Department of Electronics and Communication Engineering

Curriculum and Syllabus

Degree Module

North Eastern Regional Institute of Science and Technology

Deemed University :: Nirjuli

Arunachal Pradesh, 791109

Bridge courses for Lateral Entrants (10+3 Diploma) to Degree Module

Year Bridge-I	**Semester I**	**L**	**T**	**P**	**C**
HS 4301	Elements of Economics	3	0	0	3
PH 4301	Comprehensive Physics	4	0	2	5
CY 4301	Comprehensive Chemistry	4	0	2	5
MA 4301	Comprehensive Mathematics-I	3	1	0	4
EC-4301	Signal and Systems	3	0	2	4
EC-4302	Microprocessor and Computer Organisation	3	0	2	4
					25
Year Bridge-I	**Semester II**	**L**	**T**	**P**	**C**
HS 4401	Comprehensive Communication Skill	2	0	2	3
MA 4401	Comprehensive Mathematics-II	3	1	0	4
EC-4400	Linear Integrated Circuit	3	0	2	4
EC-4401	Industrial Electronics	3	0	2	4
EC-4402	Microcontroller and its applications	3	0	2	4
EC-4403	Network Analysis and Synthesis	3	1	0	4
					23

Both Degree bridge lateral students and vertical students combine

Year I	**Semester I**	**L**	**T**	**P**	**C**
PH 5101	Modern Physics	3	0	2	4
MA 5104	Engineering Mathematics III C	3	1	0	4
EC 5100	Digital Design using HDL	3	1	2	5
EC 5101	Microelectronics	3	1	0	4
EC 5102	Digital Signal Processing	3	0	2	4
EC 5103	Electromagnetic Theory	3	1	0	4
					25
Year I	**Semester II**	**L**	**T**	**P**	**C**
MA 5202	Applied Probability and Statistics	3	1	0	4
EC 5200	VLSI Circuits	3	1	2	5
EC 5201	Embedded System	3	1	0	4
EC 5202	Microwave Engineering	3	0	2	4
EC 5203	Analog Communication Theory	3	1	0	4
EC 5204	Analog and Digital Control	3	1	0	4
					25
Year II	**Semester I**	**L**	**T**	**P**	**C**
** 60**	Open Elective	3	0	0	3
EC 6100	Antenna and Radar Engineering	3	1	2	5
EC 6101	Digital Communication	3	0	2	4
EC 60**	Departmental Elective-I	3	0	0	3
EC 60**	Departmental Elective-II	3	0	0	3
EC 6179	Industrial Training(Audit)	0	0	0	2
EC 6199	Project Part I	0	0	4	2
*EC 6120 (EE)	Introduction to Digital Signal Processing	3	0	2	4
					22
Year II	**Semester II**	**L**	**T**	**P**	**C**
EC 6200	Computer Communication and Network	3	0	2	4
EC 6251	Comprehensive Viva	0	0	4	2
EC 60**	Departmental Elective-III	3	0	0	3
EC 60**	Departmental Elective-IV	3	0	0	3
HS 6201	Human Resource and Management	3	0	2	4
EC 6299	Project Part II	0	0	8	4
ED-6288	Extracurricular activities	0	0	0	2
					22
	List of Departmental Electives for Degree (B.Tech) final year students:	**L**	**T**	**P**	**C**
For Semester I and II		3	0	0	3
EC 6010	Artificial Neural Networks and its Application	3	0	0	3
EC 6011	Robotics	3	0	0	3
EC 6012	Multimedia Communications and Networking	3	0	0	3
EC 6013	Data Compression.	3	0	0	3
EC 6014	Telecommunication Switching	3	0	0	3

EC 6015	Principles of Operating System.	3	0	0	3
EC 6016	Fuzzy Logic and Genetic Algorithm	3	0	0	3
EC 6017	MIMO Communications Theory	3	0	0	3
EC 6018	Advanced Digital Signal Processing	3	0	0	3
EC 6019	Advanced Digital System Design	3	0	0	3
EC 6020	Wireless Communication	3	0	0	3
EC 6021	Computer Aided Design of VLSI Circuits	3	0	0	3
EC 6022	Digital Image Processing	3	0	0	3
EC 6023	Modern Control Engineering	3	0	0	3
EC 6024	Optical Fiber Communication	3	0	0	3
EC 6025	Information Theory and Coding	3	0	0	3
EC 6026	VLSI implementation of DSP architecture	3	0	0	3
EC 6027	Analog Integrated Circuit	3	0	0	3
EC 6028	Semiconductor Device Modelling	3	0	0	3
EC 6029	Modern Digital Communication Techniques	3	0	0	3
EC 6030	CMOS Mixed Signal Circuits	3	0	0	3
EC 6031	MEMS	3	0	0	3
EC 6032	Nano-electronics	3	0	0	3
EC 6033	Introduction to Plasmonics	3	0	0	3
EC 6034	Speech Processing	3	0	0	3
EC 6035	Satellite Communication	3	0	0	3
EC 6036	Biomedical Engineering	3	0	0	3
EC 6037	Wireless Sensor Networks.	3	0	0	3
EC 6038	Digital Signal Processors and Applications.	3	0	0	3
EC 6039	Digital Integrated Circuit	3	0	0	3
EC 6040	Advanced Computer Architecture.	3	0	0	3
EC 6041	Low Power VLSI Design.	3	0	0	3
EC 6042	Introduction to Computing and programming using Python	3	0	0	3
EC 6043	VLSI Digital Signal Processing Systems	3	0	0	3
EC 6044	ARM System Architecture	3	0	0	3
EC 6045	Machine Learning	3	0	0	3
	List of Open Electives for Degree Non-ECE final year students:	**L**	**T**	**P**	**C**
EC 6091	Data Compression	3	0	0	3
EC 6092	Digital Image Processing	3	0	0	3
EC 6093	Microcontroller application and System design	3	0	0	3
EC 6094	Computer Networking	3	0	0	3

DEPARTMENT: **Humanities and Social Sciences**
COURSE NUMBER: HS-4301
TITLE OF COURSE: Elements of Economics
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: Diploma in ECE/EEE.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Learning and improving the knowledge about Economics, theoretical concepts like Financial Statement and Net Worth Assessment, Estimating National Income and decision making at various economic situations.

CO2 Learning consumer's behavior for obtaining maximum satisfaction from their expenditure. Acquiring knowledge about elasticity of demand for taking decisions about production.

CO3 Developing knowledge about production theory, laws of Production.

CO4 Acquiring knowledge regarding different costs and supply theory.

CO5 Learning knowledge about price and output determination by the producers in different market conditions.

TOPICS COVERED

		lecture
Unit I	Definition of Economics, Scope of Economics, Micro & Macroeconomics, Supply, demand price determination. General market equilibrium.	9
Unit II	Consumers' behaviour: Utility analysis, Indifference curve analysis, Elasticity of demand, Market demand, and price effect.	9
Unit III	Production Theory, Cost of production, supply curve, Market structure, price determination under different market situations.	8
Unit IV	Business cycle, Market Analysis, Demand forecasting. Accounting Rules, Ratio analysis, managerial accounting, distribution channels, & advertising.	8
Unit V	Cash flow analysis, Discounted Cash flow, Net present value, Time value of money, capital budgeting.	8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Micro Economic Analysis, R.R. Barthwal, Wiley Eastern Ltd., New Deihl. 1999.
2. Principles of Micro Economics, D. D. Tewari & K. Singh, New Age International, New Delhi, 1996.
3. Modem Micro Economics, Kourtsoyanis, ELBS, McMillan, London, 1985.
4. Projects Planning, Formulation & Analysis, Prasanna Chandra, Tata McGraw Hill, New Delhi, 1996.
5. Financial Management, P. Chandra, Tata McGraw Hill, New Delhi,

DEPARTMENT: **Physics**
COURSE NUMBER: PH-4301
TITLE OF COURSE: **Comprehensive Physics**
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: Diploma in ECE/EEE

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
4	0	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1 Basics of rigid body mechanics.

CO2 Basics of thermodynamics and laws of radiations and wave optics.

CO3 Electromagnetic phenomena and Maxwell's equations.

CO4 Properties of matter regarding their magnetic properties, including super conductivity.

CO5 Elementary AC circuit.

CO6 Crystal structure of solids and basics of semiconductor physics.

CO7	Basic definition of molecular physics	
TOPICS COVERED		**lecture**
Unit I	Unit I Rotation of a rigid body, centre of mass, Torque, angular Momentum of a system, conservation of angular Momentum, K E. of rotation. Moment of inertia: Theorems of perpendicular :s and parallel axes (statement only), Expressions for M.I for different Geometrical objects (No derivation)	7
Unit II	Thermal Physics: Reversible and irreversible processes, carnot's cycle, second law of thermodynamics, concept of entropy, entropy and second law. Black body radiation, Kirchhoff's Law, Stefan's law, Energy distribution in black body radiation, Wien's law, Planck's law of radiation.	7
Unit III	Wave Optics: Huygen's principle, Young's double slit experiment, colour of thin films, Newton's rings, diffraction, single slit diffraction, diffraction grating. Polarization of light.	7
Unit IV	Electricity and Magnetism: Flux of electric field. Gauss's law and its simple application, energy stored in an electric field Electric current and current density. Theory of metallic conduction, Magnetic field. Force on a current carrying conductor, Lorentz Force, Biot- Savart law. Ampere's circuital law and its application, Gauss's law of magnetism.	7
Unit V	Dia-, para- and ferro-magnetic substances. Superconductivity. Electromagnetic induction, Faraday's law, Lenz's law of inductance, LCR circuits, Resonance, Electromagnetic oscillation and power in A.C. circuit. Electromagnetic waves, Maxwell's equations and displacement current.	7
Unit VI	Crystal structure of solids: Space lattice, unit cell, Bravais lattices, Co-ordination number Atomic Packing fraction, Miller indices. Band theory of solids: Conductors, Insulators, Semiconductors, Intrinsic & Extrinsic J Semiconductors, p-n- junction diode. Nuclear Physics: Nuclear constituents, mass defect, Binding Energy, Nuclear fission & Nuclear fission.	7

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Properties of Matter, D.S. Mathur, Shyamlal Trust, Delhi, 1996
2. University Physics, F.W Sears, M.W. Zemansky & H.D. Young, Narosa Publishing House, New Delhi,1998
3. Physics, R. Resnick, D. Halliday & K.S. Krane, 10hn Wiley & Sons, NY, 1992
4. Concepts of Physics, Pt, I & II, H.C. Verma, Bharti Bhavan, Patna, 1998
5. Materials Sc. and Engineering, V. Raghavan, Prentice Hall of India, New Delhi, 1998.
6. Introduction to Solid ~ Pbysics, A. J. Dekkar, Mc.Millan India Lt.

DEPARTMENT: **Chemistry**
COURSE NUMBER: CY-4301
TITLE OF COURSE: **Comprehensive Chemistry**
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: Diploma in ECE/EEE

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
4	0	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1	Useful to understand nature of matter at atomic level including electronic arrangement and wave mechanical model of atom.
CO2	Enrich concept of bonding among atoms of different elements found in earth crust and frequently required to understand principles of Electronic Communications.
CO3	Helps to understand the atomic size variation of elements, their role in soil texture and interaction among elements based on ionization potential, electronegativity, electron gain enthalpy which is essential requirement in dealing with Electronic Communications.
CO4	To understand the classical concepts of redox reactions, and electron transfer, concept of oxidation states, oxidizing and reducing agents and their calculation of their equivalent mass, balancing redox reactions by oxidation number method, Balancing redox reactions by ion electron method which play an important role in Electronic Communications.
CO5	This course also deals with redox processes and electrochemistry to enable students to understand water potential, electrode potential and application of Galvanic Cell, which helps to use various

kits to measure pH of the soil and energy economization through batteries required by Electronic Communications.

TOPICS COVERED		**lecture**
Unit I	Structure of the atom: Rutherford's model, hydrogen spectra, failure of Rutherford's model, Bohr's model of hydrogen and hydrogen like atoms, modification of Bohr's theory, dual nature of particle and radiation, de-Broglie equation, uncertainty principle, wave mechanical model of atom, concept of atomic orbitals, Quantum numbers, Pauli's exclusion principle, Hund's rule and Aufbau principle.	9
Unit II	Chemical Bond: Types of chemical bonds (ionic, covalent bond, coordinate covalent) Van der Waals force, metallic and hydrogen bond. Periodic Table and Periodic Properties of Elements: Mendeleev's Periodic law, long form of Periodic Table, merits and demerits of long form of Periodic Table, types of elements and their general properties, factors affecting period properties.	9
Unit III	Comparative study of sand p block elements: General properties and electronic configuration of s-block elements; their oxides, halides, hydroxides, carbonates, bicarbonates and nitrates. Properties of p-block elements with special reference to the oxidation state, oxides, halides and hydrides.	8
Unit IV	Redox Reaction: Oxidation and reduction process (classical and modem concepts), oxidation state, calculation of equivalent weights of oxidizing and reducing agents balancing of redox reactions using oxidation number change and ion electron methods.	8
Unit V	Electrochemistry: Electrolysis, laws of electrolysis, applications electrical conductance in solution, specific, equivalent and molar conductance. Kohlrausch's law, concept of weak and strong electrolytes. Galvanic Cell: Electrode potential, electrochemical series, Calculation of e.m.f. from electrode potential .	8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Modem's abc of Chemistry, (Vol-I&Il), S. P. Jauhar and S.K. Malhotra, Modem Publishers, New Delhi.
2. Principle of Physical Chemistry, B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal Publishing Co., Jalandhar- 2001.
3. Modern Inorganic Chemistry, R.C.Agarwal, Kitab Mahal Allahabad, 1999.
4. Comprehensive Chemistry (for Class XI and for Class XII), N. K. Verma & S. K. Khanna, Laxmi Publications (P) Ltd. New Delhi.
5. Chemistry Part-I, & II, R.R. Mishra, B. Bhushan & H. R. Sharma, Alya Book Depot, New Delhi.

DEPARTMENT: **Mathematics**
COURSE NUMBER: MA-4301
TITLE OF COURSE: Comprehensive Mathematics-I
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: Diploma in ECE/EEE

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	0	4	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To understand the concept of maxima and minima for the functions of two variable through various applications.
CO2 To understand the concept of solving improper integrals, Beta and Gama function
CO3 To understand the concept linear ordinary differential equation of first , second order and the differential equation of first order but not of first degree through various applications.
CO4 To understand the concept of matrix for solving linear simultaneous equations and finding inverse through various methods

TOPICS COVERED		**lecture**
Unit I	Functions of two or more independent variables, partial differential coefficients, homogenous functions, total derivatives, Change of variables.	10
Unit II	Maxima and Minima of a function of two independent variables, necessary and sufficient conditions for the existence of a maxima and minima off(x, y) at x=a, y=b, stationary and extreme points, Lagrange's method of undetermined multipliers. Improper integration, convergence of improper integrals, Beta and Gamma functions.	12

Unit III	Ordinary differential equation of 1st order and 1st degree: variables separable, homogenous equations, linear form, exact differential equations, differential equation of 1st order but of higher degree(equations solvable for p, for y and for x), Clairaut's equation, equations reducible to Clairaut's form, ordinary differential equation of second order with constant coefficients, homogenous, non-homogenous differential equations, variation of parameters method, Method of undetermined coefficients.	10
Unit IV	Rank of a matrix, elementary transformations, consistency and inconsistency of a system of linear simultaneous equations, eigen values and eigen vectors of a matrix, Caley- Hamilton theorem and its application to find the inverse of a matrix.	10

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Differential Calculus, Shanti Narayan, S. Chand & Co. Ltd.
2. Integral Calculus, Shanti Narayan, S. Chand & Co. Ltd.
3. Advanced Engineering Mathematics, E. Kreysizg, Wiley Eastern Limited.
4. Matrices, Shanti Narayan, S. Chand & Co. Ltd.

DEPARTMENT: **Electronics and Communication Engineering**
COURSE NUMBER: EC 4301
TITLE OF COURSE: **Signal and Systems**
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: Basics of electronics, mathematics and physics

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1 Represent and characterize the signals and systems using linear algebra.
CO2 Classify systems based on their properties and determine the response of LTI system using convolution.
CO3 Analyse the spectral characteristics of continuous-time and discrete-time periodic- aperiodic signals using Fourier analysis.
CO4 Apply the Laplace transform and Z- transform to analyze continuous-time and discrete-time signals and systems and understand the process of sampling and the effects of under sampling.

TOPICS COVERED		**lecture**
Unit I	Continuous and discrete time signals: Classification of Signals, Transformation of independent variable of signals, Basic continuous-time and discrete-time signals.	9
Unit II	Basic system properties. Analysis of Continuous-time and Discrete-time LTI Systems and their properties. Linear constant co-efficient differential and difference equations.	9
Unit III	Fourier-series and Fourier Transform representation of Continuous-time Signals and their properties. Discrete-Time Fourier-series and Discrete-Time Fourier Transform representation of discrete-time Signals and their properties.	8
Unit IV	Laplace Transform and its properties. Unilateral Laplace Transform. Analysis of LTI systems using Laplace-transform. Z-transform and its properties. Unilateral Z-Transform. Analysis of LTI systems using Z - transform.	8
Unit V	Sampling and reconstruction of band limited signals. Low pass and band pass sampling theorems. Aliasing. Anti-aliasing filter. Practical Sampling-aperture effect.	8

TEXT BOOK/ REFERENCE MATERIAL

1. Signals & Systems, Alan V. Oppenheim, Alan S. Willsky , S. Hamid Nawab, 2nd edition, Pearson Education.
2. Signals and Systems, S.Haykin and B. VanVeen , Wiley.
3. Signal Processing and Linear Systems, B.P.Lathi, PHI
4. Principles of Linear Systems and Signals, B.P. Lathi, Oxford.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-4302
TITLE OF COURSE: Microprocessor and Computer Organization

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES: Knowledge of Digital Circuits at Diploma level

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1 Study the organization of processors and memory hierarchies used in computer and examine information flow in memory organization.

CO2 Discuss the architecture of 8085 processor, instruction sets and timing diagram.

CO3 Have the concept of micro and macro programming.

CO4 Understand various interrupts and the concept of interfacing.

TOPICS COVERED

		lectures
Unit I	Concepts and Terminology: Digital computer concepts; Von-Neumann and Harvard architectures concept,Hardware and Software and their nature, role of operating system Evolution of computer architectures, different generations RISC and SISC architecture.	9
Unit II	Memory Unit : Memory classification, characteristics, static memories, dynamic memories, Organization of RAM, address decoding, ROM/PROM/EEPROM, Concept of memory map, memory hierarchy, Associative memory organization, Cache introduction, Replacement algorithms, Hit rate, miss penalty. Concept of virtual memory and paging.	9
Unit III	Microprocessors: Architecture of Intel 8085A microprocessor. Register organization, pin description. Instruction sets, operand addressing modes, instruction cycle, machine cycle, Timing diagram.	8
Unit IV	Programming: Concept of Micro and Macro programming, arithmetic and logical computations, block of data moving looping, counting, time delaying operations. Stack and subroutines, Concept of stack memory.	8
Unit V	Interrupts and Peripherals: Vectored interrupts, maskable and unmaskable interrupts. Intel 8085 software and hardware interrupts and their working mechanism. Usage of RIM, and SIM instructions. Peripherals: Introduction to I/O addressing. Study of peripherals like Intel 8255, 8257, 8254 and 8251.	8

TEXT BOOKS/ REFERENCE MATERIAL

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, McGraw Hill International
2. Computer Architecture and Organization, J.P.Hayes Mc Graw Hill International
3. Microprocessor Architecture Programming Application with the 8085/8080A, R.S. Gaonkar, Prentice Hall of India
4. Introduction to Microprocessors, A.P.Mathur Tata McGraw Hill
5. Fundamental of Microprocessor and Microcomputers, B. Ram, Dhanpat Rai & Sons.

DEPARTMENT: Humanities and Social Science.

COURSE NUMBER: HS-4401

TITLE OF COURSE: Comprehensive Communication Skills

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES: Diploma in ECE/EEE.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
2	0	2	4	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 67	67
	Mid-Semester Exam	30% of 67	
	End-Semester Exam	50% of 67	
Practical	Class Work & Viva	50% of 33	33
	Practical Exam	50% of 33	

COURSE OUTCOMES

CO1 Independently read, understand/comprehend and discuss texts.

CO2 Be competent in English punctuation and grammar.

CO3 Show a competence in the understanding of different forms of writing viz. Prose, Poetry and Fiction, etc.

CO4 Show an understanding and the use of Figures of Speech.

CO5 Show an understanding of appropriate writing skills

TOPICS COVERED		lectures
Unit I	Introduction to Linguistics; Sociolinguistics; Language Usage.	9
Unit II	Essay- I: Reading/Explanation & Essay- II: Reading/Explanation	9
Unit III	Introduction to Poetry: Poem-I: Reading/Explanation & Poem-II: Reading/Explanation	8
Unit IV	Introduction to Narratives and Oral Skills: Speech-: Reading/Explanation One prescribed novel for non-detailed study.	8
Unit V	Rhetoric Figures of Speech, Writing Skills, Oral Skills; ESP8	8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Modern Linguistics: an Introduction - Verma and Krishanswamy, Oxford University Press.
2. Modern Prose: Stories, Essays and Sketches - Michael Thorpe, Oxford University Press.
3. Writing Skills - Oliviera and Motta, Penguin.
4. Oxford Guide To Effective Writing & Speaking - John Seely, Oxford University Press.

DEPARTMENT: Mathematics.
COURSE NUMBER: MA-4401
TITLE OF COURSE: Comprehensive Mathematics-II.
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: Diploma in ECE/EEE.

COURSE DETAILS:

Lecture	Tutorial	practical	Contact Hours	Credits
3	1	0	4	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1	To understand the concepts Laplace transforms and its inverse with applications.
CO2	To understand the concepts double integral, triple integral, applications like as mass, Centre of gravity and moment of inertia
CO3	To understand the concept of vector differentiation of vectors, line integral, green theorem, Green's theorem for a plane, Gauss divergence theorem and Stoke's theorem. To study infinite series and the concept of convergence and divergent of infinite series using different
CO4	tests.

TOPICS COVERED		lectures
Unit I	Introduction to infinite series, convergent and divergent series, test for convergence and divergence of the series (ratio test and root test), power series, ordinary and singular points, radius of convergence.	**10**
Unit II	Laplace transform, linear property, shifting theorems, Change of scale property, Laplace transform of the derivative of a function, Laplace transform of integrals, multiplication by powers oft , division by power oft ,convolution theorem, application to solution of differential equations with constant coefficients and with variable coefficients, Z- transform and inverse Z-transform.	**10**
Unit III	Double integral, change of order of integration in double integral, Change of variables in double integral, triple integrals, application of double and triple integrals.	**11**
Unit IV	Scalar and vector field, differentiation and integration of a vector function, partial derivative of vectors, directional derivative of a scalar point function, tangent plane and normal to a level surface, Arc length. Bi normal, Gradient of a scalar field, Divergence of a vector point functions, curl of a vector point function, line integral, surface integral and volume integral, Green's theorem in the plane, Divergence theorem of Gauss and Stokes theorem through simple problem.	**11**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Advanced Engineering Mathematics, E. Kreysizg, Wiley Eastern Limited.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, Delhi.
3. Vector Analysis, M.R. Spiegel, McGraw Hill Book Company.
4. Advanced Mathematics for Engineers and Scientist~ M I. Spiegel, McGraw hill Book Company

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-4400
TITLE OF COURSE: LINEAR INTEGRATED CIRCUITS.

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES: Basics of Analog Circuits.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 To understand the concept of feedback, types of feedback and its effect on the frequency response.

CO2 To understand the basic characteristics of an OPAMP stressing on CMRR , slew rate.

CO3 To understand the principle of oscillation, types of oscillators and design.

CO4 To understand the different types of OPAMP filters, comparators and convertors.

TOPICS COVERED

		lectures
Unit I	Feedback amplifier: Feedback concept, characteristics of negative and positive feedback. Four feedback topologies, effect of negative and positive feedback on input impedance, output impedance, voltage gain, band width, noise and frequency response.	10
Unit II	OPAMP: characteristics, open loop gain, negative feedback configurations, amplifier, differential amplifiers, linear and non-linear applications.	10
Unit III	OSCILLATORS: Classification, Barkhausen Criterion, frequency stability, Tuned based Oscillators, Hartley Oscillator, Colpitts Oscillators, Clapp Oscillator, Crystal Oscillator, Phase Shift Oscillator, Wein Bridge Oscillator, voltage controlled oscillator Oscillator circuit design using BJT, FET and OP-AMP	10
Unit IV	ACTIVE FILTERS, COMPARATORS and CONVERTERS: classification and characterization of filters, types of active filters-first order and second order. Comparator and its characteristics, zero crossing detector, voltage limiters, absolute value detectors, analog multipliers and types of signal generators. Converters : types of ADC and DAC, working principle, characteristics. PLL and its applications.	12

TEXT BOOKS

1. Operational Amplifiers with Linear Integrated Circuits 4th Edition, Author(s): William D. Stanley, Publisher: Pearson (2004)
2. Op-Amps and Linear Integrated Circuits 4 Edition Author(s): Ramakant A. Gayakwad Publisher: PHI Learning (2009)
3. Electronics Principles By: A. P. Malvino,Tata McGraw Hill
4. Microelectronic By: adel S. Sedra and C Smith,Oxford university press.
5. Integrated Electronic circuits By: J. Millman and C.C.Halkias, TMH.
6. Pulse Digital and Switching Waveforms By: Taub and Shilling, TMH.
7. Electronic Devices and Circuits, Fourth Edition by David A. Bell. (PHI). Electronics Circuits By: D. Shilling, Tata McGraw

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-4401

TITLE OF COURSE: Industrial Electronics

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES: Basics of Electronics

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Explain the basic structure and V-I characteristics of various power devices.

CO2 Analysis of resistive and inductive loads in line frequency phase controlled rectifiers using SCR.

CO3 AC regulators, Cycloconverters and Choppers- basic principle of operation.

CO4	Introduction on Switching regulators - buck regulators - boost regulators- buck-boost regulators.

TOPICS COVERED		**lectures**
Unit I	Power diodes - basic structure and V-I characteristics - various types - power transistors - BJT, MOSFET and IGBT - basic structure and V-I characteristics - thyristors - basic structure - static and dynamic characteristics - device specifications and ratings - methods of turning on - gate triggering circuit using UJT - methods of turning off - commutation circuits - TRIAC	10
Unit II	Line frequency phase controlled rectifiers using SCR - single phase rectifier with R and RL loads - half controlled and fully controlled converters with continuous and constant currents - SCR inverters - circuits for single phase inverters - series, parallel and bridge inverters - pulse width modulated inverters - basic circuit operation.	10
Unit III	AC regulators - single phase ac regulator with R and RL loads- sequence control of ac regulators - cycloconverter - basic principle of operation - single phase to single phase cycloconverter - choppers - principle of operation - step-up and step-down choppers - speed control of DC motors and induction motors.	11
Unit IV	Switching regulators - buck regulators - boost regulators - buck-boost regulators - cuk regulators - switched mode power supply - principle of operation and analysis - comparison with linear power supply - uninterruptible power supply - basic circuit operation - different configurations - characteristics and applications	11

TEXT BOOKS

1. Ned Mohan et.al, Power Electronics, John Wiley and Sons, 1989
2. Sen P.C., Power Electronics, Tata Mc Graw Hill,2003
3. Rashid, Power Electronics. Prentice Hall India,1993
4. G.K. Dubey et.al, Thyristorised Power Controllers, Wiley & Sons, 2001
5. Dewan & Straughen, Power Semiconductor Circuits, Wiley & Sons, 1984
6. Singh M.D & Khanchandani K.B., Power Electronics, Tata Mc Graw Hill, 1998

DEPARTMENT:	Electronics and Communication Engineering
COURSE NUMBER:	EC 4402
TITLE OF COURSE:	Microcontrollers and Applications
DESIGNATION:	REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES:	EC 4302 and basics of electronics and digital Circuits

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1	
CO2	Know about the evolution of microcontrollers.
CO3	Acquire knowledge of assembly language programming.
CO4	Learn the idea of different addressing modes of microcontroller.
	Discuss serial communication and interfacing with devices.

TOPICS COVERED		**lectures**
Unit I	The 8051 microcontroller: Evolution of microcontrollers, overview of the 8051 family.	7
Unit II	Assembly language programming: Arithmetic, logical, jump, loop, call instructions. Input/Output port programming: pin descriptions of the 8051, I/O programming; bit manipulation	9
Unit III	Addressing modes: Immediate and register addressing modes; memory accessing. Timer/Counter programming.	9
Unit IV	Serial communication: basics, connection to RS232 and programming. Interrupts: different types and their programming	8
Unit V	Real world interfacing: LCD, ADC, Sensors, stepper motors, keyboards	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. The 8051 Microcontroller and Embedded Systems, M. A. Mazidi, and J.G. Mazidi, Pearson Education
2. Microcontroller Projects in C for 8051, D. Ibrahim, Newnes

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-4403.
TITLE OF COURSE: Network Analysis and Synthesis.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: Basics of Electrical circuits.

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	1	0	4	4

COURSE ASSESSMENT METHODS				
	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Compute responses of first, second and higher order networks using time domain analysis and Laplace Transform to solve for circuit response.
CO2 Understanding LTI two port systems using the popular parameters and solving them.
CO3 Synthesizing networks using RL, RC and LC circuits.
CO4 Applying graph theory for network analysis,

TOPICS COVERED		lectures
Unit I	Review of Network Theorems, Formulations of network equations: First – order systems, Natural response, Initial conditions, complete response of First-order systems, zero state and zero input responses. Second order system, Natural response, Overdamped, Underdamped and critically damped case. Geometry of plane, unit-step and unit impulse response, linear system with sinusoidal inputs, impedance and admittance, power, concept of Complex frequency.	12
Unit II	Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, frequency response. Characterization of LTI two port networks ZY, ABCD and h-parameters, reciprocity and symmetry. Inter relationships between the parameters, inter-connections of two port networks.	9
Unit III	Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms.	11
Unit IV	Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Node methods of analysis.	10

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. " Network Analysis", M.E. Van Valkenburg, Prentice Hall of India
2. "An Introduction to Circuit analysis: A System Approach" Donald E. Scott McGraw Hill Book Company.
3. 'Circuit Theory" A.Chakrabarti, Dhanpat Rai and Co.
4. "Networks and Systems" D.Roy Choudhary, Wiley Eastern Ltd.
5. “Engineering Circuit analysis" W.H. Hayt and Jack E-Kemmerly, Tata McGraw Hill.
6. Linear Circuits, Ram Kalyan, Oxford University Press.

DEPARTMENT: Physics.
COURSE NUMBER: PH-5101.
TITLE OF COURSE: Modern Physics.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: PH-3101.

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	2	5	4

COURSE ASSESSMENT METHODS				
	Theory	Assignments & Quiz	20% of 75	75
		Mid-Semester Exam	30% of 75	
		End-Semester Exam	50% of 75	
	Practical	Class Work & Viva	50% of 25	25
		Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Starting with the revolutionary concept of special theory of relativity students will learn Lorentz transformations, length contraction, time dilation, mass-energy equivalence, etc.

CO2 To know Blackbody radiation curve, limitations of classical physics and origin of quantum mechanics, Planck's radiation formula and its applicability in resolving long pending issue of explanation of blackbody radiation curve, photoelectric effect and Compton effect, de Broglie waves, Heisenber's uncertainty relation, Schrodinger equation, wave nature of particles, particle nature of waves, Schrodinger equation.

CO3 To apply Schrodinger equation to solve problems like particle in a box, simple harmonic oscillator, tunneling effect.

CO4 To understand and use statistical mechanics concepts like MB, BE and FD statistics in various applications.

CO5 To know about dielectric, ferroelectric materials, nano-science and nanotechnology, x-rays, electron diffraction and LASER.

TOPICS COVERED		**lectures**
Unit I	Special theory of relativity: Result of Michelson-Morly's experiment, postulates of special theory of relativity, Galilean transformation, Lorentz transformations, Simultaneity, length contraction, time dilation, Twin paradox (qualitative), relativistic Addition of velocities, mass- energy equivalence, relativistic energy-momentum relationship, mass-less particles.	9
Unit II	Limitations of classical physics, Origin of quantum theory, photoelectric effect, Energy quantum, Compton effect. Matter waves, Orbital stability of H atom, Bohr Correspondence principle. The wave equation, phase and group velocities, uncertainty Principle. Wave function, Schrodinger equation.	9
Unit III	Application of Schrodinger equation to particle in a box. Qualitative summary of Simple Harmonic oscillator. Tunnelling effect, Reflection and transmission by a barrier. Schrodinger equation for the Hydrogen atom, quantum numbers, quantization of angular momentum, concept of spin angular momentum.	8
Unit IV	Statistical mechanics: Maxwell- Boltzmann, distribution function, Molecular energies. In an ideal gas. Quantum statistics: Bose- Einstein and Fermi-Dirac distribution functions. Application of Bose- Einstein statistics to photons. Application of Fermi-Dirac statistics to free electron gas in a metal.	8
Unit V	Basics of dielectric, ferroelectric and piezo-electric materials. Brief introduction to Nano-materials, their properties and potential applications. Concepts of X-ray diffraction: powder diffraction technique, Electron Diffraction, LASER and Its applications.	8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Concepts of modem physics, Arthur Bieser, Tata Mc Graw Hill, New Delhi.
2. Modem Physics, Kenneth Krane. John Wiley & sons, 1998.
3. Materials Science & Engineering, V. Raghavan, Prentice Hall of India, New Delhi, 1998.
4. Introduction to Solid State Physics, A. J. Dekkar, Mc.Millan India Ltd.
5. Nanostructured Materials, P. Diwan & A. Bharadwaj, Pentagon Press, New Delhi, 2006.
6. Elementary Solid State Physics, M. Ali Omar, Pearson Education Asia, 2000.

DEPARTMENT: Mathematics.
COURSE NUMBER: MA-5104
TITLE OF COURSE: Engineering Mathematics -III
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: MA-3101, MA-4301.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1 Apply the Frobenius method to obtain a series solution for given Bessel's and Legendre's differential equations and also study the basic properties of Bessel's and Legendre's polynomials.

CO2 Analyze the complex functions with reference to their analyticity, Integration using Cauchy's integral theorem and find the Taylor's and Laurent series expansion of complex functions.

CO3 To compute solutions of algebraic and transcendental equations by using Newton-Raphson method, False Position method and iteration , also, to compute solutions of simultaneous algebraic equations by direct and indirect methods and to find the inverse of matrices by Crout's and Gauss-Jordon methods and also Eigen value by power method.

CO4 Understand the derivation of the Newton-Cotes formulas, recognize that the trapezoidal and Simpson's 1/3 and 3/8 rules Weddle's rule and Romberg's integration represent the areas of 1st, 2nd, and 3rd order polynomials and learn basic numerical techniques for solving differential equations (Ordinary and Partial)

TOPICS COVERED		lectures
Unit I	Series solution of ODE, solution of Legendre and Bessel's Differential equation of first kind, Partial differential equation, Solution of Laplace equation (2D).	10
Unit II	Fourier series, Even and odd functions, half range expansion, Fourier series for functions having arbitrary periods, Fourier integral, Introduction to Fourier Transform.	11
Unit III	Functions of complex variables, Analytic function, Finite differences, Interpolation with uniform intervals, Newton's forward and backward interpolation formula, Gauss forward and backward interpolation formula, Sterling's and Bessel's formulae.	11
Unit IV	Trapezoidal and Simpson's one-third and three-eighth rules. Numerical solution of first order differential equation by Euler's modified method and Runge-Kutta of order 4 method.	10

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Advanced Engineering Mathematics, E. Kreyszig, John Wiley& sons, NY, 19999.
2. Higher Engineering Mathematics, B.S. Grewal, Khanna publishers, Delhi, 2000.
3. Higher Engineering Mathematics, H.K. Dass, S Chand & Co., New Delhi, 2001.
4. Calculus and Analytic Geometry, Thomas & Finny, Narosa Publishing House, New Delhi, 1998

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5100
TITLE OF COURSE: Digital Design using HDL
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: EC3201/ Basics of Digital electronics

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 80	80
	Mid-Semester Exam	30% of 80	
	End-Semester Exam	50% of 80	
Practical	Class Work & Viva	50% of 20	20
	Practical Exam	50% of 20	

COURSE OUTCOMES

CO1 Design and analyse sequential logic circuits and synchronous finite state machines.
CO2 To learn the Basics of HDL modeling and design techniques.
CO3 To Design controller using ASM chart method.
CO4 Design and analysis of asynchronous finite state machines.

TOPICS COVERED		Lectures
Unit I	Introduction to sequential circuits: Latch, R-S, J-K, D flip flops, Master Slave arrangement, Edge triggered flip flops, shift registers, asynchronous and synchronous counters.	6
Unit II	Design tools: Introduction to HDL Basic features of HDL. Simulation and synthesis. Basic HDL modeling techniques. Algorithmic level design. Register Level Design. HDL-based design techniques. Modeling for synthesis.	10

Unit III	Synchronous sequential finite state machines: Synchronous analysis process, design approaches, state reduction, design of next state decoder and output decoder, design of counters and decoders, code sequence detector, sequential code generators	8
Unit IV	Algorithmic State Machine (ASM): ASM Chart, ASM block, Design using FFs,Design using multiplexers and PLAs.	8
Unit V	Asynchronous Sequential finite state machines: Need for asynchronous circuit analysis, cycles and races, Hazards, map entered variable approaches to asynchronous design.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. An Engineering approach to Digital Design, William J. Fletcher PHI
2. VHDL Primer, J. Bhaskar
3. Verilog HDL Synthesis, A Practical Primer, J. Bhaskar
4. Digital Design: Principles and Practices, John F. Wakerly, PHI
5. Fundamentals of Digital Circuits, A. Anand Kumar, PHI
6. Digital Design. Morris Mano. PHI
7. Digital Principles and Design Donald D. Givone TMH

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-5101.

TITLE OF COURSE: Microelectronics.

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES: Fundamental of material science.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	0	4	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

Total: 100

COURSE OUTCOMES

CO1	Understanding of the fundamentals of semiconductor materials, energy band diagram, types of semiconductors and Fermi Dirac Distribution
CO2	Examine Carrier behaviour and application to PN junction and junction properties.
CO3	Analyze the internal mechanism of BJT, MOS capacitor and MOSFET.
CO4	Comprehend Photonic devices, LEDs and LASER.

TOPICS COVERED

		Lectures
Unit I	Fundamentals of Semiconductors: Crystal Structure, Crystal Plane, Electronic Structure of Elements, Valence Band Model of Solid, Energy Band Model of Solid, E-K Diagram, Effective mass, Direct and Indirect semiconductor. Semiconductors: Silicon, Germanium, GaAs, Density of States, Fermi Dirac Distribution, Equilibrium Carrier density, intrinsic and extrinsic Fermi levels. Compensation and space charge neutrality.	5
Unit II	Carrier Transport Phenomena and PN Junction: Drift velocity, Drift current, Diffusion of Carriers, Diffusion Current. Hall effect, Generation and Recombination, Continuity equation, Carrier injection: diffusion length, PN junction formation, energy band diagram of PN junction at equilibrium, reverse and forward biased conditions, Built in potential and electric field, space charge width, junction capacitances, current voltage equation.	7
Unit III	BJT: BJT Operation. Amplification with BJTs. Minority Carrier Distributions and Terminal Currents. Solution of the Diffusion Equation in the Base Region. Evaluation of the Terminal Currents. Approximations of the Terminal Currents. Current Transfer Ratio. Coupled-Diode Model. Charge Control Analysis. Switching. Cut-off. Saturation. The Switching Cycle. Specifications for Switching Transistors. Drift in the Base Region. Base Narrowing. Avalanche Breakdown. Injection Level; Thermal Effects. Base Resistance and Emitter Crowding.	10
Unit IV	FET: Transistor Operation. Load Line. Amplification and Switching. Junction FET. Pinch-off and Saturation. Gate Control. Current-Voltage Characteristics, Metal-Semiconductor FET. GaAs MESFET. High Electron Mobility Transistor. Short Channel Effects. Ideal MOS Capacitor. Effects of Real Surfaces. Threshold Voltage. MOS Capacitance-Voltage Analysis. Current-Voltage Characteristics of MOS Gate Oxides. MOS Field-Effect Transistor. Output Characteristics. Transfer Characteristics. Mobility Models. Short Channel MOSFET I-V Characteristics. Control of Threshold Voltage. Substrate Bias Effects. Subthreshold Characteristics.	10

Unit V	Photonic Devices: LED: Luminescence process of LED material, device configuration and quantum efficiency, LED structures: Hetero junction LED, Burros surface-emitting LED, Edge emitting LED.	6
Unit VI	LASER: Basic principles, semiconductor Laser, Population Inversion at a junction, emission spectra, basic semiconductor Laser, DH Laser, Quantum Laser, Photo voltaic effect, amorphous Si solar cell, Photo conductors, PIN diode, APD.	4

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Solid State Electronic Devices, B. G. Streetman PHI
2. Microelectronics Devices, E. S. Young McGraw Hill International, New York.
3. Micro Electronics, L. Millman, Arvin Grabel Tata McGraw Hill, New Delhi.
4. Semiconductor Device Fundamentals, R. Pierret, Pearson

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5102.
TITLE OF COURSE: Digital Signal Processing.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: EC4101/EC4301

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Understand signal processing systems using basic concepts.
CO2 Analyze signal using the discrete Fourier transform and its effective computation by FFT techniques.
CO3 Specify and design FIR and IIR type digital filters and identify the fundamentals of multi rate signal processing and its applications.
CO4 Understand advanced digital signal processing techniques.

TOPICS COVERED

		Lectures
Unit I	Review of Discrete-time Fourier Transform, Frequency response of discrete time systems, All pass inverse and minimum phase systems.	5
Unit II	DFT, Relationship of DFT to other transforms, FFT, DIT and DIF, FFT algorithm, Linear filtering using DFT and FFT.	10
Unit III	Frequency response of FIR filter types, Design of FIR Digital filters: Window method, Park-McClellan's method, Frequency Sampling Method; Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters, Mapping formulas, Frequency transformations.	11
Unit IV	Direct form realization of FIR and IIR systems, Lattice structure for FIR and IIR systems, Finite-word length effects. Limit cycle oscillations.	6
Unit V	Multirate signal processing – Sampling rate conversion – applications of multirate signal processing. Parametric and non-parametric spectral estimation. Application of DSP.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. Digital Signal Processing, Algorithms and Applications, Proakis and Manolakis, 3rd edition, Prentice Hall of India, New Delhi.
2. Discrete-time Signal processing, Alan V Oppenheim and Ronald W Schafer, 3rd edition, Pearson.
3. The Scientist & Engineer's Guide to Digital Signal Processing, Steven W Smith.
4. Understanding Digital Signal Processing, Richard G Lyons, Pearson.
5. Digital Signal Processing: A Practical approach, Emmanual C. Ifeachor et. Al., Pearson Education, 2nd edition.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5103
TITLE OF COURSE: Electromagnetic Theory
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES:

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	1	0	4	4
COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz		20% of 100	
		Mid-Semester Exam		30% of 100	100
		End-Semester Exam		50% of 100	

COURSE OUTCOMES

CO1 Understand the coordinates systems, vector calculus and apply it in electromagnetic problem
CO2 Understand the physics of electrostatics and apply it to solve electrostatic problems
CO3 Understand the physics of magnetostatics and apply it to solve magnetostatics problems
CO4 Understand the time varying field and waves in different media

TOPICS COVERED		Lectures
Unit I	Review of vector Algebra, Coordinates system- Rectangular , Cylindrical, spherical and transformation ,Vector Calculus – Gradient ,Divergence and curl, Green's and Stroke theorems.	6
Unit II	Electrostatics. Coulomb's law. Gauss's law and applications. Electric potential. Poisson's and Laplace equations. Method of images. Multipole Expansion. Electrostatic fields in matter. Dielectrics and dielectric polarization. Capacitors with dielectric substrates. Force and energy in dielectric systems.	10
Unit III	Magnetostatics: Biot-Savart's Law, Ampere Circuits Law, Applications of Ampere's Law, Maxwell Equations of static fields, Magnetic Scalar and Vector Potentials, Magnetic Force- charge particle, current elements, Magnetic field in Material space, Magnetization, Magnetic Boundary Conditions, Inductor, Inductances, Magnetic Energy.	10
Unit IV	Time-varying Fields : Faraday's Law, Transformer and Motional Electromotive Forces, Displacement current, Maxwell Equations, Time Varying Harmonic Fields.	8
Unit V	Electromagnetic waves : General wave Equations, waves in lossy dielectrics, Plane wave in lossless dielectrics, free space, good conductors, Wave polarization, Poynting vector and reflection of waves	8

TEXT BOOKS/ REFERENCE MATERIAL

1. Elements of Electromagnetics 4th Edition – M.N.O. Sadiku , Oxford.
2. Electromagnetic waves and radiating systems, 2th edition, E. Jordan and K. Balmin, Prentice Hall of India, New Delhi, 2001
3. Advanced Engineering Electromagnetics, C.A. Balanis, John Willy and Sons, New York, 2001
4. Electromagnetics, 4th edition, J.D.Kraus, Tata McGrawhill, New Delhi,1991.

DEPARTMENT: Mathematics
COURSE NUMBER: MA-5202.
TITLE OF COURSE: Applied Probability and Statistics
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: MA-5104.

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	1	0	4	4
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	
			Mid-Semester Exam	30% of 100	100
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To understand the meaning of random variables and different discrete and continuous probability distributions arising out of practical problems.
CO2 To understand jointly distributed r.vs and its distribution functions, independent random variables, conditional distribution of discrete and continuous r.vs.
CO3 To understand the moment generating functions, central limit theorem and its applications.
CO4 To understand the concept of curve fittings and find correlations between different variables.

CO5	To understand estimation of population parameters, testing of hypothesis, Contingency table and goodness of fit.	
TOPICS COVERED		lectures
Unit I	Random Variables: discrete and continuous, distribution functions and their properties, Probability mass and density functions. Expectation and Variance. Negative binomial and geometric distributions, uniform distribution, Beta distribution, Gamma distribution, Weibull distribution and exponential distribution.	9
Unit II	Jointly distributed random variable, joint distribution function, independent random variable, sum of independent random variables, and conditional distribution of discrete and continuous cases.	9
Unit III	Properties of expectations and Variance, covariance, correlation, conditional expectations, moment generating functions, the central limit theorem and its applications.	8
Unit IV	Curve fitting: Method of least squares, Simple, multiple and partial correlation, Regression lines, regression coefficients, multiple and partial correlation coefficients.	8
Unit V	Sampling distribution of mean when 0' is known and unknown, Sampling distribution of variance. Estimation of parameters, test of hypothesis for mean and Variance, Contingency table and goodness of it.	8
TEXT BOOKS, AND/OR REFERENCE MATERIAL	1. A First Course in Probability, S Ross, PH, 1998. 2. Probability and Statistics with Reliability, Queuing and Computer Science Applications, K.S. Trivedi, PHI, 1999.	

DEPARTMENT:	Electronics and Communication Engineering.				
COURSE NUMBER:	EC-5200.				
TITLE OF COURSE:	VLSI Circuits				
DESIGNATION:	REQUIRED /~~ELECTIVE~~ course				
PRE-REQUISITES:	EC-4200/EC-4400, EC-5101.				
COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	1	2	6	5
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz Mid-Semester Exam End-Semester Exam	20% of 80 30% of 80 50% of 80	80
	Practical		Class Work & Viva Practical Exam	50% of 20 50% of 20	20

COURSE OUTCOMES		
CO1	Understand CMOS technology and be able to do DC and transient analysis of digital CMOS circuits.	
CO2	Describe the techniques used for VLSI fabrication and ability to estimate timing characteristics, noise margins, power consumption of a digital VLSI circuit. Design static	
CO3	CMOS and dynamic clocked CMOS circuits.	
CO4	Analyze working of SRAM cell and DRAM cell	
TOPICS COVERED		Lectures
Unit I	VLSI design flow Design; MOS Transistor; DC Transfer Characteristics: Static CMOS Inverter DC Characteristics,	8
Unit II	CMOS Processing Technology: CMOS Technologies, Layout design rules, CMOS Process enhancements; Stick Diagrams; Technology-Related CAD Issues, Manufacturing Issues.	8
Unit III	Delay: Delay Models; Logical Efforts of Paths, Timing Analysis of Delay Models Power: Dynamic Power and Static Power.	7
Unit IV	Combinational Circuit Design: CMOS Logic Gates, The Compound Gates, Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers. Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass-Transistor Circuits. Circuit Pitfalls, SOI Circuit Design, Subthreshold Circuit Design	10

Unit V	Sequential MOS logic circuitry: Behavioral of Bistable element, Flip-Flop. Sequencing Static Circuits; Circuit Design of Latches and Flip-Flops; Memory: SRAM; DRAM; Embedded DRAM.; Read-Only Memory: Programmable ROMs, NAND ROMs.	9

TEXT BOOK/ REFERENCE MATERIAL

1. "CMOS VLSI Design", Pearson Education, Neil H.E. Weste, David Harris, Ayan Banerjee , 3rd Edition.
2. "CMOS digital Integrated Circuits, Analysis and Design",Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. "Basic VLSI Design", Douglas.A.Pucknell, Kamaran Eshraghian, PHI,3rd Edition
4. "Introduction to VLSI Circuits & Systems", John P. Uyemura Wiley India Edition,

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5201
TITLE OF COURSE: Embedded System
DESIGNATION: REQUIRED / ~~ELECTIVE~~ course.
PRE-REQUISITES: EC 4102 / EC 4302, EC 4202/ EC 4402.

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Distinguish between embedded systems and general systems and understand embedded system design models
CO2 Understanding embedded I/O and interfacing
CO3 Design of architectures of embedded processors and communication used in embedded systems
CO4 Study of embedded software and OS for real time operating systems and their issues

TOPICS COVERED

		lectures
Unit I	Introduction to Real Time Embedded Systems: Embedded Systems Components, Memory, Digital Signal Processors, General Purpose Processors, Embedded Processors and Memory-Interfacing	10
Unit II	Embedded Systems I/O: Interfacing bus, Protocols, Timers, Interrupts, DMA,USB and IrDA, AD and DA Converters, Analog Interfacing	10
Unit III	Design of Embedded Processors: Field Programmable Gate Arrays and Applications with HDL, Embedded Communications: Serial, Parallel, Network, Wireless Communication	10
Unit IV	Embedded System Software and Software Engineering issues: Introduction to Real-Time Systems, Real-Time Task Scheduling, Concepts in Real-Time Operating Systems, Commercial Real-Time Operating Systems, Introduction to Software Engineering, Requirements Analysis and Specification, Modelling Timing Constraints, Software Design	12

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Real Time Systems, Rajib Mall, PHI, New Delhi
2. Embedded Systems Architecture - A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard, Newnes, Elsevier
3. An Embedded System Primer, Simon, PHI
4. Embedded Systems-Architecture, Programming and Design, Raj Kamal , TMH
5. "Embedded System Design: A Unified Hardware/Software Introduction", Frank Vahid, Tony D. Givargis , Wiley Publishers.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5202.
TITLE OF COURSE: Microwave Engineering
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: EC5103

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Understand important and unique engineering issues at microwave and millimeter wave frequencies.
CO2 Use the smith chart as a graphical tool to solve transmission line problem
CO3 Adopt network theory and the use of scattering matrix for analyzing microwave components.
CO4 Understand and analyze the different microwave sources.

TOPICS COVERED		Lectures
Unit I	Introduction: Microwave frequencies, systems and measurements. Electron motion in EM field , review of Maxwell equations, waves and reflection of waves	9
Unit II	Microwave Transmission lines-Transmission line Equations and Solutions, Reflection and transmission Co-efficient, Standing waves and SWR, Line impedance and Admittance, Impedance matching using Smith chart.	9
Unit III	Microwave wave guides-Detailed study of Rectangular and Circular Wave guides. Microwave components-rectangular, Circular and Semi Circular cavity resonators. Slow wave structures, Microwave hybrid Circuits, S parameters.Wave guide Tees, Directional Couplers, Circulators and Isolators, Hybrid couplers.	8
Unit IV	Microwave Sources-Klystrons, Reflex klystrons, TWTs, Klystron, Hybrid amplifier, BWO, Microwave Switching tubes. Magnetrons, Forward wave cross-field amplifiers.	8
Unit V	Microwave solid state devices-Transistors, Tunnel Diodes, Gunn LSA, InP. Avalanche transit time devices-Real Diode, IMPATT, TRAPATT, and BARITT Diodes.	8

TEXT BOOKS/ REFERENCE MATERIAL

1. Foundations of Microwave Engineering, 2 nd Ed, R. E. Collin, McGraw Hill International, New York,2001.
2. Microwave Devices and Circuits,3rd Ed, Samuel Y. Lio, Prentice Hall of India, New Delhi,1995.
3. Micorwave Engineering 2nd Edition, David M. Pozar, Wiley

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5203.
TITLE OF COURSE: Analog Communication Theory.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: EC-4100/ Basics of Communication, EC-4203/EC-44013, EC-5103, EC-5102.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	0	4	4

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Identify and understand different modulation and demodulation schemes for analog communications (AM, FM and PM).
CO2 Evaluate fundamental communication system parameters, such as bandwidth, power and signal to noise ratio, noise figure, sampling frequency.
CO3 Design analog communication systems to meet desired application requirements.
CO4 Elucidate the design tradeoffs and performance of communications systems.

TOPICS COVERED		**Lectures**
Unit I	Signals and spectra: line spectra and Fourier series, Fourier transform and continuous spectra. Properties of Fourier transform. Impulses in frequency and time.	6
Unit II	Signal transmission and filtering: response of LTI systems, transfer functions, distortionless transmission, linear distortion. Equalization. Nonlinear distortion and companding. Ideal filters, real filters and quadrature filters. Hilbert transform. Correlation and spectral density -correlation of power and energy signals, spectral density functions.	6
Unit III	Probability and Random variables: principles, conditional probabilities and statistical independence. Random variables and probability functions. Statistical averages. Probability models: Binomial and Poisson distribution. Gaussian and Rayleigh PDF. Random processes: principles, ensemble averages and correlation functions. Stationary and Ergodic process.	7

Unit IV	Noise: types, sources, frequency domain representation of noise, spectral components of noise, equivalent BW, additive white Gaussian noise and signal to noise ratio.	6
Unit V	Linear CW modulation: bandpass systems and signals, AM, DSB signals and spectra. Tone modulation and phasor analysis. Modulators and transmitters. SSB and VSB signals and their spectra. Synchronous and envelope detection. Exponential CW modulation: FM and PM signals, narrowband FM and PM. Tone, multitone and periodic modulation. Wideband FM, direct and indirect FM, capture effect, detection.	10
Unit VI	Noise in CW modulation: system models, predetection S/N, quadrature components. Linear modulation with noise, synchronous and envelope detection, threshold effect.	7

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Modern Digital and Analog Communication Systems, Latest edition, B.P.Lathi, Oxford University Press, New Delhi.
2. An Introduction to Analog and Digital Communication, Symon Haykins, John Willy and Sons, New York (Latest Edition)
3. Electronic Communication Systems, 4th edition, G.Kennedy and Bernard Davis, Tata McGrawhill, New Delhi.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-5204
TITLE OF COURSE: Analog and Digital Control
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: EC4101/EC 4301, EC4203/EC4403

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	0	4	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Realize block diagrams, mathematical model and transfer functions of open and closed loop control systems.
CO2 Have an in-depth knowledge on transient, steady state and stability of a control system.
CO3 Specify control system performance in the frequency-domain in terms of gain and phase margins, design compensators to achieve the desired performance.
CO4 Model and analyze control systems using state-space analysis and knowledge on digital control System.

TOPICS COVERED

		Lectures
Unit I	Elementary control concepts: Open loop and close loop control system. Transfer function, impulse response, modeling of electrical and mechanical (translational and rotational) systems, DC motor block diagram simplification, and signal flow graphs.	8
Unit II	Transient response analysis of I and II order system: Type of systems and its effect on error function, stability, steady state error.	6
Unit III	Stability concept: Routh Hurwitz criterion of stability, Root locus techniques: Root-Loci and complementary root loci rules for root locus plots.	7
Unit IV	Frequency Response Analysis: Nyquist plot and Bode plot. Gain and phase margins, compensation typical examples. Compensators and controllers: lead, lag and lag-lead compensators, proportional, PI and PID controllers.	10

Unit V	State Space Analysis: State Variables and State Model, State Transition Matrix and its properties, Concept of Controllability and Observability. Digital Control System: Sampled Data Control System, Step Response (First & Second Order Systems), Introduction to Digital PID Controller, block schematic of PLC and addressing.	11

TEXT BOOKS/ REFERENCES

1. Control Systems Engineering , Nagaratha and Gopal.
2. Discrete-Time Control Systems, K. Ogata, Pearson Education/PHI, 2 Edition
3. Modern Control Engg, K.Ogata, 2nd ed., PHI, 1995
4. Automatic Control Systems, B.C.Kuo, 7th ed., PHI, 1995.
5. Digital Control Systems, B.C. Kuo, 2nd ed., Saundey Publication, New York, 1992.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6100.
TITLE OF COURSE: Antenna and Radar Engineering
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES:

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	1	2	6	5

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Gain knowledge of Antenna and radiation concept.
CO2 Understand dipole antenna, Antenna Arrays and its design for given specifications
CO3 Understand and design Microstrip antenna, horn antenna etc. and learn antenna measurement technique.
CO4 Understand the basic operation of different radar systems

TOPICS COVERED

		Lectures
Unit I	Antenna fundamentals-Antenna parameters, point source electric doublet, Instantaneous and short dipoles, Quarter and Half wavelength Dipoles.	10
Unit II	Antenna: linear array, planar array, Loop Antennas. Broadband Frequency independent antennas: Spiral antennas, log periodic antennas. Aperture antennas, Horn antennas.	14
Unit III	Microstrip antennas and its analysis. Antenna Measurements- antenna ranges, radiation patterns, gain measurement, directivity measurement, polarization measurement	12
Unit IV	Rader fundamentals, Range equation, Different types of radar with practical applications.	6
Unit V	Antenna fundamentals-Antenna parameters, point source electric doublet, Instantaneous and short dipoles, Quarter and Half wavelength Dipoles.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. Antenna theory: Analysis and design, C.A Balanis, John Wiley and Sons, New York,1982
2. Antennas, J.D.Kraus, McGraw hill International, New York, 1988

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6101.
TITLE OF COURSE: Digital Communication.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: EC-5203.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Interpret and understand the building blocks of a typical digital communication system.

CO2 Compute probability of error and hence the inter symbol interference from eye diagram.
CO3 Derive expressions for the power spectrum of digital modulated signals.
CO4 Design an encoder and decoder for a typical error control coding scheme.

TOPICS COVERED		**Lectures**
Unit I	Sampling and pulse modulation: sampling theorem, types. PAM, PPM, PDM and PCM systems. TDM and FDM systems and their comparison. Cross talk and guard times. Practical sampling and aliasing. Baseband digital transmission: digital PAM signals, transmission limitations. Power spectra and digital PAM, spectral shaping by precoding. Signal coding Techniques, PCM Generation and Reconstruction, Quantization Noise, Non uniform Quantization and companding. DPCM, DM, ADM and ADPCM; Linear Predictive Coding. Transmission of base band signal over Band Limited system-RZ and NRZ format.	9
Unit II	Matched filter, Error rate due to Noise, ISI, Nyquist criteria for distortionless baseband binary transmission, Optimum Linear Receiver, Adaptive Equalization.	7
Unit III	Geometric representation of signals - Gram-Schmidt Orthogonalisation procedure, Vector Noise Channel, Likelihood functions, Maximum Likelihood decoding, Correlation receiver, Probability of Error, Frame patterns, Bit and Frame synchronization carrier recovery.	8
Unit IV	Introduction to Information Theory-Definition of information, Self and Mutual information, Entropy and Information rate. Discrete memoryless source and coding, Discrete channel capacity, Shannon-Hartley equation for channel capacity, Markov chains. Principles of Error Detection and Correction methods, Channel Coding - Linear Block Codes, Cyclic Codes, Convolutional Coding, Automatic request for retransmission systems.	9
Unit V	Digital CW Modulation-Principles, Block schematics and Comparative Study of ASK, FSK and PSK systems, Introduction to Quadrature Carrier and M-ary systems, Modems and standards, Modern Digital Communication Technologies- ISDN, BISDN etc. Cellular digital Radio, Spread Spectrum techniques and Personal communication Networks.	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Digital Communications, Simon Haykin John Wiley and Sons.
2. Digital Communications, Proakis , McGraw Hill.
3. Communication Systems, A. B. Carlson, McGraw Hill.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6179.
TITLE OF COURSE: Industrial Training
DESIGNATION: REQUIRED ~~/ELECTIVE~~ AUDIT course
PRE-REQUISITES: Basics of all subjects studied
COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
0	0	0	0	2

Practical	Training Report and Grade	50% of 100	100
	Training Seminar and Viva Voce	50% of 100	

COURSE OUTCOMES
CO1 Collaborate to learn new content and gain diverse perspectives.
CO2 Acquire skills like collaboration, communication and independent learning, lifelong learning and the challenges ahead.
CO3 Getting exposure to the corporate world.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6199.
TITLE OF COURSE: Project Part I
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: All previously studied subjects
COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
0	0	4	0	2

Practical	**As per Rubrics**	100

COURSE OUTCOMES

CO1 Collaborate to learn new content and gain diverse perspectives.

CO2 Acquire skills like collaboration, communication and independent learning, lifelong learning and the challenges ahead.

RUBRICS

	Performance Indicators	Good 4	Satisfactory 3	Average 2	Poor 1
Selection of the Project Topic	**Topic**	Topic on emerging technology in two weeks time	Topic on Latest Developments in four weeks time	Topic on the Existing Technology or Methodology in four weeks time	Could not decide the Topic in four weeks time
	Literature Survey	Collecting relevant literature in 2 weeks from Journals / Books	Collecting relevant literature in 4 weeks from Journals / Books	Collecting relevant literature in more than 4 weeks with the help of Guide	Could not get any literature
Report Preparation	**Preparation & Planning**	Preparation of the report in 4 weeks time	Preparation of the report in 6 weeks time	Preparation of the report in more than 6 weeks time	Report Preparation in complete even in 8 weeks
	Team work	Good Coordination among Team Members and good rapport with the Faculty	Coordination among Team Members and with the Faculty is satisfactory	Coordination among Team Members with the help of the Faculty	Poor Coordination among Team Members and with the Faculty
Evaluation	**Presentation**	Presentation is good with required figures and data	Presentation is satisfactory.	Presentation needs improvement	Poor Presentation
	Viva - Voce	Responding immediately with confidence	Responding and answering to the satisfactory level	Responding with much delay and answering about 50% of the questions	Not able to respond.

***This Subject will be offered to Degree Students of B.Tech Electrical Engg second year, first semester.**

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6120.

TITLE OF COURSE: Introduction to Digital Signal Processing.

DESIGNATION: REQUIRED /~~ELECTIVE~~ course

PRE-REQUISITES:

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	2	5	4

COURSE ASSESSMENT METHODS				
	Theory	Assignments & Quiz	20% of 75	75
		Mid-Semester Exam	30% of 75	
		End-Semester Exam	50% of 75	
	Practical	Class Work & Viva	50% of 25	25
		Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Understand signal processing systems using basic concepts.
CO2 Understand the basic concept of LTI system and its realization.
CO3 Analyze signal using the discrete Fourier transform and its effective computation by FFT techniques.
CO4 Specify and design FIR and IIR type digital filters and identify the fundamentals of multi rate signal processing and its applications.

TOPICS COVERED		Lectures
Unit I	Introduction to basic elements of DSP systems, Advantages of Digital over Analog Signal Processing, multi-channel and multidimensional signals, continuous vs. discrete time and discrete valued signals, concept of frequency in discrete time signals. A/D and D/A conversions. Sampling theory, Aliasing, Quantization and coding.	10
Unit II	Some elementary discrete time signals, Classification of discrete time signals. Block diagram representation of discrete time systems. Analysis of discrete time, Linear time invariant systems- convolution, properties of convolution, interconnection of LTI systems, Causality and stability, systems with finite-duration and infinite –duration impulse responses. Recursive and non-recursive systems, constant coefficient difference equations, structures for realization of LTI systems..	10
Unit III	Correlation of discrete time signals, Z-transform, poles and zeroes, pole location and time domain behaviour for causal signals, properties of Z-transform.	8
Unit IV	Discrete Fourier transform- Its properties and applications, efficient computation of DFT- fast Fourier Transform algorithms, direct computation, divide-conquer approach, radix-2 FFT, Radix-4 FFT, divide in time and divide in frequency algorithms.	8
Unit V	Design of digital filters- symmetric and anti-symmetric FIR filters, design of linear phase FIR filters using windows, design of linear- phase filters by the frequency sampling method. Introduction to linear prediction, power spectrum estimation and multi rate digital signal processing	6

TEXT BOOKS/ REFERENCE MATERIAL

1. Digital Signal Processing, Algorithms and Applications, Proakis and Manolakis, 3rd edition, Prentice Hall of India, New Delhi.
2. Discrete-time Signal processing, Alan V Oppenheim and Ronald W Schafer, 3rd edition, Pearson.
3. The Scientist & Engineer's Guide to Digital Signal Processing, Steven W Smith.
4. Understanding Digital Signal Processing, Richard G Lyons, Pearson.
5. Digital Signal Processing: A Practical approach, Emmanual C. Ifeachor et. Al., Pearson Education, 2nd edition.
6. Digital Signal Processing, A Computer based Approach, 2 edition, S.K.Mitra, Tata McGraw Hill, New Delhi, 2001.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6200.
TITLE OF COURSE: Computer Communication and Networks

DESIGNATION: REQUIRED / ~~ELECTIVE~~ course
PRE-REQUISITES: EC 4102/EC4302

COURSE DETAILS:

Lecture	Tutorial	Practical's	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work and Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1 Understand the issues and challenges at all levels of abstraction in the architecture of a computer network.
CO2 Understand how to Develop networked applications.
CO3 Realize protocols at different layers of a network hierarchy.
CO4 Recognize network security issues and be able to design/code for certain properties.

TOPICS COVERED		**lectures**
Unit I	Review of data communication techniques, basic networking concepts, layered network and protocol concepts, quality of service, Network structure , protocol Hierarchies, The OSI reference model, Service Primitives, Example Networks : ARPANET, SNA etc.	**8**

Unit II	The Physical Layer: Transmission Media, Transmission and Switching, Terminal, The medium Access sub layer, The ALOHA protocols, LAN Protocols, Ethernet, Token bus, Token ring.	**8**
Unit III	The Data link layer: Design issues, Error control, Sliding Window Protocols, protocols performance.	**8**
Unit IV	The Network layer: Design issues, Routing algorithms, congestion control Algorithms, Internet working.	**8**
Unit V	The Transport layer: Design issues, connection management. The Session layer: Design issues, Remote procedure call. The Presentation layer: Design issues, data compression techniques concepts, Introduction to Cryptography. The Application layer: Design issues, File transfer, Access and management, Virtual terminals.	**10**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Computer networks, 3rd Ed., A.S Tanenbaum , Prentice Hall of India, New Delhi. 2001.
2. Data communications, Computer Networks, and Open Systems, 4th Ed, Fred Halsall, Addison Wesely Longman , Singapore 1995.
3. Data and Computer communications, 5th Ed W.Stallings, Prentice Hall of India, New Delhi.2001.
4. Forouzen, "Data Communication and Networking", TMH

DEPARTMENT: Humanities and Social Science.
COURSE NUMBER: HS-6201.
TITLE OF COURSE: Human Resource and Management.
DESIGNATION: REQUIRED /~~ELECTIVE~~ course
PRE-REQUISITES: HS-4401/HS-4101.
COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 75	75
	Mid-Semester Exam	30% of 75	
	End-Semester Exam	50% of 75	
Practical	Class Work & Viva	50% of 25	25
	Practical Exam	50% of 25	

COURSE OUTCOMES

CO1	Understand Human Resource Management, its development, purpose, functions, and the approaches to the management of HR in the changing environment. Understand
CO2	how recruitment, selection, induction, and placement takes place.
CO3	Get an insight how training and development, and succession planning takes place.
CO4	Understand the various ways of motivating, and evaluating employees.
CO5	Learn how to compensate, deal with unions, and resolve conflict.
CO6	Critical Thinking: Students will be able to understand, analyse, test and evaluate arguments and evidence.
CO7	Effective Communication Skills: Students will develop reading, writing, active listening, and public speaking skills.
CO8	Interpersonal Skills: Students will develop effective teamwork, ethical standards, conflict resolution, and effective management.
CO9	Use of existing and new technology: Students will demonstrate the ability to incorporate and use modern technology in collecting and analysing data from a variety of sources.

TOPICS COVERED

		lectures
Unit I	HRM, Definition, Scope, HRM vs. Personnel Management, Functions of HRM in changing environment.	9
Unit II	Human Resource Planning, Recruitment, Selection, Induction and Placement.	9
Unit III	Training, Executive Development, Career and Succession Planning.	8
Unit IV	Motivation Job description, enrichment, analysis and Evaluation, Performance Appraisal.	8
Unit V	Compensation planning, Wage policy in India, Globalization and Compensation planning, Industrial Relations Scenario in India, Trade Unionism, Collective Bargaining, Industrial Conflict Resolution, Industrial democracy and workers participation in Management.	8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Human Resource Management, S.P. Robbins, Prentice Hall of India, New Delhi, 1991.
2. Human Resource Management, Mirza S. Sayadin, Tata McGraw Hill, New Delhi, 2000.
3. Personnel Management. C.B. Manoria, Himalayan Publishing House, New Delhi, 1995.
4. Organizational Behavior, Fred Luthans, McGraw Hill International, New York, 1999

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6299.
TITLE OF COURSE: Project Part II
DESIGNATION: REQUIRED ~~/ELECTIVE~~ course
PRE-REQUISITES: All previously studied subjects

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
0	0	8	0	4
Practical		**As per Rubrics**		100

COURSE OUTCOMES

CO1 Acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO2 Achieve skills to communicate effectively and to present ideas clearly and coherently to specific audience in both the written and oral forms.
CO3 Attain collaborative skills through working in a team to achieve common goals.
CO4 Learn on their own, reflect on their learning and take appropriate actions to improve it.

RUBRICS

Task	Performance indicators	Good 4	Satisfactory 3	Average 2	Poor 1
Selection of Topic	Selection of Topic	Selection of the topic by referring literature and discussion with guide in two weeks.	Selection of the topic by referring research journals in a month	Selection of the topic by referring research journals in more than a month	Selection of the topic with the help of the guide
	Developing Project Plan & Distribution of work	Splitting the project into small tasks and scheduling them to finish it in time and division of the work among the members of the team is good and coordination in the team is good.	Splitting the project into small tasks and scheduling them to finish it in time and different tasks of the job shared among the members of the team with satisfactory coordination.	Splitting the project into small tasks is not sufficient and sharing different tasks among the team members needs some more attention	Not able to split the project into small tasks. Needs lot of work to be done.
Literature Survey	Collection of Literature	Collected related research articles are recent, good and sufficient for the project work.	Collected related research articles are satisfactory for the project work.	Need some more research articles for the project work and need time.	Not collected relevant articles.
Performance of the task	Experiment / Analysis/ Industrial Problem	Work completed in all aspects and is ready to prepare the dissertation.	Work completed 80%. Can start preparing the dissertation.	Work completed only 50-60%. Need more attention to compete the tasks.	Work not completed. Need lot of attention.

	Team Work	Coordinates team efforts and communication among members is good.	Coordinates team efforts and communication among members is satisfactory.	Requires more coordination and communication among the team	No proper coordination among the team
Review	**Presentation**	Presentation should be good with results and with good figures	Presentation is satisfactory with the results.	Presentation needs some improvement	Presentation in incomplete in all aspects.
	Understanding	Understanding the task fully. Knowing all the tasks of the project, 100%.	Ability of correlating the theoretical aspects with the practical aspects is in between 60-80%	Ability of correlating the theoretical aspects with the practical aspects is in between 50-60%	Ability of correlating the theoretical aspects with the practical aspects is less than 50%
Dissertation Preparation	**Dissertation Preparation**	Dissertation prepared with neat sketches, and complete with all the necessary calculations or analysis, contents of the dissertation are well planned and coverage of all the topics is good	Dissertation prepared with neat sketches, and complete with all the necessary calculations or analysis, contents of the dissertation are well planned and coverage of all the topics is satisfactory	Dissertation prepared with sketches and required calculations but needs improvement	Dissertation prepared is not complete in all aspects and the coverage of all the contents is poor
Viva-voce	**Understanding**	Answering 100% questions related to the project	Answering 80% questions related to the project	Answering about 60% of questions related to the project	Answering less than 50% of the questions related to the project
	Response	Responding immediately with confidence	Responding and answering to the satisfactory level	Responding with much delay and answering about 50% of the questions	Not able to respond. Understanding the concepts is poor

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6010.
TITLE OF COURSE: Artificial Neural Networks and its Application.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: MA-3101, EC-5102, MA4301.

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understand the basics of artificial intelligence and neural networks.
CO2 Understand various algorithms such as single layer perceptron, LMS algorithm and solve problems on adaptive filtering.
CO3 Use the concept of multilayer perception to solve problems of extremely complex nature.
CO4 Understand and perform numerical analysis for various model networks to solve various optimization problems.

TOPICS COVERED lectures

Unit I	Network architecture, Artificial intelligence and neural networks, Learning processes, Learning with or without a teacher, Memory adoption, and statistical nature of learning process.	9
Unit II	Single layer perception, Adaptive filtering problem, LMS Algorithm, Learning curve, Perception convergence	8
Unit III	Multi-layer perception: Back propagation, algorithm, output presentation and decision rule, supervised learning as optimization problem, Generalized radial basics, Function network.	8
Unit IV	Temporal processing using feed forward network, Network Architectures, Distributed time lagged feed forward network, Temporal back propagation algorithm.	8
Unit V	Dynamically driven recurrent networks, Sate space model, Learning algorithms, Real time recurrent learning, Kalman Filter, De-coupled extended kalman filters.	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Neural network- A Comprehensive foundation, 2nd Ed, Simon Haykin, Addison Wiseley Longman, New York, 2001.
2. Neural Network- Algorithms, Applications and programming, J A Freeman and D M Skapura, AWL, NY, 2000.
3. An introduction to Neural Network, James A Anderson, Prentice Hall of India, New Delhi.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6011.
TITLE OF COURSE: Robotics.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: EC-5100.

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1	Students will be able to differentiate between different types of automated and robotic systems.
CO2	Understand the process of manufacturing and their application.
CO3	Understand and apply various techniques to solve problems of control navigation
CO4	Ability to program a robot to avoid obstacles in a planned environment.

TOPICS COVERED

Unit I	Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.	lectures 9
Unit II	Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.	8
Unit III	Motion Analysis: Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.	8
Unit IV	Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.	8
Unit V	Trajectory planning and avoidance of obstacles, path planning, Robot programming, languages and software packages. Robot actuators and Feedback components. Feedback components, position sensors – potentiometers, resolvers, encoders – Velocity sensors. Robot Applications in Manufacturing	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K and Nagrath I J / TMH.
3. Robotics / Fu K S/ McGraw Hill.
4. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.

5. Robotic Engineering / Richard D. Klafter, Prentice Hall
6. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science
7. Introduction to Robotics / John J Craig / Pearson Edu.
8. Robot Dynamics and Control – Mark W. Spong and M. Vidyasagar / John Wiley and Sons (ASIA) Pte Ltd.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6012.
TITLE OF COURSE: Multimedia Communications and Networking
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: EC-6101.

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understanding the basics of analog and digital video: video representation and transmission and analyze analog and digital video signals and systems. Knowing the
CO2 fundamental video processing techniques
CO3 Acquiring the basic skill of designing video compression and to familiarize with video compression standards
CO4 Knowing the basic techniques in designing video transmission systems: error control and rate control

TOPICS COVERED

		lectures
Unit I	Basics of analog and digital video: colour video formation and specification, analog TV system, video raster, digital video formats. Frequency domain analysis of video signals, spatial and temporal frequency response of the human visual system.	9
Unit II	Scene, camera, and motion modelling, 3D motion and projected 2D motion, models for typical camera/object motions.	8
Unit III	2D motion estimation: optical flow equation, different motion estimation methods (pel-based, block-based, mesh-based, global motion estimation, multi-resolution approach),Basic compression techniques: information bounds for lossless and lossy source coding, binary encoding, scalar/vector quantization	8
Unit IV	Waveform-based coding: transform coding, predictive coding including motion compensated prediction and interpolation, block-based hybrid video coding, scalable video coding	8
Unit V	Video compression standards (H.261 and H.263, MPEG1, MPEG2, MPEG4, MPEG7). Error control in video communications. Video transport over the Internet and wireless networks	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. "JPEG2000: Image Compression Fundamentals, Standards, and Practice," D. Taubman and M. Marcellin, Kluwer, 2001. ISBN: 079237519X.
2. "H.264 and MPEG-4 Video Compression," Iain E G Richardson, John Wiley & Sons, September 2003, ISBN 0-470-84837-5
3. "Video Coding for Mobile Communications: Efficiency, Complexity and Resilience", M. E. Al-Mualla, C. N. Canagarajah and D. R. Bull, Elsevier Science, Academic Press, 2002. ISBN: 0120530791
4. "Digital Video Processing," A. Murat Tekalp, Prentice Hall, Englewood Cliffs, NJ, 1995.
5. "Introduction to Data Compression," Khalid Sayood, 2nd ed., Morgan Kaufmann, 2000.
6. "Digital Compression for Multimedia: Principles & Standards," Jerry Gibson, Toby Berger, Tom Lookabaugh, Rich Baker and David Lindbergh, Morgan Kaufmann, 1998. ISBN 1-55860-369-7
7. "Digital Pictures – Representation, Compression and Standards," A. N. Netravali and B. G. Haskell, 2nd ed. Plenum Press, 1995.

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6013

TITLE OF COURSE: Data Compression.

DESIGNATION: ~~REQUIRED~~ /ELECTIVE course

PRE-REQUISITES: EC 5203

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To understand the basic knowledge of lossless and lossy compression.
CO2 To analyse and evaluate the arithematic coding and dictionary techniques.
CO3 To analyse the lossless and lossy image compression.
CO4 To understand scalar and vector quantization and evaluate transform coding.

TOPICS COVERED

		Lectures
Unit I	Information theoretic foundations: Lossless and lossy compression, Modeling and coding Entropy, conditional entropy, information, channels Data models: static and adaptive Coding: Fano, Huffman, Golomb, Rice, Tunstall.	8
Unit II	Arithmetic coding: Encoding, Decoding, Adapatation. Dictionary techniques: Static techniques, Adaptive coding: The LZ family.	9
Unit III	Context modeling: PPM, Burrows-Wheeler, Move-to-front,DMC, Lossless image compression: Multiresolution CCITT Group 3 and 4 ,JBIG, JBIG2, Lossy coding preliminaries: Distortion,Rate distortion ,Linear system models.	9
Unit IV	Scalar and vector quantization: Uniform and nonunform quantizers, Adaptive quantization, Lloyd-Max quantizer, LBG quantizer, Tree-structured quantizers, Trellis-coded quantization.	8
Unit V	Transform coding: Bases, inner products, orthogonality and orthonormality Karhunen-Loéve transform, DCT, Walsh-Hadamard transform,J PEG.	8

TEXT BOOKS/ REFERENCE MATERIALS

1. Introduction to Data Compression, 3rd Edition, Sayood, Khalid, Morgan Kaufmann, 2006.
2. Source and Channel Coding, Anderson, J.B. and Mohan, S.,Kluwer, 1991.
3. Vector Quantization and Signal Compression, Gersho, A. and Gray, R.M., Kluwer, 1992.
4. Digital Pictures, Representation and Compression, Netravali, A.N., Plenum, 1989.
5. Discrete Cosine Transform, Rao, K.R. and Yip, P., Academic Press, 1990.

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6014

TITLE OF COURSE: Telecommunication Switching

DESIGNATION: ~~REQUIRED~~ /ELECTIVE course

PRE-REQUISITES: EC5203

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Analyze the performance of a digital telephone switch.
CO2 Understand the basics of switching and multiplexing in public and private telephone networks.
CO3 Knowledge on fundamental concepts of network synchronization and able to diagnose and

correct the synchronization faults ..

CO4 Knowledge on designing and modelling of switching systems and understand the standards of ISDN, digital loop carrier systems.

TOPICS COVERED		**Lectures**
Unit I	Telecommunications Transmission- Four-wire circuits, TDM, PCM, Differential coding, Pulse Transmission, Line Coding, Binary N – Zero Substitution, Digital Biphase. SONET/SDH: SONET Frame Formats, Operations, Administration and Maintenance, Payload Framing and Frequency Justification, Virtual Tributaries, DS3 & E4 Payload Mapping, SONET Optical Standards, Networks, SONET Rings.	8
Unit II	Evolution of switching system, Switching Networks, Digital Switching-Switching Functions, Space Division Switching, Time Division Switching, two-dimensional switching: STS Switching, TST Switching, Signalling techniques-In channel, Common channel signalling, SS7 signalling.	9
Unit III	Network Synchronization Control and Management Timing: Timing Recovery, Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies:Slips,AsynchronousMultiplexing,Network Synchronization, Network Control, Network Management.	8
Unit IV	Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, And Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, And Delay Systems: Exponential Service Times, Constant Service Times, Finite Queues.	9
Unit V	Digital Subscriber Access: ISDN, High-Data-Rate Digital Subscriber Loops, VDSL, Digital Loop Carrier Systems, Fiber in the Loop, Hybrid Fiber Coax Systems, and Voice band Modems, Local microwave Distribution Service, Digital Satellite Services.	8

TEXT BOOKS/ REFERENCES

1. Telecommunication Switching System and Networks, Viswanathan. T., PHI 1994
2. Telecommunication transmission systems, Robert G. Winch, 2nd ed. TMH 2004
3. Digital Telephony, Bellamy John, John Wily & Sons, Inc. 3rd ed. 2000
4. Intro. to Telecommunications, Marion Cole, 2nd ed. Pearson education 2008.
5. Encyclopedia of Networking and telecom., Tom Sheldon, TMH seventh reprint 2006.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6015
TITLE OF COURSE: Principles of Operating System.

DESIGNATION: ~~REQUIRED /~~ ELECTIVE course
PRE-REQUISITES: EC 4102/ EC 4302

COURSE DETAILS:

Lecture	Tutorial	Practical's	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Acquire the basic knowledge about the structure and functions of OS.
CO2 Understand about Processes, Threads and Scheduling algorithms
CO3 Explore different techniques of various memory management schemes
CO4 Understand I/O management and File systems.

TOPICS COVERED		**Hours**
Unit I	Introduction to the Operating System: Type of OS: Batch System, Time Sharing System, Real Time System, Multiuser/Single User System, System Calls, System Call Interface. Function of Operating System: Process Management, Memory Management, File Management, I/O Devices Management, Information Management.	**9**

	Process Management: Process Concept, Process State, Process Control Block, Process Scheduling, Context Switch, CPU Scheduling, Scheduling Criteria, Scheduling Algorithms, Pre Emptive/ Non Pre-emptive Scheduling, Threads, Thread Structure.	
Unit II	Process Synchronisation: Critical Section Problem, Race Condition, Synchronisation hardware, Semaphores, Classical Problems of Synchronisation. Deadlocks: Characterisation, Methods for Handling Deadlocks Avoidance, Recovery and Detection.	**9**
Unit III	Memory Management: Contiguous Allocation, External Internal Fragmentation, Paging Segmentation, Segmentation with Paging. Virtual Memory: Virtual Memory Concept, Demand Paging, Page Replacement, PR Algorithms, Allocation of Frames, Thrashing.	**8**
Unit IV	Information Management: File Concepts, Access Methods, Directory Structure, Allocation Methods: Contiguous Allocation, Linked Allocation, Indexed Allocation Free Space Management. Device Management: Disk Structure, Disk Scheduling Algorithms, Disk Management.	**8**
Unit V	Real Time Systems: Introduction, Real-Time Task Scheduling, Handling Resource Sharing and Dependencies among Real-Time Tasks, Real-Time Communication.	**8**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Silbershatz and Galvin, "Operating System Concept", Addition Wesley, 2002.
2. Milan Milenkovic, Tata Mcgraw-Hill, 2000 "Operating System " Concepts & Design".
3. Rajib Mall, Pearson Education ,"Real-Time Systems: Theory and Practice, 1/e"
4. Charles Crowley, "Operating Systems", Tata Mcgraw-Hill Edition
5. A. S. Tannenbaum, "Operating System Concept", Addition Weseley, 2002
6. Flynn, Mchoes, "Understanding Operating System", Thomson Press, Third Edition, 2003

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6016
TITLE OF COURSE: Fuzzy Logic and Genetic Algorithm
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES:

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	
	Mid-Semester Exam	30% of 100	100
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Recognize the feasibility of applying a fuzzy computing methodology for a particular problem.
CO2 Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO3 Apply genetic algorithm to combinational optimization problems.
CO4 Apply pattern classifications and regression problems. And compare solutions by various fuzzy and GA approaches for a given problem.

TOPICS COVERED

		lectures
Unit I	FUZZY SET THEORY: Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets –Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.	9
Unit II	OPTIMIZATION: Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.	8
Unit III	Gene Expression Programming: Encoding: the genotype, Expression trees: the phenotype, K-expressions and genes, Multigenic chromosomes,Cells and code reuse, gene expression algorithm	8
Unit IV	NEURO FUZZY MODELING: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.	9

	Unit V	APPLICATIONS OF COMPUTATIONAL INTELLIGENCE: Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction. 8

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. "Neuro-Fuzzy and Soft Computing", J.S.R.Jang, C.T.Sun and E.Mizutani, PHI, 2004, Pearson Education 2004.
2. "Fuzzy Logic with Engineering Applications", Timothy J.Ross, McGraw-Hill, 1997.
3. "Genetic Algorithms: Search, Optimization and Machine Learning", Davis E.Goldberg, Addison Wesley, N.Y., 1989.
4. "Neural Networks, Fuzzy Logic and Genetic Algorithms", S. Rajasekaran and G.A.V.Pai, PHI, 2003.
5. "Computational Intelligence - PC Tools", R.Eberhart, P.Simpson and R.Dobbins, AP Professional, Boston, 1996.
6. Gene Expression Programming: Mathematical Modeling by an Artificial Intelligence. Ferreira, C. (2006). Springer-Verlag. ISBN 3-540-32796-7.

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6017

TITLE OF COURSE: MIMO Communications Theory

DESIGNATION: ~~REQUIRED~~/ ELECTIVE course

PRE-REQUISITES: EC5203

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

- **CO1** Acquire knowledge on fading channels and communication techniques on fading channel
- **CO2** Knowledge on MIMO channels and determine capacity and information rate of the channel.
- **CO3** Knowledge on space time codes and trellis code to increase the capacity of MIMO channel in block fading and frequency selective fading channel.
- **CO4** Develop concatenated codes and iterative decoding.

TOPICS COVERED		**Lectures**
	Fading channels and Diversity Techniques: Wireless channels, Error/Outage probability over fading channels, Diversity techniques, Channel coding as a means of time diversity, Multiple antennas in wireless communications.	8
Unit I		
	Capacity and Information Rates of MIMO channels: Capacity and Information rates of noisy, AWGN and fading channels, Capacity of non-coherent MIMO channels, Constrained signaling for MIMO communications.	8
Unit II		
	Space-time block and Trellis code: Alamouti scheme, Orthogonal and Quasi-orthogonal space-time block codes, Linear dispersion codes, Generic space-time trellis codes, Basic space-time code design principles, Representation of space-time trellis codes for PSK constellation, Performance analysis for space-time trellis codes, Comparison of space-time block and trellis codes.	10
Unit III		
	Concatenated codes and Iterative Decoding: Development of concatenated codes, Concatenated codes for AWGN and MIMO channels, Turbo coded modulation for MIMO channels, Concatenated space-time block coding.	8
Unit IV		
	Space-time coding for frequency selective fading channels: MIMO frequency-selective channels, Capacity and Information rates of MIMO FS fading channels, Space-time coding and Channel detection for MIMO FS channels, MIMO OFDM systems.	8
Unit V		

TEXT BOOKS/ REFERENCES

1. Coding for MIMO Communication systems, Tolga M. Duman and Ali Ghrayeb, John Wiley & Sons, West Sussex, England, 2007.
2. Space-time processing for MIMO communications, A.B. Gershman and N.D. Sidiropoulus, Wiley, Hoboken, NJ, USA, 2005.
3. Space-time block coding for Wireless communications, E.G. Larsson and P. Stoica, Cambridge University Press, 2003.

4. Space-time codes and MIMO systems, M. Janakiraman, Artech House, 2004.
5. Space-time coding: Theory & Practice, H. Jafarkhani, Cambridge University Press, 2005.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6018
TITLE OF COURSE: Advanced Digital Signal Processing.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: EC5102,EC4203

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1	Study the concepts of discrete time systems, and design FIR and IIR filters.
CO2	Understand properties of Hilbert transform for a discrete time system.
CO3	Study Cepstrum analysis and Homomorphic Deconvolution and use its characteristics in speech processing.
CO4	Understand multirate DSP, alteration systems, Nyquist filters, wavelet transform, adaptive filters and different algorithms related to it like LMS and RLS algorithms.

TOPICS COVERED		lecuters
Unit I	Review: Discrete-Time Signals and Systems, Sampling, Z-transform, DFT, Filter design techniques- FIR, IIR.	**10**
Unit II	Discrete Hilbert transforms: Real and Imaginary Part, sufficiency of the FT for causal Sequences, Sufficiency Theorems for Finite length Sequences, Relationship between Magnitude and Phase, HT Relation for complex sequences.	**8**
Unit III	Cepstrum analysis and Homomorphic Deconvolution: Definition of complex cepstrum Homomorphic Deconvolution, Properties of complex Logarithm, Alternative expression for complex cepstrum, The complex cepstrum of exponential sequences, Realization of the Characteristic system, Examples of Homomorphic Filtering, Application to speech processing.	**7**
Unit IV	Multirate DSP: The basic sample rate Alteration device Filters in sampler rate Alteration System, Multistage Design of Decimator and interpolator. The polyphase Decomposition, Arbitrary rate sampler rate converter, Digital filter banks, Nyquist filters, two channel quadrature mirror filter bank, L channel QMF banks, Cosine modulated L- channel filter banks, Multilevel filter bank, STFT, Wavelet transform, DCT.	**9**
Unit V	Adaptive filters: Introduction, Examples of Adaptive filtering, The minimum mean Square Error Criterion, The windrow LMS algorithm, Recursive Least Square Algorithm, Forward and Backward Lattice method, Gradient adaptive Lattice method.	**8**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Digital Signal Processing : A Practical approach, Emmanual C. Ifeachor et. Al., Pearson Education, 2nd edition
2. Digital Signal Processing, Algorithms and Applications 3rd edition, Proakis and Manolakis,Prentice Hall of India, New Delhi, 1999.
3. Digital Signal Processing, A Computer based Approach, 2nd edition, S.K.Mitra, Tata McGraw Hill, New Delhi, 2001.
4. Theory and Application of Digital Signal Processing., L.R. Rabiner and B.Gold, PHI
5. Adaptive Filters, Simon Haykin, PHI

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6019
TITLE OF COURSE: Advanced Digital System Design
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5100

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understand the fundamentals of various Combinational and Sequential logic design techniques and theorems.
CO2 Learn the Basics of VHDL modeling and design techniques.
CO3 Understand the basic concepts of Programmable Logic Devices and Design of state machine using Algorithmic State Machines chart.
CO4 Understand about various types of FPGA, Xilinx series, and Design examples.

TOPICS COVERED		Lectures
Unit I	Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Timing, Electrical Characteristics., Power Dissipation.	6
Unit II	Current state of the field: SoC, IP Design, SoPC, Design methodology, System Modeling, Hardware-Software Co-design, Device Technology, Application Domains.	6
Unit III	Digital system Design: Top down Approach to Design, Case study, Data Path, Control Path, Controller behavior and Design, Case study Mealy & Moore Machines, Timing of sequential circuits, Pipelining, Resource sharing, FSM issues	7
Unit IV	VHDL for Synthesis: Introduction, Behavioral, Data flow, Structural Models, Simulation, Cycles, Process, Concurrent Statements, Sequential Statements, Loops, Delay Models, Sequential Circuits, FSM Coding, Library, Packages, Functions, Procedures, Operator Inferencing, Test bench.	7
Unit V	Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, Design Flow, Programmable Interconnections, Complex PLD's (MAX - 7000, APEX), Architecture, Resources, Applications.	7
Unit VI	FPGA's: Introduction, Logic Block Architecture, Routing Architecture, Programmable, Interconnections, Design Flow, Xilinx Virtex-II (Architecture), Boundary Scan, Programming FPGA's, Constraint Editor, Static Timing, Analysis, One hot encoding, Applications, Tools, Case Study, Xilinx Virtex II Pro, Embedded System on Programmable Chip, Hardware-software co-simulation, Bus function models, BFM Simulation, Debugging FPGA Design, Chipscope Pro.	9

TEXT BOOK/ REFERENCE MATERIALS

1. Digital Design: Principles and Practices, Jon F Wakerly, Prentice Hall.
2. VHDL for programmable logic, Kevin Skahil, Addison Wesley.
3. VHDL:analysis and modeling of digital systems, Zainalabedin Navabi, McGraw-Hill.
4. PLD, FPGA data sheets

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DEPARTMENT: Electronics and Communication Engineering
COURSE NUMBER: EC 6020
TITLE OF COURSE: Wireless Communication

DESIGNATION:	~~REQUIRED~~ /ELECTIVE course				
PRE-REQUISITES:	Analog and Digital Communication Theory				
COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	
			Mid-Semester Exam	30% of 100	100
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Familiarize with various generations of wireless communication systems.
CO2 Familiarize with cellular communication systems.
CO3 Understand the effects of channel encountered in wireless Communication.
CO4 Understand the counter techniques of channel effects.

TOPICS COVERED		**Lectures**
Unit I	Wireless Communication Systems: evolution of mobile radio communications. Radio communication systems: paging systems, cordless telephone systems, cellular telephone systems; comparison of common wireless communications, generations of cellular mobile communication networks. Radio wave propagation, free space propagation model.	7
Unit II	Mobile communication: Limitations of conventional mobile system. Cellular communication: introduction, frequency reuse, cluster size, cellular system architecture, mobile station, base station, MSC, channel assignment strategies, call handover strategies, interference and system capacity, improving capacity in cellular systems.	11
Unit III	Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Two-Ray model, Fresnel Zone Geometry, Knife edge Diffraction Model, Scattering. Small Scale Fading: Factors, types of small scale fading, Rayleigh and Ricean Distribution.	12
Unit IV	Equalization and Diversity: Equalization Fundamentals, Linear and Non Linear Equalizers, Algorithms for Adaptive Equalizers. Diversity techniques: Selection Diversity, Maximal Ratio Combining, Polarization Diversity, Frequency Diversity and Time Diversity. RAKE Receiver.	12

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Wireless Communication Principles and Practice, Theodore S Rapaport, Pearson Education.
2. Wireless Communication, Andrea Goldsmith, Cambridge
3. Fundamentals of Wireless Communication, David Tse, Cambridge

DEPARTMENT:	Electronics and Communication Engineering.				
COURSE NUMBER:	EC-6021				
TITLE OF COURSE:	Computer Aided Design of VLSI Circuits.				
DESIGNATION:	~~REQUIRED~~ /ELECTIVE course				
PRE-REQUISITES:	EC-5101, EC-5200				
COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	
			Mid-Semester Exam	30% of 100	100
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To analyse various physical design methods in VLSI.
CO2 To understand the concepts behind the VLSI design rules and routing techniques.
CO3 To use the simulation techniques at various levels in VLSI design flow.
CO4 To understand the concepts of various algorithms used for floor planning and routing techniques.

TOPICS COVERED

		Lectures
Unit I	Introduction to VLSI Methodologies - VLSI Physical Design Automation - Design and Fabrication of VLSI Devices - Fabrication process and its impact on Physical Design.	8
Unit II	A Quick Tour of VLSI Design Automation Tools - Data structures and Basic Alogrithms - Algorithmic Graph theory and computational complexity - Tractable and Intractable problems.	9
Unit III	General purpose methods for combinational optimization, partitioning, floor planning and pin assignment, placement and routing.	8
Unit IV	Simulation: Gate-level modeling and simulation; Switch-level modeling and simulation, Combinational Logic Synthesis: Binary Decision Diagrams, Two Level Logic Synthesis.	8
Unit V	Physical Design Automation of FPGAs, MCMS, High level Synthesis: Hardware models, Internal representation, Allocation, assignment and scheduling, Simple scheduling algorithm, Assignment problem, High level transformations.	9

TEXT BOOKS/ REFERENCE MATERIALS

1. Algorithms for VLSI Design Automation, S.H. Gerez, John Wiley & Sons, 2002.
2.Algorithms for VLSI Physical Design Automation, N.A. Sherwani, Kluwer Academic Publishers, 2002.
3.VLSI Physical Design automation: Theory and Practice, Sadiq M. Sait, Habib Youssef, World scientific 1999.
4.Computer Aids for VLSI Design, Steven M.Rubin, Addison Wesley Publishing 1987..

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6022
TITLE OF COURSE: Digital Image Processing
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: EC5102,EC4203/ EC 4403

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Identify and analyze the fundamental steps in Image processing.
CO2 Characterize the hardware and software components of imaging systems.
CO3 Understand the models and interpret the spatial and frequency domain image processing algorithms and analyze and verify different image recognition techniques.
CO4 Apply the concepts and image processing tools for different image processing and pattern recognition applications.

TOPICS COVERED		lectures
Unit I	Fundamental concepts of digital geometry, Digital image representation, Fundamental steps, Image Processing systems, Image acquisitions, Storage, Communication, Display fundamentals. Elements of visual perception, Simple image model, Sampling and quantization, Basic relationships between pixels, neighbour of pixels, Connectivities, Relation, Equivalence and transitive clause, Distance measures, Arithmetic/logic operations	9
Unit II	Imaging Geometry: basic transformations, perspective transformations, Camera models; Photographic films- Film structure and exposure, film Characteristics diaphragm and shutter setting. Introduction to Fourier Transform, the discrete Fourier Transform, properties, separability, translation periodicity and conjugate symmetry, rotation, distributivity, and scaling, average value, Laplacian, convolution, and Correlation sampling, Fast Fourier Transforms, FFT algorithm, Inverse FFT , Implementation	8
Unit III	Image enhancement: Spatial domain methods, Frequency domain method, Enhancement by point processing , Simple intensity transforms, Histogram processing, Spatial filtering, Smoothing filters Image restoration : Degradation model, Degradation model for continuous Functions, algebra approach to restoration, Un-constrained restoration, constrained restoration, Removal of blur caused by uniform linear motion, Blind image, Deconvolution, Some algorithms.	8
Unit IV	Image coding- Redundancy, Interpixel redundancy, Measuring information, Information channel, Fundamental coding theorem, Image Segmentation , Line detection, Edge detection, Thresholding , Region splitting and merging.	8
Unit V	Image compression, Image compression models: The source encoder and decoder, Channel encoder and decoder, Error free compression, Variable length coding, Lossless predictive coding, Lossy compression: Lossy predictive coding, Transformed coding, Synthesis and analysis of image, Recognition, interpretition.	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Digital Image Processing Using Java, Efford, AWL, NY, 2000.
2. The Computer Image, A Watt and F.Policarpo AWL,NY, 1999
3. Fundamentals of Image Processing by A.K.Jain, PHI

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6023
TITLE OF COURSE: Modern Control Engineering
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5204

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz		20% of 100	100
		Mid-Semester Exam		30% of 100	
		End-Semester Exam		50% of 100	

COURSE OUTCOMES

CO1 Understand the State Space analysis, Controllability, Observability of control systems.
CO2 Analyse the stability of a system using JHRY criterion, Bilinear Transformation.
CO3 Analyse discrete control systems in Time Domain as well as in Frequency Domain, design of compensators.
CO4 Design feedback controllers in digital domain.

TOPICS COVERED		Lectures
Unit I	Review of Z-Transforms, State Space Representation of discrete time systems, State transition matrix and its Properties, Discretization of continuous time state-space equations, Controllability and Observability, Duality between	10

	Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.	
Unit II	Stability Analysis, Mapping between the S-Plane and the Z-Plane, Primary strips and Complementary Strips, Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane, Jury stability test, Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.	10
Unit III	Design of Discrete Time Control System, Transient and steady-State response Analysis, Design based on the frequency response method, Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.	12
Unit IV	State Feedback Controllers & Observers, Design of state feedback controller through pole placement, Ackerman's formula, State Observers .	10

TEXT BOOKS/ REFERENCES

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2 Edition.
2. Digital Control Systems , V. I. George, C. P. Kurian, Cengage Learning.
3. Modern Control Engineering, Gopal.
4. Digital Control Systems, Kuo, Oxford University Press, 2 Edition, 2003.
5. Digital Control and State Variable Methods by M.Gopal, TMH.

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6024

TITLE OF COURSE: **Optical Fiber Communication**

DESIGNATION: ~~REQUIRED~~ /ELECTIVE course

PRE-REQUISITES: EC5103

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0		3	3
COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz		20% of 100	
		Mid-Semester Exam		30% of 100	100
		End-Semester Exam		50% of 100	

COURSE OUTCOMES

CO1 Quantitatively analyze individual components of Optical Fiber Communication link.

CO2 Compute analog and digital optical fiber link design parameters.

CO3 Analyze optical source, Fiber and Detector operational parameters.

CO4 Understand, model and analyze the components of optical networking technology

TOPICS COVERED		Lectures
Unit I	Introduction: Advantage over other communication system. Optical wave guides-Ray theory of transmission, Total internal reflection, acceptance angle, Numerical aperture, skews rays.	6
Unit II	EM theory of optical propagation. Setup and graded index fibers, Modes and their coupling, single mode fiber, mode field diameter, spot size. Transmission characteristics of optical fiber- Intrinsic and Extrinsic absorption, Linear scattering, Fiber band loss, Material and waveguide dispersion, Intermodal dispersion, Modified single mode fiber.	8
Unit III	Optical sources-LASERS: Absorption and emission of radiation, Einstein relation, Population inversion, Optical feedback and threshold condition for laser oscillation. Optical emission from semiconductors- PN Junction, Spontaneous and stimulated emission and lasing. Heterojunctions, semiconductor injection laser, efficiency, Laser modes, Single mode operations, Injection Laser characteristics. LED structure- surface and edge emitters. LED characteristics-Optical output power, output spectrum, Modulation BW.	10
Unit IV	Optical detectors-Principles, Direct and Indirect absorption, Group 3 to 5 alloy. Quantum efficiency, p-n-p-n, Avalanche and p-i-n photodiode. Receiver structure-Low and high impedance front end.	8
Unit V	Optical amplification-Semiconductor Laser and fiber amplifier. Optical TDM, WDM. Transmission link analysis, Point to point links, System considerations, Link power budget, Rise time budget. Fiber attenuation measurements-Optical time domain reflecto-meter. Fiber fault location, Dispersion measurements.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. Optical Fiber Communication: Principles and Practice, 2nd Ed. John Senior, Prentice Hall of India, New Delhi., 1992
2. Optical Fiber Communication, 3rd Ed., G. Keiser, McGraw Hill International, New York, 2000

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6025

TITLE OF COURSE: Information Theory & Coding

DESIGNATION: ~~REQUIRED /~~ELECTIVE course

PRE-REQUISITES: EC 5203

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	100
			Mid-Semester Exam	30% of 100	
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Acquire the basic knowledge about entropy and Find nature of random signal and its statistical characteristics.

CO2 Understand how to make code optimum in containing information generated by source.

CO3 Find the technique to enhance the transmission efficiency of the system.

CO4 Understand different modulation techniques such as bandwidth limited and power limited also Find the technique to combat transmission impairments.

TOPICS COVERED		lectures
Unit I	Entropy: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality	**9**
Unit II	Asymptotic Equipartition Property: Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding	**9**
Unit III	Channel Capacity: Examples of Channel Capacity, 7.2 Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem	**6**
Unit IV	Block Codes Digital communication channel, Introduction to block codes, Single-parity check codes, Product codes, Repetition codes, hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request schemes Linear Codes Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error syndromes, Error detection and correction, Shortened and extended linear codes	**10**
Unit V	Convolution codes Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder	**8**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Joy A. Thomas, Thomas M. Cover, "Elements of information theory", Wiley-Inter science; 2 edition
2. S. Gravano, "Introduction to Error Control Codes" OUP Oxford
3. Robert B. Ash, "Information Theory", Dover Publications
4. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley, 2005
5. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6026
TITLE OF COURSE: VLSI Implementation of DSP Structures
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC4101/EC4301, EC5102

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	100
			Mid-Semester Exam	30% of 100	
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understand the overview of DSP concepts
CO2 Improve the speed of digital system through transformation techniques.
CO3 Perform Pipelining and parallel processing in FIR systems to achieve high speed and low power.
CO4 Perform Pipelining and parallel processing in IIR systems and adaptive filters and understand clocking issues and asynchronous system

TOPICS COVERED		Lectures
Unit I	An overview of DSP concepts, Representations of DSP algorithms. Loop bound and iteration bound.	6
Unit II	Transformation Techniques: Retiming, Folding and Unfolding	8
Unit III	Pipelining of FIR filters. Parallel processing of FIR filters. Pipelining and parallel processing for low power, Combining Pipelining and Parallel Processing. Systolic Architecture Design	10
Unit IV	Pipeline interleaving in digital filters. Pipelining and parallel processing for IIR filters. Low power IIR filter design using pipelining and parallel processing, Pipelined adaptive digital filters.	10
Unit V	Synchronous pipelining and clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining, Implementation of wave- pipelined systems, Asynchronous pipelining.	8

TEXT BOOK/ REFERENCE MATERIALS

1. "VLSI Digital Signal Processing Systems", K.K.Parhi, John-Wiley.
2. "Digital Signal Processing with FPGAs", U. Meyer -Baese, Springer.
3. "VLSI Signal Processing", W.Burleson, K. Konstantinides, T.H. Meng.
4. "Digital signal processing in VLSI", R.J. Higgins.
5. "VLSI and modern signal processing", S.Y.Kung, H.J. Whitehouse.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6027
TITLE OF COURSE: Analog Integrated Circuit
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC4200/EC4400, EC5101

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz		20% of 100	100
		Mid-Semester Exam		30% of 100	
		End-Semester Exam		50% of 100	

COURSE OUTCOMES

CO1 Analyze bias circuit using CMOS current mirror.
CO2 Design differential operational amplifier.
CO3 Analyze basic gm-C filter.
CO4 Analyze basic operation of PLL

TOPICS COVERED		Lectures
Unit I	Basic MOS Device Physics; MOS device models; Single State Amplifier: Common Source Stage; Source Follower; Common Gate Stage; Cascode Stage	8

Unit II	Differential Amplier: Basic Differential Pair; Common-Mode Response; Differential Pair with MOS Loads; Gilbert Cell; Passive and Active Current Mirrors: Cascode Current Mirrors; Active Current Mirror; Signal Analysis; Frequency Response of Amplifier;	10
Unit III	Noise: Statistical Characteristics of Noise; Types of Noise; Representation of Noise in Circuits; Noise in Single-stage Amplifier. Feedback: Feedback topologies; Effect of loading.	6
Unit IV	Operational Amplifier: Single-stage and Two stage Opamp; Stability and Frequency Compensation; Bandgap References; Introduction to Switched-Capacitor Circuits; Nonlinear and Mismatch.	10
Unit V	Oscillators: Ring, LC, VCO. Phase-Lock Loop: Charge-Pump PLL, Non-ideal effect in PLL; Delay Locked Loops. Short-Channel effects and Device Models.	8

TEXT BOOK/ REFERENCE MATERIALS

1. Design of Analog CMOS Integrated Circuits, B. Razavi, McGraw-Hill Science.
2. Analysis and Design of Analog Integrated Circuits, P. Gray, P. Hurst, S. Lewis, and R. Meyer, 5th Edition, Wiley.
3. Analog Integrated Circuit Design, T. Carusone, D. Johns and K. Martin, 4th Edition, Wiley.
4. CMOS Analog Circuit Design, Phillip E. Allen, Douglas R. Holberg , Oxford.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6028
TITLE OF COURSE: Semiconductor Devices Modelling
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: PH5101,EC5101

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Calculate carrier distributions in thermal equilibrium and non-thermal equilibrium conditions for intrinsic and doped semiconductors,
CO2 Apply basic semiconductor drift-diffusion equations and continuity of Fermi energy to determine current flow in semiconductor devices,
CO3 Determine alignment of metal-semiconductor band diagrams and identify whether a junction is Ohmic or Schottky
CO4 Design a BJT and MOSFET that meets specific performance criteria.

TOPICS COVERED

		Lectures
Unit I	Energy bands in 3D crystals, Density of States, Fermi-Dirac Statistics, Doping, Equilibrium Statistics, Equilibrium Concentration. Recombination-Generation, Bulk Recombination, Surface Recombination/Generation.	7
Unit II	Carrier Transport, Hall effect, Drift, Diffusion, Continuity Equation, Numerical Solution of Transport Equation.	10

Unit III	Electrostatics of P-N Junction Diodes, P-N Diode I-V Characteristics, Fermi Level Differences for Metals and Semiconductors, Schottky Diode I, Schottky Diode II, Non-ideal Effects, ac response, large signal response.	10
Unit IV	Introduction to Bipolar Junction Transistor, BJT design, Heterojunction BJT	8
Unit V	MOSFET Electrostatics, MOS capacitor frequency response, MOSFET IV characteristics, Non-ideal effects in MOSFET, Modern MOSFET. Reliability of MOSFET	7

TEXT BOOK/ REFERENCE MATERIALS

1. "Advanced Semiconductor Fundamentals", Robert F Pierret, Pearson Education, Volume VI Modular Series on Semiconductor Devices
2. "Semiconductor Device Fundamentals", Robert F Pierret, Pearson Education, Volume I Modular Series on Semiconductor Devices
3. "Operation and Modeling of the MOS Transistor", Tsividis, Y,Oxford University Press.
4. Fundamentals of Modern VLSI Devices, Taur and Ning, Cambridge Press, 1999.
5. "Physics of Semiconductor Devices ", S. M. Sze and K. K. Ng, 3rd Edition, Wiley-Interscience.
6. Introduction to Solid State Physics, C. Kittle, 7th Edition, Wiley.
7. Compound Semiconductor Device Physics, S S. Tiwari, Academic Press, 1991

DEPARTMENT: Electronics and Communication Engineering
COURSE NUMBER: EC 6029
TITLE OF COURSE: Modern Digital Communication Techniques
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC 5203

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS			
Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understand data conversion techniques.
CO2 Understand digital modulations.
CO3 Familiarize with digital data transmission techniques.
CO4 Familiarize with information theory and coding schemes.

TOPICS COVERED		**Lectures**
Unit I	Analog-to-Digital Conversion: Sampling theorem, Pulse-Amplitude Modulation, Channel bandwidth. Natural and Flat top sampling. Quantization of signals, Quantization error, Pulse-code modulation (PCM), Electrical representation of binary digits, PCM system, Companding, Multiplexing. Differential PCM, Delta modulation, Adaptive delta modulation, Vocoders, Channel Vocoder, Linear Predictive coder.	10
Unit II	Digital Modulation Techniques: Binary Phase-Shift Keying (BPSK), Differential Phase-Shift Keying, Differentially-Encoded PSK (DEPSK), Quadrature Phase-Shift Keying (QPSK), Quadrature Amplitude Shift Keying (QASK), Binary Frequency-Shift Keying (BFSK), Similarity of BPSK and BFSK, M-ary FSK, Minimum Shift Keying (MSK).	10
Unit III	Data Transmission: Baseband signal receiver, Probability of error. Matched Filter, Probability of error in Matched filter, Coherent reception of PSK and FSK, Non-Coherent reception of FSK, PSK and QPSK. Error probability of BPSK, BFSK and QPSK. Bit-by-bit encoding versus Symbol-by-Symbol encoding,	11

	Relationship between Bit error rate and Symbol Error rate, comparison of modulation systems.	
Unit IV	Information Theory and Coding: Discrete messages, information, Entropy, Information rate, coding to increase average information per bit. Shannon's theorem, Capacity of Gaussian channel, Bandwidth-S/N tradeoff, use of orthogonal signals to attain Shannon's limit, Efficiency of orthogonal signal transmission, Coding: Parity check bit coding, error detection and error correction coding, Block codes, Convolution codes, Comparison of error rates in coded and uncoded transmission.	11

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Electronic communications systems, Wayne Tomasi, Pearson Educaion Asia.
2. Principles of Communication Systems, Taub and Schilling TMH.
3. Digital Communication, S. Haykin, Wiley.
4. Analog and Digital Communication, S. Haykin, Wiley.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6030
TITLE OF COURSE: CMOS Mixed Signal Circuits.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC-5200

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	100
			Mid-Semester Exam	30% of 100	
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To understand the basic knowledge of continuous and discrete time filters.
CO2 To design the different types of DACs.

CO3 To design the different types of ADCs.
CO4 To analyse the various locked loops.

TOPICS COVERED

		Lectures
Unit I	Analog and discrete-time signal processing, Analog integrated continuous-time and discrete-time (switched-capacitor) filters.	9
Unit II	Basics of Digital to analog converters (DAC); DACs:Voltage, current, and charge scaling DACs, Cyclic DAC, Pipeline DAC.	12
Unit III	Basics of Analog to digital converters (ADC), Successive approximation ADCs. Dual slope ADCs, High-speed ADCs: Flash ADC, pipeline ADC and related architectures, High-resolution ADCs: Delta-sigma converters.	12
Unit IV	Mixed-Signal layout, Interconnects, Phase locked loops, Delay locked loops and their applications.	

TEXT BOOKS/ REFERENCE MATERIALS

1.CMOS mixed-signal circuit design by R. Jacob Baker Wiley India, IEEE press, reprint 2008.
2. CMOS circuit design, layout and simulation by R. Jacob Baker Revised second edition, IEEE press, 2008.
3. Design of analog CMOS integrated circuits by Behad Razavi McGraw-Hill, 2003

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6031.

TITLE OF COURSE: Micro Electro Mechanical System (MEMS).

DESIGNATION: ~~REQUIRED /~~ELECTIVE course

PRE-REQUISITES:

COURSE DETAILS:

Lecture	Tutorial	Practical's	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

100

COURSE OUTCOMES

CO1

CO2 Acquire the basic knowledge about MEMS and micro fabrication.

CO3 Understand about design Processes and technology used for MEMS Structure.

CO4 Explore various fabrication and machining process of Micro systems.

Recognise the real time issues and requirement in industry

TOPICS COVERED

		Lectures
Unit I	Introduction to MEMS and Micro Systems: MEMS and Microsystems, Typical MEMS and Microsystem Products, Evolution of Microfabrication, Microsystems and Microelectronics, The Multidisciplinary Nature of Microsystem, Applications of Microsystems in the Automotive Industry, Applications of Microsystems in Other Industries.	**9**
Unit II	Working Principles of Microsystems: Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers	**8**
Unit III	Engineering Mechanics for Microsystem Design: Introduction, Static bending of thin plates, Mechanical Vibration, Thermo mechanics, Fracture mechanics, Thin Film mechanics, Use of FEA in MEMS structures.	**8**
Unit IV	Scaling Laws in Miniaturization: Introduction to Scaling, scaling in Geometry, scaling in Rigid-Body Dynamics, The Trimmer Force Scaling Vector, scaling in Electrostatic Forces, scaling in Electromagnetic Forces, scaling in Electricity.	**8**
Unit V	Microsystem Materials: Molecular Theory and Intermolecular Forces, Silicon Piezo Resistors, Microsystem Fabrication Process: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Etching, Applications of MEMS in Automatic-Telecom and Other Industries.	**9**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Gregory T. A. Kovacs, " Micromachined Transducers Source books" , The McGraw- Hill, Inc. 1998.
2. Tai,Ran Hsu, "MEMS & Microsystems Design & Manufacture", Tata Mc Graw Hill,2002
3. Stephen D. Senturia, "Microsystem Design" , Kluwar Publishers, 2001.
4. M. H. Bao, " Micro Mechanical Transducers, Volume 8, Handbook of Sensors and Actuators", Elsevier. 2000.
5. Masood Tabib-Azar, "Microactuators", Kluwer, 1998.
6. Ljubisa Ristic, "Sensor Technology and Devices", Artech House, 1994.

7. James M Gere and Stephen P Timoshenko, “Mechanica of Meterials”, 2nd Edition, Brooks / Cole Engineering Division 1984.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6032
TITLE OF COURSE: Nano electronics.
DESIGNATION: ELECTIVE course
PRE-REQUISITES: EC5101

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 To explain challenges due to scaling on CMOS devices, VLSI circuit design and fundamental limits of operation.
CO2 To analyse and explain working of novel MOS based silicon devices and various multi gate devices.
CO3 To analyse and explain working of SOI devices and their performance comparison with Silicon devices.
CO4 To understand Nano electronic systems and building blocks such as: low-dimensional semiconductors, hetero structures, carbon nanotubes, quantum dots, nanowires etc

TOPICS COVERED **lectures**

Unit I	Challenges going to sub- 100 nm MOSFETs -Oxide layer thickness, tunnelling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, subthreshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation. High-K gate dielectrics, effects of high- K gate dielectrics on MOSFET performance.	8hrs
Unit II	Novel MOS- based devices – Multiple gate MOSFETs, Silicon-on-nothing, Silicon-on-insulator devices, FD SOI, PD SOI, Fin-FETs, vertical MOSFETs, strained Si devices.	8hrs
Unit III	Hetero structure based devices –Type I, II and III Heterojunction, Si-Ge hetero-structure, hetero structures of III - V and II-VI compounds -resonant tunnelling devices, MODFET/HEM.	8hrs
Unit IV	Carbon nanotubes based devices –CNFET, characteristics, Spin-based devices –spin FET, characteristics.	9hrs
Unit V	Quantum structures –quantum wells, quantum wires and quantum dots, Single electron devices –charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.	9hrs

TEXT BOOK

1. Nanoelectronics – Principles & devices, Mircea Dragoman and Daniela Dragoman.
2. Nanoelectronics and Nanosystems, Karl Goser.
3. Nanoscale Transistors, Device Physics, Modeling and Simulation: Mark Lundstrom and Jing Guo.
4. Physics of Quantum Well Devices, Springer 2002, B.R. Nag

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6033
TITLE OF COURSE: **Introduction to Plasmonics**
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5103

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100
		Mid-Semester Exam	30% of 100
		End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Understand the electromagnetic of metals

CO2 Understand and analyze the surface Plasmon polariton at single and multilayer system
CO3 Understand the different concept of excitation technique of surface Plasmon polariton
CO4 Apply the physics of plasmonics for plasmon waveguide

TOPICS COVERED		Lectures
Unit I	ELECTROMAGNETICS OF METALS: Maxwell's Equations and Electromagnetic Wave Propagation, the Dielectric Function of the Free Electron Gas ,The Dispersion of the Free Electron Gas and Volume Plasmons, Real Metals and Interband Transitions ,The Energy of the Electromagnetic Field in Metals	8
Unit II	SURFACE PLASMON POLARITONS AT METAL / INSULATOR INTERFACES: The Wave Equation, Surface Plasmon Polaritons at a Single Interface, Multilayer Systems, Energy Confinement and the Effective Mode Length	7
Unit III	EXCITATION OF SURFACE PLASMON POLARITONS AT PLANAR INTERFACES: Excitation upon Charged Particle Impact, Prism Coupling,Grating Coupling, Excitation Using Highly Focused Optical Beams, Near-Field Excitation, Coupling Schemes Suitable for Integration with Conventional Photonic Elements	8
Unit IV	ELECTROMAGNETIC SURFACE MODES AT LOW FREQUENCIES Surface Plasmon Polaritons at THz Frequencies , Designer Surface Plasmon Polaritons on Corrugated Surfaces ,Surface Phonon Polaritons	4
Unit V	PLASMON WAVEGUIDES Planar Elements for Surface Plasmon Polariton Propagation , Surface Plasmon Polariton Band Gap Structures,Surface Plasmon Polariton Propagation Along Metal Stripes, Metal Nanowires and Conical Tapers for High-Confinement Guiding and Focusing Localized Modes in Gaps and Grooves	6

TEXT BOOKS/ REFERENCE MATERIAL

1. S. A. Maier, Plasmonics: Fundamentals and Applications
2. Heinz Raether , "Surface Plasmons on Smooth and Rough Surfaces and on Gratings

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6034
TITLE OF COURSE: Speech Processing
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES: EC5102

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz Mid-Semester Exam End-Semester Exam	20% of 100 30% of 100 50% of 100	100

COURSE OUTCOMES

CO1 Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO2 Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO3 Apply genetic algorithm to combinational optimization problems.
CO4 Apply neural networks to pattern classifications and regression problems. And compare solutions by various soft computing approaches for a given problem.

TOPICS COVERED		lectures
Unit I	Introduction to fundamentals of digital speech processing: Speech signal, storage, synthesis, speaker verification, identification and recognition, Discrete times systems, sampling, FIR and IIR Digital Filters.	**7**
Unit II	Models of the speech signals: Speech production, acoustic theory, digital models of speech signals, Vocal tract, time dependent processing of speech, pitch, speech and silence discrimination.	**9**
Unit III	Digital representation of speech waveform: Sampling speech signal, statistical speech models, instantaneous, quantization, adaptive quantization, differential quantization, delta modulation, differential PCM, and Direct digital code conversion.	**9**
Unit IV	Short Term Fourier Analysis, digital filter banks, spectrographic displays, pitch detection, Analysis by synthesis system, Homomorphic Speech Processing, Homomorphic systems for convolution, Complex Speech Spectrum, Pitch detection and formant estimation, homomorphic vocoder.	**8**
Unit V	Linear Predictive coding of speech: Linear predictive analysis, Gain computation, Prediction error signal, Frequency domain interpretation, Applications of LPC parameters and speech synthesis.	**9**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. "Digital Processing of Speech Signals", Lawrence Rabiner, Ronald W. Schafer, Macmillan Publishing, 1993.
2. "The Scientist and Engineer"s Guide to Digital Signal Processing", Steven W. Smith, California Technical Publishing, 1997.
3. "Discrete-Time Speech Signal Processing – Principles and Practice", Thomas F Quatieri, Pearson Education, 2004.
4. "Speech Recognition", Claudio Becchetti and Lucio Prina Ricotti, John Wiley and Sons, 1999.
5. "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Ben Gold and Nelson Morgan, Wiley- India Edition, 2006.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6035
TITLE OF COURSE: Satellite Communication
DESIGNATION: ~~REQUIRED~~ / ELECTIVE course
PRE-REQUISITES: EC5203

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz Mid-Semester Exam End-Semester Exam	20% of 100 30% of 100 50% of 100	100

COURSE OUTCOMES

CO1 Acquire knowledge on orbital mechanics of satellite communication systems.

CO2 Knowledge on satellite and earth segments , analyze and evaluate a satellite link budget with impairement analysis to improve the link performance.

CO3 Select an appropriate modulation, multiplexing, and multiple access scheme for satellite communication link.

CO4 know about coding for digital satellite links and analyze and design satellite applications.

TOPICS COVERED		**Lectures**
Unit I	Orbital mechanics: locating the satellite in the orbit w.r.t. earth look angle determination, Azimuth & elevation calculations, limits of visibility, eclipse, sun-transit outage, launches and launch vehicle.	8
Unit II	Space segment, Earth segment and Satellite link design: Attitude and Orbit control system, Telemetry, tracking and command (TT&C), communications subsystems, Transponders, Spacecraft antennas. Earth station antennas, Amplifiers, Converters, Reliability, basic transmission theory of satellite link, noise figure and noise temperature, satellite uplink and down link analysis and design, link budget, C/N calculation-propagation impairments.	10
Unit III	Satellite access: Analog telephone transmission, FM theory, FM Detector theory, analog TV transmission, S/N ratio Calculation for satellite TV linking, Digital transmission- base band and band pass transmission of digital data, M-PSK, FSK, Access techniques: FDMA, TDMA, CDMA, Assignment methods, Spread Spectrum Communication.	8
Unit IV	Error control: Encoding & FEC for Digital satellite links: Channel capacity, error detection and correction coding, linear block codes, binary cyclic codes, and convolution codes.	8
Unit V	Satellite applications: VSAT technology, Mobile satellite services: GSM, GPS, Satellite navigation system, Direct Broadcast satellite (DBS), Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, E-mail, Video conferencing, Internet.	8

TEXT BOOKS/ REFERENCES

1. Satellite communication, Timothy Pratt, Charles W. Bostian, John Wiley &sons, Publication, 2003 .
2. Digital Satellite Communications, Tri T. Ha, 2nd Edition, Tata McGraw Hill.
3. Satellite Communication, Dennis Roddy, 4th Edition, Mc Graw Hill International, 2006
4. Satellite Communication Systems Engineering, Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Prentice Hall/Pearson, 2007
5. The Satellite Communication Applications, Bruce R. Elbert, Hand Book, Artech House Bostan London, 1997.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6036
TITLE OF COURSE: Biomedical Engineering
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES:

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Understanding biomedical signals and specifically cardiological signals like ECG
CO2 Analyzing biomedical signals in Frequency domain
CO3 Spectral Analyzing of biomedical signals
CO4 Understanding adaptive filtering of biomedical signals

TOPICS COVERED		lectures
Unit I	Introduction: General measurement and diagnostic system, classification, Biomedical signal acquisition, difficulties in signal acquisition. ECG: signal origin,	8

	parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system	
Unit II	ECG Data Reduction, compression: Turning Point, AZTEC, Cortes, FAN, Transformation, Karhunen - Loeve Transform, DPCM, Huffman coding, Data compression. Signal averaging: Basics, Signal averaging as a digital filter, A typical averager, Software and limitations	8
Unit III	Frequency Domain Analysis, Spectral analysis, linear filtering, cepstral analysis and homomorphic filtering. Removal of high frequency noise, motion artefacts and power line interference in ECG, Time Series Analysis: AR models, Estimation of AR parameters, ARMA models. Spectral modelling and analysis of PCG signals	8
Unit IV	Spectral Estimation, Evaluation of prosthetic heart valves using PSD techniques. Comparison of the PSD estimation methods. Event Detection and waveform analysis: Identification of heart sounds, Morphological analysis of ECG waves and activity	9
Unit V	Adaptive Filtering: Introduction, General structure, LMS, adaptive noise cancellation in ECG, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG. EEG: EEG signal characteristics, Sleep EEG classification and epilepsy	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. "Biomedical Signal Analysis" A case study approach, Rangaraj M Rangayyan, John Wiley publications.
2. "Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)", Arnon Cohen, CRC press.
3. "Biomedical Signal Processing Principles and Techniques" D.C.Reddy, Tata Mc Graw-Hill
4. "Biomedical Digital Signal Processing", Willis J. Tompkins, PHI.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6037
TITLE OF COURSE: Wireless Sensor Networks.

DESIGNATION: ~~REQUIRED /~~ ELECTIVE course
PRE-REQUISITES: EC4203, EC 4403

COURSE DETAILS:

Lecture	Tutorial	Practical's	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Understanding of various aspects of wireless sensor networks, describe the concepts, implementation, and use of wireless sensor networks.
CO2 Discuss the challenges in designing MAC, routing and transport.
CO3 Describe protocols for wireless ad-hoc/sensor networks
CO4 Describe and implement protocols on a sensor testbed network and propose, implement, and evaluate new ideas for solving wireless sensor network design issues.

TOPICS COVERED		**Lectures**
Unit I	Introduction: Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture, Hardware components, Energy consumption of sensor nodes, Network architecture, Sensor network scenarios, Design principles.	**9**

	Physical Layer: Introduction, wireless channel and communication fundamentals, physical layer and transceiver design consideration in wireless sensor networks, Example physical Layers Bluetooth, IEEE 802.11b, WINS, µAMPS	
Unit II	Data Link Layer: MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, LEACH, Link Layer protocols, Error control, Framing.	**8**
Unit III	Network Layer: Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data centric and content-based networking, Data aggregation	**8**
Unit IV	Applications: Target detection tracking, Habitat monitoring, Military battlefield awareness Environmental disaster monitoring, Underwater Acoustic and Deep space networks, Wireless Body Area Networks (WBAN) for health-monitoring, Open issues and Design challenges.	**9**
Unit V	Case Study: Security in Sensor networks, Localization, IEEE 802.15.4 low rate WPAN, Practical implementation issues, Sensor Node Hardware- Node-level software platforms, Node-level simulators.	**8**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Holger Karl, Andreas willig "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Oct 2007
2. Feng Zhao, Leonidas Guibas, Elsivier , "Wireless Sensor Networks: an information processing approach –publication, 2004.
3. Edgar H. Callaway, "Wireless Sensor Networks : Architecture and Protocol", CRC press 2003 First Edition.
4. C S Raghavendra Krishna, M Sivalingam and Tarib Znati, "Wireless Sensor Networks" Springer publication, 2006

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6038
TITLE OF COURSE: Digital Signal Processors and Applications.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5100, EC5102

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1	Recognize the fundamentals of fixed and floating point architectures of various DSPs.
CO2	Learn the architecture details and instruction sets of fixed and floating point DSPs
CO3	Infer about the control instructions, interrupts, and pipeline operations.
CO4	Comprehend the features of on-chip peripheral devices and its interfacing along with its programming details.

TOPICS COVERED

		Lectures
Unit I	Difference between DSP and other microprocessor architectures. An overview of Motorola and Analog Device DSPs.	7
Unit II	TMS320C54X fixed point and TMS320C3X floating point DSP architectures, CPU, memory, buses and peripherals. Addressing modes, instruction sets , control operations, interrupts.	9
Unit III	Repeat operations. Pipeline operation. Pipeline conflicts and programming concepts.	10
Unit IV	Interfacing, serial interface, parallel interface, DMA operations, A/D and D/A converter interfaces.	10

Unit V	DSP tools. DSP applications. MAC, filter design, implementation of DFT, echo cancellation, spectrum analyzer. Speech and video processing. Architecture of other DSPs.	6

TEXT BOOKS/ REFERENCE MATERIALS

1. Digital Signal Processor, Architecture, Programming and Applications, B. Venkataramani & M. Bhaskar, (2/e), McGraw- Hill.
2. Digital Signal Processing, Implementations using DSP Microprocessors, S. Srinivasan & Avtar Singh,Brooks/Cole.
3. Digital Signal Processors: Architectures, Implementations, and Applications, Sen M. Kuo & Woon-Seng S. Gan, Prentice Hall.
4. A Simple approach to digital signal processing, C. Marven & G. Ewers,Wiley Inter science.
5. Digital Signal Processing: Theory, Applications and Hardware, R.A. Haddad & T.W. Parson, Computer Science Press NY.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6039
TITLE OF COURSE: Digital Integrated Circuit
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5200, EC 6100

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Assess the quality metrics of a digital design and understand the impact of technology scaling.
CO2 Know how to determine the VTC of a CMOS inverter and compute its noise margins and design a CMOS inverter that meets certain delay and power specifications
CO3 Know how to analyze and design complex logic gates in standard CMOS technology, and compute their delay and power consumption and know the method of logical effort. How to design arithmetic circuits.
CO4 Be able to analyze and design static sequential circuits and understand basic clocking issues and the impact of interconnect parasitics on circuit performance and signal integrity.

TOPICS COVERED		Lectures
Unit I	Challenges in Digital IC Design, MOS device model with Sub-micron effects, VTC parameters DC characteristics.	7
Unit II	CMOS INVERTER: CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Supply and Threshold Voltage Scaling, Components of Energy and Power Switching, Short-Circuit and Leakage Components SPICE Simulation Techniques	10
Unit III	COMBINATIONAL LOGIC: Pass Transistor / Transmission Gate Logic DCVSL, Introduction to Dynamic Logic, Dynamic Logic Design Considerations Power	10

	Dissipation in CMOS, Leakage Power Dissipation, Logical Effort Sizing - Performance Optimization of Digital Circuits ARITHMETIC STRUCTURES: Adders, Multipliers, Shifters, Design Methodology, Layout Techniques and Mapping	
Unit IV	SEQUENTIAL CIRCUIT: Classification / Parameters Static Latches and Register, Race Condition, Dynamic Latches and Registers, Two Phase vs. Single Phase, Pulse Based Registers, Latch vs. Register Systems, Metastability	10
Unit V	INTERCONNECT: Capacitance Estimation, Buffer Chains, Low Swing Drivers, Power Distribution, Issues in Timing - Impact of Clock Skew and Jitter CLOCK DISTRIBUTION: Origins of Clock Skew / Jitter and Impact on Performance, Clock Distribution Techniques, Self-timed Circuits	5

TEXT BOOK/ REFERENCE MATERIALS

1. Digital Integrated Circuits - A Design Perspective, Jan M Rabaey, Prentice Hall,
2. CMOS Digital Integrated Circuits - Analysis & Design, Sung-Mo Kang & Yusuf Leblebici, MacGraw Hill.
3. CMOS circuit design, layout, and simulation, R. J. Baker, H. W. Li, and D. E. Boyce, Wiley-IEEE Press, 2007
4. Analysis and Design of Digital Integrated Circuits, David A. Hodges, Horace G. Jackson, and Resve A. Saleh, McGraw-Hill.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6040
TITLE OF COURSE: Advanced Computer Architecture.
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC 5100

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

	Assignments & Quiz	20% of 100	
Theory	Mid-Semester Exam	30% of 100	100
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Study the architectures and elements of computer and basic classification of parallel processing.
CO2 Study the different types of data processor arithmetic circuit of CPU and control unit design
CO3 Understand memory hierarchies used in computer and information flow in computers
CO4 Understand the basic idea of parallel processing and parallel computing.

TOPICS COVERED

		Lectures
Unit I	Introduction: review of basic computer architecture, quantitative techniques in computer design, measuring and reporting performance. Evolution of computer architectures, different generations. CISC and RISC processors, Flynn's Classification	6
Unit II	CPU Design: ALU organization , Serial and Parallel Adder, implementation of high speed Adder Carry Look Ahead and carry Save Adder; Multiplication of signed binary numbers-Booth's algorithm, Divide algorithms- Restoring and Non-Restoring, Floating point number arithmetic, Hardwired control, Micropragammed control, practical aspects of circuit implementations.	12
Unit III	Hierarchical memory technology: Inclusion, Coherence and locality properties. Cache memory organizations, Techniques for reducing cache misses, Virtual memory organization, mapping and management techniques, memory replacement policies.	8
Unit IV	Pipelining : Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards, and structural hazards, techniques for handling hazards. Exception handling, Pipeline optimization techniques, Compiler techniques for improving performance.	6
Unit V	Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures, Array and Vector processors.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. Computer Organization,Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Mc Graw Hill International
2. Computer Architecture and Organization, J.P.Hayes Mc Graw Hill International
3. Advanced Computer Architecture, Kai Hwang, McGraw Hill International.
4. Computer Organization and Architecture, William Stallings, Macmillan Publishing Company.
5. Designing Efficient Algorithms for Parallel Computers, M.J. Quinn, McGraw Hill International.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6041
TITLE OF COURSE: Low Power VLSI Design
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC 5100 and EC 5200

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

100

COURSE OUTCOMES

CO1 To understand the need for low power CMOS design and power analysis
CO2 To gain knowledge on low power circuit design styles for VLSI circuits.
CO3 Study the advanced technique of low power VLSI circuit.
CO4 Study of low power VLSI circuit from architecture point of view

TOPICS COVERED

		Lectures
Unit I	Introduction: Introduction to low power VLSI design-Need for low power-CMOS leakage current-static current- Basic principles of low power design-probabilistic power analysis-random logic signal-probability and frequency-power analysis techniques-signal entropy	10
Unit II	Circuit level and logic level design: Circuit - transistor and gate sizing; pin ordering, network restructuring and reorganization, adjustable threshold voltages; logic-signal gating; logic encoding.	10
Unit III	Special low power VLSI design techniques: Power reduction in clock networks - CMOS floating node - low power bus - delay balancing, Low power technique for SRAM, Adiabatic computation, Pass transistor	12
Unit IV	Architecture and System: Power and performance management, Switching activity reduction, Parallel architecture with voltage reduction.	10

TEXT BOOKS/ REFERENCE MATERIAL

1. Practical Low Power Digital VLSI Design, Gary Yeap, Springer US, Kluwer Academic Publishers.
2. Low power CMOS VLSI circuit design, Kaushik Roy, Sharat C. Prasad, Wiley Inter Science Publications.
3. Low Voltage Low Power VLSI Subsystems, Kiat-Seng Yeo, Kaushik Roy, Tata Mc-Graw Hill.
4. Basic VLSI Design, Douglas A.Pucknell & Kamran Eshraghian, 3 rd edition, PHI.
5. Digital Integrated circuits, J.Rabaey, PH.

DEPARTMENT:	Electronics and Communication Engineering.				
COURSE NUMBER:	EC-6042				
TITLE OF COURSE:	Introduction to Computing and programming using Python				
DESIGNATION:	~~REQUIRED~~ /ELECTIVE course				
PRE-REQUISITES:	ES-3100 and basics of computer programming				
COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz		20% of 100	100
		Mid-Semester Exam		30% of 100	
		End-Semester Exam		50% of 100	

COURSE OUTCOMES

CO1 Learn a language for expressing computations—Python
CO2 Learn about the process of writing and debugging a program
CO3 Learn about the process of moving from a problem statement to a computational formulation of a method for solving the problem
CO4 Learn a basic set of "recipes"—algorithms

TOPICS COVERED		Lectures
Unit I	Introduction to Python – Some numerical programs – Function and Abstraction by specifications -	6
Unit II	Structured Types, Mutability, Higher Order functions – Testing and Debugging – Exceptions and Assertions – Classes and Object-oriented Programming	9
Unit III	Floating point architecture. Expressions. Conditional statements. Loops. Functions and procedures. Run time environment.	9
Unit IV	A simplistic introduction to algorithmic complexity – some simple algorithms and data structures – Plotting and more about classes – Stochastic Programs, Probability and statistics – Random walk and more data visualizations.	10
Unit V	Monte-Carlo Simulation – Understanding experimental data – Lies, Danned lies and Statistics – Knapsback and Graph optimization problems – Dynamic Programming.	8

TEXT BOOK/ REFERENCE MATERIALS

1. Introduction to Computation and Programming Using Python. Guttag, John.
2. Think Python: How to Think Like a Computer Scientist, Allen B. Downey, Dreamtech.
3. Python For Data Analysis, W Mckinney, ORielly.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6043
TITLE OF COURSE: VLSI Digital Signal Processing Systems
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC5102

COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 learn various transforms and its corresponding architectures
CO2 acquire the knowledge of effect of round off noise computation
CO3 design Bit level arithmetic Architectures and optimize the implementation of FIR filters and constant multipliers
CO4 design basic arithmetic units and realize their architecture for higher radices and learn different numerical strength reduction techniques

TOPICS COVERED		Lectures
Unit I	Algorithms for fast convolution, Algorithmic strength reduction in filters and transforms: Parallel FIR Filters, DCT and inverse DCT, Parallel Architectures for Rank-Order Filters.	6
Unit II	Scaling and Round off Noise - State variable description of digital filters, Scaling and Round off Noise computation, Round off Noise in Pipelined IIR Filters, Round off Noise Computation using state variable description, Slow-down, Retiming and Pipelining.	10
Unit III	Bit level arithmetic Architectures- parallel multipliers, interleaved floor-plan and bit-plane-based digital filters, Bit serial multipliers, Bit serial filter design and implementation, Canonic signed digit arithmetic, Distributed arithmetic.	10
Unit IV	Redundant arithmetic -Redundant number representations, carry free radix-2 addition and subtraction, Hybrid radix-4 addition, Radix-2 hybrid redundant multiplication architectures, data format conversion, Redundant to Non-redundant converter.	10
Unit V	Numerical Strength Reduction - Subexpression Elimination, Multiple Constant Multiplication, Subexpression Sharing in Digital Filters, Additive and Multiplicative Number Splitting.	6

TEXT BOOK/ REFERENCE MATERIALS

1. "VLSI Digital Signal Processing Systems", K.K.Parhi, John-Wiley.
2. Digital Signal Processing with FPGAs, U. Meyer -Baese, Springer.
3. Digital signal processing in VLSI, Richard J. Higgins.
4. VLSI Design Methodologies for Digital Signal Processing, Magdy A. Bayoumi.
   VLSI and modern signal processing, Sun Yuan Kung, Harper J. Whitehouse.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6044
TITLE OF COURSE: ARM System Architecture
DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
RE-REQUISITES: EC4202/EC4402/EC5201

COURSE DETAILS:	Lecture	Tutorial	Practical	Contact Hours	Credits
	3	0	0	3	3

COURSE ASSESSMENT METHODS	Theory	Assignments & Quiz	20% of 100	100
		Mid-Semester Exam	30% of 100	
		End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Describe the programmer's model of ARM processor and create and test assembly level programming.
CO2 Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
CO3 Analyze floating point processor architecture and its architectural support for higher level language.
CO4 Become aware of the Thumb mode of operation of ARM.

TOPICS COVERED		Lectures
Unit I	RISC machine. ARM programmer's model. ARM Instruction Set. Assembly level language programming. Development tools.	10
Unit II	ARM organization. ARM instruction execution. ARM implementation. ARM coprocessor interface. . Interrupt response.	10
Unit III	Floating point architecture. Expressions. Conditional statements. Loops. Functions and procedures. Run time environment.	10
Unit IV	Thumb programmer's model. Thumb Instruction set. Thumb implementation.	12

TEXT BOOK/ REFERENCE MATERIALS

1. ARM System Architecture, S. Furber, Addison-Wesley.
2. ARM system Developer's guide, Andrew Sloss, Dominic Symes & Chris Wright, Elsevier.
3. Technical reference manual for ARM processor cores, including Cortex, ARM 11, ARM 9 & ARM 7 processor families.
4. User guides and reference manuals for ARM software development and modeling tools.
5. ARM Architecture Reference Manual, David Seal, Addison-Wesley.

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6045.

TITLE OF COURSE: Machine Learning

DESIGNATION: ~~REQUIRED /~~ELECTIVE course

PRE-REQUISITES: Linear Algebra

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100	100
	Mid-Semester Exam	30% of 100	
	End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.

CO2 Have an understanding of the strengths and weaknesses of many popular machine learning approaches.

CO3 Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

CO4 Be able to design and implement various machine learning algorithms in a range of real-world applications.

TOPICS COVERED

		lectures
Unit I	Introduction, linear classification, perceptron update rule Perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization, logistic regression	8
Unit II	Supervised learning: Supervised learning setup. LMS. Logistic regression. Perceptron. Exponential family. Generative learning algorithms. Gaussian discriminant analysis. Naive Bayes. Support vector machines. Model selection and feature selection. Ensemble methods: Bagging, boosting. Evaluating and debugging learning algorithms.	9
Unit III	Learning theory: Bias/variance tradeoff. Union and Chernoff/Hoeffding bounds. VC dimension. Worst case (online) learning. Practical advice on how to use learning algorithms.	8
Unit IV	Unsupervised learning: Clustering. K-means. EM. Mixture of Gaussians. Factor analysis. PCA (Principal components analysis). ICA (Independent components analysis).	8
Unit V	Reinforcement learning and control: MDPs. Bellman equations. Value iteration and policy iteration. Linear quadratic regulation (LQR). LQG. Q-learning. Value function approximation. Policy search. Reinforce. POMDPs.	9

TEXT BOOK

1. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.

REFERENCE MATERIALS

1. MacKay, David. Information Theory, Inference, and Learning Algorithms. . Cambridge, UK: Cambridge University Press, 2003. ISBN: 9780521642989.
2. Hastie, T., R. Tibshirani, and J. H. Friedman. The Elements of Statistical Learning: Data Mining, Inference and Prediction. New York, NY: Springer, 2001. ISBN: 9780387952840.
3. Dutta, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
4. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.

List of open electives for students of other departments

DEPARTMENT:	Electronics and Communication Engineering.				
COURSE NUMBER:	EC-6091.				
TITLE OF COURSE:	Data Compression.				
DESIGNATION:	~~REQUIRED~~ /ELECTIVE course.				
PRE-REQUISITES:					
COURSE DETAILS:	Lecture	Tutorial	Practicals	Contact Hours	Credits
	3	0	0	3	3
COURSE ASSESSMENT METHODS	Theory		Assignments & Quiz	20% of 100	100
			Mid-Semester Exam	30% of 100	
			End-Semester Exam	50% of 100	

COURSE OUTCOMES

CO1 Understand the conceptual and statistical basis for commonly used lossy and lossless compression techniques.

CO2 Understand the difference between a static compression technique from an adaptive one.

CO3 Apply the concept of scalar and vector quantization to various techniques like data correction, pattern recognition, density estimation and clustering.

CO4 Understand and apply the concept of transform coding to audio signals and video signals.

TOPICS COVERED		Lectures
Unit I	Information theoretic foundations: Lossless and lossy compression ,Modeling and coding Entropy, conditional entropy, information, channels Data models: static and adaptive Coding: Fano, Huffman, Golomb, Rice, Tunstall	6
Unit II	Arithmetic coding: Encoding ,Decoding ,Adapatation . Dictionary techniques: Static techniques ,Adaptive coding: the LZ family	9
Unit III	Context modeling: PPM ,Burrows-Wheeler ,Move-to-front ,DMC, Lossless image compression: Multiresolution CCITT Group 3 and 4 ,JBIG, JBIG2 , Lossy coding preliminaries: Distortion ,Rate distortion ,Linear system models ,	8
Unit IV	Scalar and vector quantization: Uniform and nonunform quantizers , Adaptive quantization , Lloyd-Max quantizer ,LBG quantizer ,Tree-structured quantizers ,Trellis-coded quantization	7
Unit V	Differential encoding: Predictive DPCM ,Adaptive DPCM ,Delta modulation	6
Unit VI	Transform coding: Bases, inner products, orthogonality and orthonormality ,Karhunen-Loéve transform ,DCT , Walsh-Hadamard transform ,JPEG	6

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Sayood, Khalid, Introduction to Data Compression, 3rd Edition, Morgan Kaufmann, 2006.
2. Anderson, J.B. and Mohan, S., Source and Channel Coding, Kluwer, 1991.
3. Gersho, A. and Gray, R.M., Vector Quantization and Signal Compression, Kluwer, 1992.
4. Netravali, A.N., Digital Pictures, Representation and Compression, Plenum, 1989.
5. Rao, K.R. and Yip, P., Discrete Cosine Transform, Academic Press, 1990.
6. Storer, J.A., Data Compression Methods and Theory, Computer Science Press, 1988.
7. Williams, R.N., Adaptive Data Compression, Kluwer, 1991.
8. Ash, Robert B., Information Theory, John Wiley and Sons, 1965
9. Bell, T.C., Cleary, J.G., and Witten, I.H., Text Compression, Prentice Hall, 1990.
10. Witten, I.H., Moffat, A., and Bell, T.C., Managing Gigabytes, 2nd Edition, Morgan Kaufmann, 1999

DEPARTMENT:	Electronics and Communication Engineering.
COURSE NUMBER:	EC-6092
TITLE OF COURSE:	Digital Image Processing
DESIGNATION:	~~REQUIRED~~ /ELECTIVE course.
PRE-REQUISITES:	EC5102,EC4203

COURSE DETAILS:

Lecture	Tutorial	Practical	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	0.30*75	75
	Mid-Semester Exam	0.50*75	
	End-Semester Exam	0.20*75	
Practical	Class Work & Viva	0.7*25	25
	Practical Exam	0.3*25	

COURSE OUTCOMES

CO1	Identify and analyze the fundamental steps in Image processing.
CO2	Characterize the hardware and software components of imaging systems.
CO3	Understand the models and interpret the spatial and frequency domain image processing algorithms and analyze and verify different image recognition techniques.
CO4	Apply the concepts and image processing tools for different image processing and pattern recognition applications.

TOPICS COVERED		Lectures
Unit I	Fundamental concepts of digital geometry, Digital image representation, Fundamental steps in image processing, Elements of digital image Processing systems, Image acquisitions, Storage, Processing, Communication, Display digital image fundamentals. Elements of visual perception, Simple image model, Sampling and quantization, Basic relationships between pixels, neighbour of pixels, Connectivities, Relation, Equivalence and transitive clause, Distance measures , Arithmetic/logic operations	6
Unit II	Imaging Geometry: basic transformations, perspective transformations, Camera models; Photographic films- Film structure and exposure, film Characteristics diaphragm and shutter setting. Introduction to Fourier Transform, the discrete Fourier Transform, some properties of two dimensional Fourier Transform, separability, translation periodicity and conjugate symmetry, rotation, distributivity, and scaling, average value, Laplacian, convolution, and Correlation sampling, Fast Fourier Transforms, FFT algorithm, Inverse FFT , Implementation	9
Unit III	Image enhancement: Spatial domain methods, Frequency domain method, Enhancement by point processing , Simple intensity transforms, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing filters Image restoration : Degradation model, Degradation model for continuous Functions, algebra approach to restoration, Un-constrained restoration, constrained restoration, Removal of blur caused by uniform linear motion, Blind image, Deconvolution, Some algorithms.	8
Unit IV	Image coding- Redundancy, Interpixel redundancy, Measuring information, Information channel, Fundamental coding theorem, Image Segmentation , Line detection, Edge detection, Thresholding , Region splitting and merging.	10
Unit V	Image compression, Image compression models: The source encoder and decoder, Channel encoder and decoder, Error free compression, Variable length coding, Lossless predictive coding, Lossy compression: Lossy predictive coding, Transformed coding, Synthesis and analysis of image, Recognition, interpretition.	9

TEXT BOOKS, AND/OR

1. Digital Image Processing Using Java, Efford, AWL, NY, 2000.
2. The Computer Image, A Watt and F.Policarpo AWL,NY, 1999
3. Fundamentals of Image Processing by A.K.Jain, PHI

REFERENCE MATERIAL

DEPARTMENT: Electronics and Communication Engineering.

COURSE NUMBER: EC-6093

TITLE OF COURSE: Microcontroller Applications and Embedded System Design

DESIGNATION: ~~REQUIRED~~ /ELECTIVE course.

PRE-REQUISITES: EC5100, EC3201

COURSE DETAILS:

Lecture	Tutorial	Practicals	Contact Hours	Credits
3	0	2	5	4

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	0.30*75	75
	Mid-Semester Exam	0.50*75	
	End-Semester Exam	0.20*75	
Practical	Class Work & Viva	0.7*25	25
	Practical Exam	0.3*25	

COURSE OUTCOMES

CO1 Understanding the 8051 microcontroller and its basics for programming.

CO2 Distinguish between embedded systems and general systems and understand embedded system design models.

CO3 Study embedded operating systems and real time operating systems and interpret architectures of processors used in embedded systems

CO4 Overview of memory organization and identify the role of embedded system in various appliances and applications

TOPICS COVERED

		Lectures
Unit I	Introduction to Microcontrollers and Microprocessors: Basic Architectures of Microcontrollers, Processor Types and Memory Structures, Organization of Data Memory	9
Unit II	Introduction to Intel 8051 Microcontroller: Instruction Set, Addressing Modes and Port Structure, External Memory Access, Timers, Interrupts, Program Branching Instructions, and Serial Communication.	7
Unit III	Introduction to Real Time Embedded Systems: Embedded Systems Components, Memory, Digital Signal Processors, General Purpose Processors, Embedded Processors and Memory-Interfacing	8
Unit IV	Embedded Systems I/O: Interfacing bus, Protocols, Timers, Interrupts, DMA,USB and IrDA, AD and DA Converters, Analog Interfacing	9
Unit V	Design of Embedded Processors: Field Programmable Gate Arrays and Applications, Introduction to Hardware Description Languages. Embedded Communications, System Software and Software Engineering issues	9

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. The 8051Microcontroller and Embedded Systems, Md. A. Mazidi, J.G. Mazidi, Pearson Education
2. Real Time Systems, Rajib Mall, PHI, New Delhi
3. Embedded Systems Architechture - A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard, Newnes, Elsevier
4. An Embedded System Primer, Simon, PHI
5. Embedded Systems-Architecture, Programming and Design, Raj Kamal , TMH

DEPARTMENT: Electronics and Communication Engineering.
COURSE NUMBER: EC-6094.
TITLE OF COURSE: Computer Networking.

DESIGNATION: ~~REQUIRED~~ /ELECTIVE course
PRE-REQUISITES: EC 4102

COURSE DETAILS:

Lecture	Tutorial	Practical's	Contact Hours	Credits
3	0	0	3	3

COURSE ASSESSMENT METHODS

Theory	Assignments & Quiz	20% of 100
	Mid-Semester Exam	30% of 100
	End-Semester Exam	50% of 100

COURSE OUTCOMES

CO1 Understand the issues and challenges at all levels of abstraction in the architecture of a computer network.
CO2 Understand how to Develop networked applications.
CO3 Realize protocols at different layers of a network hierarchy.
CO4 Recognize network for real time application.

TOPICS COVERED

		Hours
Unit I	Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Physical Layer	**9**
Unit II	Transmission Media, Switching methods, ISDN, Terminal Handling	
Unit III	Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols - Overview of IEEE standards - FDDI. Data Link Layer - Elementary Data Link Protocols, Sliding Window protocols, Error Handling.	**8**
Unit IV	Network Layer: Point - to Pont Networks, routing, Congestion control Internetworking -TCP / IP, IP packet, IP address, IPv6.	**8**
Unit V	Transport Layer: Design issues, connection management, session Layer-Design issues, remote procedure call. Presentation Layer-Design issues, Data compression techniques, cryptography - TCP - Window Management	**8**
	Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application. Example Networks - Internet and Public Networks.	**9**

TEXT BOOKS, AND/OR REFERENCE MATERIAL

1. Computer networks, 3rd Ed., A.S Tanenbaum , Prentice Hall of India, New Delhi. 2001.
2. Data communications, Computer Networks, and Open Systems, 4th Ed, Fred Halsall, Addison Wesely Longman , Singapore 1995.
3. Data and Computer communications, 5th Ed W.Stallings, Prentice Hall of India, New Delhi.2001.
4. Forouzen, "Data Communication and Networking", TMH