lectures)
Reflector antennas- plane and corner reflectors. Paraboloidal reflectors- Geometry, pattern characteristics, feed methods. Lens antenna- Introduction, geometry of non-metallic dielectric lenses, zoning, applications. Microstrip antennas- Basic characteristics of microstrip antennas, advantages and limitations, rectangular patch antennas- geometry and parameters, feeding methods.

Module 5 : Wave Propagation - (7 lectures)
Concepts of Propagation- frequency ranges and types of propagations. Ground wave propagation- features, parameters, wave tilt. Sky wave propagation- Formation of Ionospheric layers and their characteristics, mechanism of reflection and refraction, critical frequency, MUF, skip distance, virtual height, ionospheric absorption. Space wave propagation- Mechanism, LOS and Radio Horizon, field strength variation with distance and height, effect of Earth's curvature, absorption, super refraction, Duct propagation, Troposcatter.

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, Antenna and Radio Wave Propagation, McGraw Hill, 1985
4. I.J. Bahl and P.Bhartia, Micro Strip Antennas, Artech House, 1980
5. K.D. Prasad, Antenna and Wave Propagation
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. E.C. Jordan and B.C.Balmann, Electromagnetic waves and radiating system, P.H.I.

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. Design of the antenna of required specification.
4. Understand the behaviour of nature of Electromagnetic wave propagation.

EC EL08	Bio-Medical Electronics	3L:0T:0P	3 credits

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.

ECEL09	Mobile Communication and Networks	3L:0T:0P	3 credits

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. 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 mobileterminal- 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 EL10	Digital Image & Video Processing	3L:0T:0P	3 credits

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 Subb and filter banks, wavelet packets.

Image Compression-Redundancy–inter-pixel and psycho-visual; Loss less 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-cuts and 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

EC EL11	Mixed Signal Design	3L:0T:0P	3 credits

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- Nonidealities 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 signaling and data transmission; Current-mode signaling and data transmission.

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

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. de Plassche, 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 EL12	Wireless Sensor Networks	3L:0T:0P	3 credits

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee, Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to Tiny OS and nesC.

Text/Reference Books:

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice" , By John Wiley & Sons Publications, 2011
2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004
4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science.
5. Philip Levis, And David Gay "Tiny OS Programming" by Cambridge University Press 2009

Course Outcomes:

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

1. Design wireless sensor networks for a given application
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN

ECEL13	CMOS Design	3L:0T:0P	3 credits

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, 4^{th} Edition, 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.

ECEL14	Power Electronics	3L:0T:0P	3 credits

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.

ECEL15	Satellite Communication	3L:0T:0P	3 credits

Module 1: Introduction to Satellite Communication - (8 Hours)

Principles and architecture of satellite Communication, advantages, disadvantages, applications and frequency bands used for satellite communication. Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, orbital perturbations, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Module 2: Satellite sub-systems - (8 Hours)

Study 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.

Module 3: Typical Phenomena in Satellite Communication - (8 Hours)
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.

Module 4: Satellite Link Design Fundamentals - (8 Hours)
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.

Module 5: Modulation and Multiple Access Schemes - (8 Hours)
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
1. 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.

ECEL16	**High Speed Electronics**	**3L:0T:0P**	**3 credits**

Transmission line theory (basics) crosstalk and non ideal 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 –Up conversion Down conversion, Conversion gain and spurious response.
Oscillators Principles: PLL Transceiver architectures Printed Circuit Board Anatomy, 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", Cambridge University 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.

ECEL17	Wavelets	3L:0T:0P	3 credits

Introduction to time frequency analysis; the how, what and why about wavelets, Short time Fourier transform, Wigner-Ville transform.; Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis, Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory, Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

Text/Reference Books:

1. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
2. I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.
3. C.K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.
4. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.
5. P.P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.
6. A.N. Akansu and R.A. Haddad, Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.
7. B. Boashash, Time-Frequency signal analysis, In S. Haykin, (editor), Advanced Spectral Analysis, pages 418-517. Prentice Hall, New Jersey, 1991.

Course Outcomes:

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

1. Understand time-frequency nature of the signals.
2. Apply the concept of wavelets to practical problems.
3. Mathematically analyze the systems or process the signals using appropriate wavelet functions.

ECEL18	Embedded Systems	3L:0T:0P	3 credits

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.

ECEL19	Nano electronics	3L:0T:0P	3 credits

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 the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

ECEL20	Error Correcting Codes	3L:0T:0P	3 credits

Linear block codes: Systematic linear codes and optimum decoding for the binary symmetric channel; Generator and Parity Check matrices, Syndrome decoding on symmetric channels; Hamming codes; Weight enumerators and the McWilliams identities; Perfect codes, Introduction to finite fields and finite rings; factorization of (X^n-1) over a finite field; Cyclic Codes. BCH codes; Idempotents and Mattson Solomon polynomials; Reed-Solomon codes, Justeen codes, MDS codes, Alterant, Goppa and generalized BCH codes; Spectral properties of cyclic codes.

Decoding of BCH codes: Berlekamp's decoding algorithm, Massey's minimum shift register synthesis technique and its relation to Berlekamp's algorithm. A fast Berlekamp - Massey algorithm. Convolution codes; Wozencraft's sequential decoding algorithm, Fann's algorithm and other sequential decoding algorithms; Viterbi decoding algorithm.

Text/Reference Books:
1. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.
2. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Understand the error sources
2. Understand error control coding applied in digital communication

ECEL21	Scientific computing	3L:0T:0P	3 credits

Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting Eigen values and singular values Eigen values and Eigen vectors, Methods for Computing All Eigen values, Jacobi Method, Methods for Computing Selected Eigen values, Singular Values Decomposition, Application of SVD

Non-linear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation

Method Optimization: One-Dimensional Optimization, Multi-dimensional Unconstrained Optimization, Nonlinear Least Squares

Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler"s Method, Taylor Series Method, Runga Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences

Telecommunication and Switching Networks

Text/ Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey", McGraw-Hill, 2nd Ed., 2002
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008
4. Kiryanov D. and Kiryanova E., " Computational Science", Infinity Science Press, 1st Ed., 2006
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, " Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010

Course Outcomes:

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

1. Understand the significance of computing methods, their strengths and application areas.
2. Perform the computations on various data using appropriate computation tools.

LIST OF SUBJECTS FOR OPEN ELECTIVE (OE)

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

1. SOFT COMPUTING

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

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

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

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

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

Suggested Text Books & References:

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

2. IMAGE PROCESSING

Digital image fundamentals:

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

Image Transform:

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

Image Enhancement:

Image Enhancement in Spatial domain, Some Basic Gray Level Trans - formations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, homomorphic filtering.

Image Restoration:

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

Color image processing:

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

Suggested Text Books & References:

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

3. ROBOTICS

Introduction:

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

Sensors:

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

Drive Systems & Grippers for Robot:

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

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

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

Suggested Text Books & References:

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

4. CRYPTOGRAPHY AND SECURITY

Introduction to security attacks, services and mechanism, introduction to cryptography.

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

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

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

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.

Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET).

System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Suggested Text Books & References:

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

COMPUTER ORGANISATION AND ARCHITECTURE

Introduction:

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

Internal and Cache Memory:

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

Basic non pipelined CPU Architecture and Operating System:

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

Parallel Processing and Multi-core Computer:

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

Suggested Text Books & References:

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

6. OPERATING SYSTEM

Introduction and Overview of Operating Systems:

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

Structure of the Operating Systems:

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

Process Management:

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

Memory Management:

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

Virtual Memory:

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

File Systems:

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

Scheduling:

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

Message Passing:

Implementing message passing, Mailboxes, Inter process communication in UNIX.

Suggested Text Books & References:

1. "Operating Systems - A Concept based Approach", D. M. Dhamdhare, TMH,
2. Operating Systems Concepts, Silberschatz and Galvin, John Wiley India Pvt. Ltd,
3. Operating System – Internals and Design Systems, Willaim Stalling, Pearson Education,
4. Design of Operating Systems, Tannenbhaum, TMH, 46

7. Telecommunication and Switching Networks

Introduction: Evolution of Telecommunication, Switching System, Classification of Switching, Types of Telephone Switching Systems, Elements of Telecommunication, Telecommunication Standard.

Telephone System: PSTN, Modern Telecom System, Telephone Network, Telephone Set, Telephone Network organization, Principles and examples of step by step, Cross bar and reed relay systems, Telephone numbering plan, Central Battery System, Transmission impairments, Two-four-wire transmission, Subscriber Loop Design.

Telecommunication traffic: Telecommunication traffic, Traffic considerations, Erlang, Grade of Service, Traffic Measurement, Mathematical model for telecommunication traffic.

Switching System: Resource sharing and need for switching, Need for Networks, Switching, Types of Switching, Circuit Switching, Message Packet Switching, Store & Forward Switching, Function of Switching System, Electronic Switching System, Multiplexing, FDM, Implementation of Switching System, Blocking and Non-blocking Switches, Single & Multi stage Switches, Space Switching, Time Switching, Hybrid Switching, Path finding, Complexity, Blocking Probability of Switch.

Telephone Exchange: Stored Program Controlled Exchange, Electronic Exchange, Electronic Switching & Stored Program Control Systems, Digital Switching Time, Space & Hybrid Switches, Example of Digital Exchanges, Example of Modern Exchanges (C-DOI exchange), Availability of Parallel Exchange.

Signaling Systems: Signaling, Types of Signaling information, Forms of Signaling, Channel Associated Signaling (CAS), Common Channel Signaling, CCITT No-7 System, SS7 Signaling, Architecture Computer & Data Networks, ARPANET, ALOHA-Toke Protocols Network Topology, Multiple Access Schemes, Layered Architectures, Networks Protocols, Local Area Network, Evolution towards ISDN.

Text/Reference Books:

1. J. E. Flood, Telecommunication and Switching Traffic & Networks, Pearson Education , 2001.
2. Thiagarajan Viswanathan, Telecommunication Switching Systems & Networks, PHI, 2006.
3. John G. van Bose and Fabrizio u devetak, Signaling in Telecommunication Networks, Wiley inter science. 2nd edition , 2007.
4. Roger L. Freeman, Telecommunication System Engineering: Analog and Digital Network Design, John Wiley & Sons.