



Draft Syllabus Electronics (Hons)

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1. Introduction

The syllabus for Electronics at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC.

While framing the syllabus as per the UGC guideline, the topics have been kept as generic as possible in order to provide enough freedom to the individual Universities to detail out their own syllabus as per their own infrastructure, expertise and strength.

Electronics is an applied science and acts as a bridge between pure physics and engineering. This flavour has been retained in the syllabus by bringing in a blend of physical concepts and their translation into applications.

Core papers must address a minimum level of knowledge and understanding. The pre-requisite knowledge for each paper, followed by a minimum learning outcome have been enlisted in next section such that the course will focus on the proper understanding of the basic concepts and develop the problem solving ability and analytical skill of the student.

There is wide deviation in the infrastructure, be it physical or in human resource, in the form of teachers' expertise and ability and aspiration of the students. Hence, University is free to choose the Electives as per their infrastructural strengths.

Some Electives, as suggested by UGC, appear to be rather ambitious and are usually taught in the Post Graduate level. These topics, being very relevant, may be taught in a way suitable for the Undergraduate Honours student. The idea here is to make the student aware of the potentials of these subjects and grasp the basic concepts only. This will prepare the student with the pre-requisite for a post-graduate paper later in life.

Project Work may be introduced instead of the 4th Elective with a credit of 6 split into 2+4, where 2 credits will be for continuous evaluation and 4 credits reserved for the merit of the dissertation.

2. Scheme for CBCS Curriculum

2.1 Credit Distribution across Courses

Credits			
Course Type	Total Papers	Theory + Practical	Theory*
Core Courses	14	$14 \times 4 = 56$ $14 \times 2 = 28$	$14 \times 5 = 70$ $14 \times 1 = 14$
Discipline Specific Electives	4	$4 \times 4 = 16$ $4 \times 2 = 8$	$4 \times 5 = 20$ $4 \times 1 = 4$
Generic Electives	4	$4 \times 4 = 16$ $4 \times 2 = 8$	$4 \times 5 = 20$ $4 \times 1 = 4$
Ability Enhancement Language Courses	2	$2 \times 2 = 4$	$2 \times 2 = 4$
Skill Enhancement Courses	2	$2 \times 2 = 4$	$2 \times 2 = 4$
Totals	26	140	140

*Tutorials of 1 Credit will be conducted in case there is no practical component

2.2 Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course - I	English communication / Environmental Science	2
	Core course - I	Basic Circuit Theory and Network Analysis	4
	Core course - I Practical	Basic Circuit Theory and Network Analysis Lab	2
	Core course - II	Mathematical Foundation for Electronics	4
	Core course - II Practical	Mathematical Foundation for Electronics Lab	2
	Generic Elective - 1	TBD	4
	Generic Elective - 1 Practical	TBD	2
II	Ability Enhancement Compulsory Course - II	English communication / Environmental Science	2
	Core course - III	Semiconductor Devices	4
	Core course - III Practical	Semiconductor Devices Lab	2
	Core course - IV	Applied Physics	4
	Core course - IV Practical	Applied Physics Lab	2
	Generic Elective - 2	TBD	4
	Generic Elective - 2 Practical	TBD	2
III	Core course - V	Electronics Circuits	4
	Core course - V Practical	Electronics Circuits Lab	2
	Core course - VI	Digital Electronics and Verilog/VHDL	4
	Core course - VI Practical	Digital Electronics and Verilog/VHDL Lab	2
	Core course - VII	C Programming and Data Structures	4
	Core course - VII Practical	C Programming and Data Structures Lab	2
	Skill Enhancement Course - 1	TBD	2

	Generic Elective - 3	TBD	4
	Generic Elective - 3 Practical	TBD	2
IV	Core course - VIII	Operational Amplifiers and Applications	4
	Core course - VIII Practical	Operational Amplifiers and Applications Lab	2
	Core course - IX	Signals and Systems	4
	Core course - IX Practical	Signals and Systems Lab	2
	Core course - X	Electronic Instrumentation	4
	Core course - X Practical	Electronic Instrumentation Lab	2
	Skill Enhancement Course-2	TBD	2
	Generic Elective - 4	TBD	4
	Generic Elective - 4 Practical	TBD	2
V	Core course - XI	Microprocessor and Microcontrollers	4
	Core course - XI Practical	Microprocessor and Microcontrollers Lab	2
	Core course - XII	Electromagnetics	4
	Core course - XII Practical	Electromagnetics Lab	2
	Discipline Specific Elective - 1	TBD	4
	Discipline Specific Elective - 1 Practical	TBD	2
	Discipline Specific Elective - 2	TBD	4
	Discipline Specific Elective - 2 Practical	TBD	2
VI	Core course - XIII	Communication Electronics	4
	Core course - XIII Practical	Communication Electronics Lab	2
	Core course - XIV	Photonics	4
	Core course - XIV Practical	Photonics Lab	2
	Discipline Specific Elective - 3	TBD	4

	Discipline Specific Elective - 3 Practical	TBD	2
	Discipline Specific Elective - 4	TBD	4
	Discipline Specific Elective - 4 Practical	TBD	2

2.3 Choices for Discipline Specific Electives

Discipline Specific Elective - 1 to Discipline Specific Elective - 4 (Choose any 4)			
Power Electronics	Numerical Techniques	Modern Communication Systems	Semiconductor Fabrication and Characterization
Electrical Machines	Basic VLSI Design	Digital Signal Processing	Control Systems
Computer Networks	Nanoelectronics	Embedded Systems	Biomedical Instrumentation
Transmission Lines Antenna and Wave Propagation	Nanoelectronics - Science and Growth Technologies		

2.4 Choices for Skill Enhancement Courses

Skill Enhancement Course-1 & Skill Enhancement Course-2			
Design and Fabrication of Printed Circuits	Robotics	Matlab	Internet and Java Programming
Networking and Mobile Communication		Circuit Modelling using PSPICE	Mobile Application Programming

2.5 Prerequisites and Minimum Learning Outcomes

Subject Code	Subject	Pre-requisites for the Subject
Core T1	Basic Circuit Theory and Network Analysis	Class 11 & 12 knowledge of Ohm's Law, Kirchhoff's Law, Electrostatics and Laws of Electromagnetism. Basic concept of scalars and vectors
Core P1	Basic Circuit Theory and Network Analysis	Knowledge of passive circuit components and Network theorems
Core T2	Mathematics Foundation for Electronics	Basic idea of differential equation, complex plane, sequence and series taught in school in classes 11 and 12.
Core P2	Mathematics Foundation for Electronics	Knowledge of Scilab / MatLAB / Other Mathematical Computational software
Core T3	Semiconductor Devices	(Core paper Applied Physics) Basic Quantum concepts, Fermi-Dirac statistics, Different types of materials i.e., conductors, insulators and semiconductors, basic idea of p and n type
Core P3	Semiconductor Devices	Knowledge of working principle of semiconductor devices (diode, transistor, SCR, UJT)
Core T4	Applied Physics	Knowledge of school level (class 11 & 12) Physics on Classical Mechanics, Newton's Laws, Basic Electricity, Electrostatics, Electronics, Crystal structure & Atomic structure.
Core P4	Applied Physics	Knowledge of programming language (C / MatLab / Scilab)

Core T5	Electronic Circuits	Papers Circuit Theory taught in previous semester and basic concept of the characteristics and working of semiconductor devices.
Core P5	Electronic Circuits	Knowledge of working principle of linear active circuits (rectifier, power supply, oscillator)
Core T6	Digital Electronics and Verilog/VHDL	Basic ideas of BJT and MOSFET as switch taught in previous semester in paper Semiconductor Devices.
Core P6	Digital Electronics and Verilog/VHDL	Knowledge of digital circuits and VHDL language with appropriate software
Core T7	C Programming and Data Structures	Basic idea of binary system, concept of searching and sorting algorithms
Core P7	C Programming and Data Structures	Knowledge of different data structures and series representation of functions.
Core T8	Operational Amplifiers and Applications	Ability to analyse transistor circuits. (Papers Electronic Circuits taught in previous semester).
Core P8	Operational Amplifiers and Applications	Knowledge of working principle of OPAMP and 555 timer based circuits
Core T9	Signals & Systems	Concept of Continuous and Discrete system, series representation-criterion for convergence.
Core P9	Signals & Systems	Knowledge of Scilab / MatLab / Other Mathematical Simulation software
Core T10	Electronic Instrumentation.	Basic knowledge of statistics, principle of moving coil instruments (class 12 level),

		digital system, phasor diagram, AC/DC behaviour of circuit elements
Core P10	Electronic Instrumentation.	Knowledge of basic circuit theory working principle of different measurement bridges and transducers
Core T11	Microprocessor and Microcontrollers	Basic knowledge of Binary and hexadecimal number system, register, memory, A-D conversion techniques
Core P11	Microprocessor and Microcontrollers	Knowledge of A/D conversion techniques, DC motor, stepper motor.
Core T12	Electromagnetics	Knowledge of basic laws of electrostatics, magneto statics and laws of electromagnetic induction.
Core P12	Electromagnetics	Knowledge of Scilab/any other similar freeware
Core T13	Communication Electronics	Knowledge of Fourier Transform, Basic electronic circuits using diodes and transistors, digital systems
Core P13	Communication Electronics	Knowledge of different modulation techniques (Implementation using Hardware and circuit simulation software)
Core T14	Photonics	Knowledge of laws of geometrical optics - (reflection, refraction in plane and curved surfaces) (school level), principles of wave propagation in waveguide, working principle of junction diode.
Core P14	Photonics	Basic knowledge of Physical optics and optical fiber.

DSE T1	Power Electronics	Knowledge of p-n junction and BJT (basic physics and breakdown mechanisms), rectifier circuits, MOSFET, basic laws of electromagnetic induction.
DSE P1	Power Electronics	Basic knowledge of power electronic devices.
DSE T2	Numerical Techniques	Basic knowledge of differential equation, matrix, idea of series representation and its convergence.
DSE P2	Numerical Techniques	Knowledge of programming language (C / MatLab) and working formula of various numerical methods
DSE T3	Modern Communication Systems	Knowledge of amplitude modulation, concept of FDMA and TDMA physics of wave propagation in optical fibers, optical sources and detectors
DSE P3	Modern Communication Systems	Basic knowledge of different modulation techniques, optical fiber and wireless communication.
DSE T4	Semiconductor Fabrication and Characterization	Knowledge of Si/Ge as a semiconductor material, basic operation of BJT,MOSFET
DSE P4	Semiconductor Fabrication and Characterization	Needs familiarity with a process simulation software.
DSE T5	Electrical Machines	Basic principles of electromagnetic induction and PMMC instruments.
DSE P5	Electrical Machines	Familiarity with operating principles of DC motor and SCR based phase control

DSE T6	Basic VLSI Design	Basics of Digital design, logic families, Memory
DSE P6	Basic VLSI Design	Needs familiarity with CMOS based digital circuit design
DSE T7	Digital Signal Processing	Knowledge of Fourier Series and Transform
DSE P7	Digital Signal Processing	Needs familiarity with Scilab/ MATLAB / Other Mathematical Simulation software
DSE T8	Control Systems	Working formula of different electrical, mechanical and thermal systems, concept of pole-zero, stability, circuit for lead and lag networks.
DSE P8	Control Systems	Needs familiarity with Scilab / MATLAB / Other Mathematical Simulation software
DSE T9	Computer Networks	Basic knowledge of digital transmission
DSE P9	Computer Networks	Needs familiarity with Scilab / MATLAB / Other Mathematical Simulation software
DSE T10	Nano electronics	Knowledge of quantum mechanics, concept of density of states
DSE P10	Nano electronics	Needs familiarity with physics of different growth techniques and process Simulation software
DSE T11	Embedded Systems	Knowledge of architecture of microcontroller and assembly language programming.
DSE P11	Embedded Systems	Needs familiarity with AVR programming and interfacing techniques
DSE T12	Biomedical Instrumentation	Basic idea of human physiology (school level), transducers.

DSE P12	Biomedical Instrumentation	Needs familiarity with working principles of different medical diagnostic tools
DSE T13	Transmission Lines, Antenna and Wave Propagation	Basic idea of Maxwell's Field equations
DSE P13	Transmission Lines, Antenna and Wave Propagation	Needs familiarity with Scilab / Matlab / other mathematical Simulation software
DSE T14	Nano electronics - Science and Growth Technologies	Knowledge of quantum mechanics, concept of density of states
DSE P14	Nano electronics - Science and Growth Technologies	Needs familiarity with physics of different growth techniques and process Simulation software
GE T1	Electronic Circuits and PCB Designing	Knowledge of quantum mechanics, concept of density of states
GE P1	Electronic Circuits and PCB Designing	Knowledge of circuit components and Network theorems.
GE T2	Digital System Design	Basic ideas of BJT and MOSFET as switch taught in previous semester in paper Semiconductor Devices.
GE P2	Digital System Design	Knowledge of digital circuits and VHDL language.
GE T3	Instrumentation	Basic knowledge of statistics, principle of moving coil instruments (class 12 level), digital system, phasor diagram, AC/DC behaviour of circuit elements
GE P3	Instrumentation	Basic knowledge of A/D conversion techniques, instrumentation amplifier, transducers

		and Bio-medical Instrumentation system (should be taught after module on Practical Electronics)
GE T4	Practical Electronics	Ability to analyse transistor circuits. (Papers Electronic Circuits taught in previous semester).
GE P4	Practical Electronics	Basic knowledge of OPAMP, 555 Timer, Arduino Board and its interfacing
GE T5	Communication Systems	Knowledge of Fourier Transform, Basic electronic circuits using diodes and transistors, digital systems
GE P5	Communication Systems	Knowledge of working principle on VCO and different modulation techniques
GE T6	Microprocessor and Microcontroller System	Basic knowledge of Binary and hexadecimal number system, register, memory, A-D conversion techniques
GE P6	Microprocessor and Microcontroller System	Basic knowledge of working principle of A/D conversion techniques, stepper motor.

Subject Code	Subject	Minimum Learning Outcomes
Core T1	Basic Circuit Theory and Network Analysis	1. Identify and measure circuit elements 2. Relate circuit elements and measuring instruments to basic laws of electrostatics and magneto statics learnt at the 10+2 level. 3. Analyse and calculate circuit parameters under DC and AC excitation.
Core T2	Mathematics Foundation for Electronics	1. Classify a physical problem in mathematical terms, 2. Choose appropriate solution methodology and solve it.
Core T3	Semiconductor Devices	1. Calculate carrier concentration and relate it to Fermi Level position, Calculate current components and different coefficients from given data. 2. Draw energy-diagrams for band-bending in all junctions, calculate built-in potentials, junction capacitances, space charge etc. 3. Draw equivalent circuits with all junction circuit components. 4. Explain transistor action & calculate current and other transistor parameters, 5. Differentiate between large and small signal behavior; 6. Explain I-V characteristics of the BJT for different modes of operation. 7. Explain concept of channel modulation and voltage control concepts, 8. Solve Poisson's equation for specific cases; 9. Identify different regions of the I-V curve and identify the dominant current components in each region; 10. Explain the working of CMOS, its advantages and pull-up and pull-down phenomena. 11. Explain the working of Power devices; identify their differences.

Core T4	Applied Physics	1. Basic properties of materials -mechanical, thermal, magnetic and electrical. 2. Learn the basic concepts of Thermodynamics. 3. Calculate the distribution function for the three statistics. 4. Develop a concept of density of states and Fermi level.
Core T5	Electronic Circuits	1. Analyze the circuits containing active elements. 2. Compare relative merits of different biasing techniques. 3. Understand of merits and application areas of different classes of amplifiers.
Core T6	Digital Electronics and Verilog/VHDL	1. Handle different types of numbers and their manipulation. 2. Perform Boolean arithmetic. 3. Analyze Truth Table/Transition Table and design digital circuits. 4. Map memories. 5. Simulate simple Logic circuits using VHDL.
Core T7	C Programming and Data Structures	1. Independently write programs for solving problems related to mathematical functions using different data structures.
Core T8	Operational Amplifiers and Applications	1. Explain the role of the different stages of OPAMPs with respect to OPAMP parameters ; 2. Analyze various OPAMP based circuits. They should feel equipped to carry out design of circuits using IC 555 and 556.
Core T9	Signals & Systems	1. Appreciate representation of a signal in different domains - viz time, frequency, space 2. Classify a signal and predict result of different operations on it.

		3. Perform signal transformations on Continuous and Discrete systems. 4. Inter relationship between different transforms and their zone of existence
Core T10	Electronic Instrumentation.	1. Gauge the capability of a measuring system 2. Choose appropriate techniques for measurement of different parameters of a system.
Core T11	Microprocessor and Microcontrollers	1. Explain the architecture of a microprocessor and implement simple assembly language programming. 2. Explain basic architecture of microcontroller and implement simple interfacing circuits using it.
Core T12	Electromagnetics	1. Apply the basic laws of electrostatics and magnetostatics to find fields for different charge and current distributions 2. Understand the basic principles of electromagnetic wave propagation through free space and guided media
Core T13	Communication Electronics	1. Understand the basics of different modulation techniques. 2. Relative merits of AM/PM and Analog/Digital modulation
Core T14	Photonics	1. Understanding of the basic concepts of Interference, Diffraction and polarization and methods of producing them. 2. Acquire knowledge about the components of optoelectronic communication system i.e. -Source (LED,LASER), Media (OPTICAL FIBER) , Detector (Photodiodes etc)
DSE T1	Power Electronics	1. Idea of the working principle of SCR and other power electronic -switching devices

		and their simple applications 2. Various signal conditioning circuits, basic idea of DC motor
DSE T2	Numerical Techniques	1. Learn techniques for solving differential equation, integration , differentiation and interpolation using numerical methods
DSE T3	Modern Communication Systems	1. Basic idea of the working of advanced digital modulation techniques, satellite communication. 2. Governing parameters of traffic engineering and the basics of cellular communication system and its evolution (from 2G to 4G) 3. Different network topologies adopted in today's communication system.
DSE T4	Semiconductor Fabrication and Characterization	1. Different options available for growth of semiconductor devices 2. Different steps in VLSI fabrication and the relative merits and demerits of the different options available for each stage of the process cycle 3. Characterization technique to choose for obtaining a certain device/structural parameter
DSE T5	Electrical Machines	1. Basic operational principles of DC and Induction motor (single phase) 2. Different starting mechanisms of these machines
DSE T6	Basic VLSI Design	Students should be able to analyse various parameters of MOS based digital circuits.
DSE T7	Digital Signal Processing	1. Behaviour of a system from its transfer function, concept of pole- zero and stability. 2. Frequency analysis of a system in the discrete domain.

DSE P7	Digital Signal Processing	
DSE T8	Control Systems	1. Calculation of gain of feedback control systems, time and frequency response and stability analysis of a system.
DSE T9	Computer Networks	Students should get a basic idea of network and protocol architecture.
DSE T10	Nano electronics	Students will learn the physics of quantum nanostructures, their synthesis and characterization techniques.
DSE T11	Embedded Systems	Introduction to architecture of embedded systems and simple interfacing techniques
DSE T12	Biomedical Instrumentation	Students should learn the different available Physiological transducers and imaging systems and their applicability in different cases
DSE T13	Transmission Lines, Antenna and Wave Propagation	Wave propagation in conductors, transmission lines and waveguides. Principle of signal propagation using basic antenna structure and calculation of its parameters.
DSE T14	Nano electronics - Science and Growth Technologies	Knowledge of quantum mechanics, concept of density of states
GE T1	Electronic Circuits and PCB Designing	1. DC analysis of a circuit. 2. Construct a simple regulator and amplifier 3. Design a PCB of a simple circuit
GE T2	Digital System Design	1. Handle different types of numbers and their manipulation. 2. Perform Boolean arithmetic.

		3. Analyze Truth Table/Transition Table and design digital circuits. 4. Map memories. 5. Simulate simple Logic circuits using VHDL
GE T3	Instrumentation	1. Gauge the capability of a measuring system, choose appropriate techniques for measurement of different parameters of a system. 2. Understand the basic working principles of different Biomedical instrumentation system
GE T4	Practical Electronics	1. Explain the role of the different stages of OPAMPs with respect to OPAMP parameters 2. Analyze various OPAMP based circuits. They should feel equipped to carry out design of circuits using IC 555 and 556.
GE T5	Communication Systems	1. Understand the basics of different modulation techniques. 2. The relative merits of AM/PM and Analog/Digital modulation
GE T6	Microprocessor and Microcontroller System	3. Explain the architecture of a microprocessor and implement simple assembly language programming. 4. Explain basic architecture of microcontroller and implement simple interfacing circuits using it.

3. Core Subjects Syllabus

3.1 Core T1 - Basic Circuit Theory and Network Analysis

Basic Circuit Theory and Network Analysis		
	Credits	4
Basic Circuit Concepts		
Circuit elements- different types of resistors, inductors and capacitors - identification and classification based on construction. Ideal and practical voltage and current sources. Dependent sources.		
Circuit Analysis & DC transient analysis		
Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Linear Circuits, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Principle of Duality, Star-Delta Conversion (Concept only) Transient response of RL, RC and RLC Circuit under DC excitation		
AC Circuit Analysis		
Sinusoidal energy source, Phasor relationships of RL, RC circuits. Power in AC Circuits: True and apparent power, concept of wattless component, Power factor. Series and Parallel RLC Circuits: Resonance, Frequency Response, Quality (Q) Factor and Bandwidth. Wave shaping by RC circuits: Concept of Filters, Integrator, differentiator.		
Network Theorems		
Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.		

Network Graph Theory: equivalent graph, incidence matrix, fundamental Tie-Set/cut-set

Reference Books

- ▶ S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
- ▶ Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
- ▶ W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)
- ▶ Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
- ▶ A Bruce Carlson, Circuits, Cengage Learning
- ▶ Kuo Network Analysis and Synthesis, Wiley India
- ▶ Dorf Introduction to Electric Circuits, Wiley India
- ▶ Decarlo Lin Linear Circuit Analysis, Oxford
- ▶ Ghosh, Network Theory: Analysis and Synthesis, PHI

3.2 Core P1 - Basic Circuit Theory and Network Analysis Lab

	Credits	2
Basic Circuit Theory and Network Analysis		
1. Familiarization with a. Resistance in series, parallel and series - Parallel. b. Capacitors & Inductors in series & Parallel. c. Multimeter - Checking of components. d. Voltage sources in series, parallel and series - Parallel e. Voltage and Current dividers 2. Measurement of Amplitude, Frequency & Phase difference using CRO. 3. Verification of Kirchoff's Law. 4. Verification of Norton's theorem. 5. Verification of Thevenin's Theorem. 6. Verification of Superposition Theorem. 7. Verification of the Maximum Power Transfer Theorem. 8. RC Circuits: Time Constant, Differentiator, Integrator. 9. Designing of a Low Pass RC Filter and study of its Frequency Response. 10. Designing of a High Pass RC Filter and study of its Frequency Response. 11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.		

3.3 Core T2 - Mathematics Foundation for Electronics

Mathematics Foundation for Electronics		
	Credits	4
Ordinary Differential Equation & Series solution of differential equations and special functions		
First Order Ordinary Differential Equations, Basic Concepts and different types of Differential Equations. Second Order homogeneous and non-homogeneous Differential Equations. Different solution techniques as applied to physical problems- like thermal, hydraulic, electrical systems. Solution by Power series method. Error functions and gamma function.		
Matrices		
Introduction to Matrices, Different techniques for solution of a System of Linear Algebraic Equations. Eigen Values and Eigen Vectors, Linear Transformation, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Classification of different types of Real and Complex Matrices.		
Sequence and Series		
Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series- conditions and methods.		
Complex Variables and Functions		
Complex Variable, Complex Function, Continuity, Differentiability, Analyticity. Different types of functions. Line Integral in Complex Plane, Sequences, Series and Power Series, Taylor's Series, Laurent Series, Zeroes and Poles. Residue integration method.		
Laplace		
Laplace Transform-Properties , Transform of different signals ,inverse transform, application in Circuit Analysis - Equivalent circuit of inductor, capacitor in s-domain		

Reference Books

- ▶ E. Kreyszig, advanced engineering mathematics, Wiley India (2008)
- ▶ Murray Spiegel, Seymour Lipschutz, John Schiller, Outline of Complex Variables, Schaum Outline Series, Tata McGraw Hill (2007)
- ▶ B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007)
- ▶ Pal & Bhunia, Engineering Mathematics, Oxford
- ▶ Garg / Gupta, Engineering Mathematics Volume I & II Pearson
- ▶ Dass H.K./Verma Rama Higher Engineering Mathematics S Chand
- ▶ John Bird Engineering Mathematics

3.4 Core P2 - Mathematics Foundation for Electronics Lab

Mathematics Foundation for Electronics		
	Credits	2
(Scilab/MATLAB/ any other Mathematical Simulation software)		
Mathematical Foundation for electronics labs		
1. Solution of First Order Differential Equations 2. Solution of Second Order homogeneous Differential Equations 3. Solution of Second Order non-homogeneous Differential Equations 4. Convergence of a given series. 5. Divergence of a given series. 6. Solution of linear system of equations using Gauss Elimination method. 7. Solution of linear system of equations using Gauss - Seidel method.		

3.5 Core T3 - Semiconductor Devices

Semiconductor Devices		
	Credits	4
Semiconductor Basics		
Introduction to Semiconductor Materials, Elemental & Compound semiconductors, Direct and indirect bandgap semiconductors, Intrinsic & extrinsic semiconductors, Carriers in semiconductors. Concept of Effective Mass, Density of States, Carrier Concentration and relation with position of Fermi Level and doping, Temperature Dependence of Carrier Concentrations; Charge neutrality condition, degenerate and non-degenerate semiconductors. Carrier Transport Phenomena Carrier Drift, Mobility (Low and high temp behaviour), Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation And Recombination Processes, Continuity Equation.		
Physics of Junctions		
Homojunction & Heterojunction; Metal-metal contact; Metal-semiconductor contact (both Ohmic & Schottky junction). Semiconductor-semiconductor Homojunction: Depletion Layer at the junction, Junction in presence and absence of field, Thermal Equilibrium, Junction capacitance; Junction breakdown. PN junction diode: Current-voltage Characteristics; DC and AC equivalent circuit (Eber's-Moll equation and Charge balance equation) Application of Junction properties: Varactor diode, Solar cell; Zener diode.		
Bipolar Junction Transistors (BJT)		
BJT as a current control device, Basic Transistor Action, Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base- Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.		

Field Effect Transistors:

Transverse Field Effect & Channel isolation, Categories of FETs.

JFET: Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics.

MOSFET: MOS capacitor, Channel formation, Threshold voltage (ideal & real), Current-voltage relation, Depletion & Enhancement type MOSFET; Complimentary MOS (CMOS).

Power Devices

UJT, Basic concept,

SCR, Basic working principle and Characteristics; Triac, Diac,

Reference Books

- ▶ S. M. Sze, Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India edition (2002).
- ▶ Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
- ▶ Dennis Le Croisette, Transistors, Pearson Education (1989)
- ▶ Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
- ▶ Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
- ▶ Dimitrijevic, Principles of Semiconductor Devices, Oxford
- ▶ Neamen, Semiconductor Physics & Devices, Tata McGraw Hill
- ▶ Dutta, Semiconductor Devices & Circuits, Oxford
- ▶ Hu, Modern Semiconductor Devices for Integrated Circuits, Pearson

3.6 Core P3 - Semiconductor Devices Lab

Semiconductor Devices		
	Credits	2
List of Practical		
1. Study of the I-V Characteristics of Diode - Ordinary and Zener Diode. 2. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i, r_o, β. 3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α. 4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, r_i, r_o. 5. Study of the I-V Characteristics of the UJT. 6. Study of the I-V Characteristics of the SCR. 7. Study of the I-V Characteristics of JFET. 8. Study of the I-V Characteristics of MOSFET. 9. Study of Characteristics of Solar Cell 10. Study of Hall Effect/measurement of temperature sensitivity of carrier concentration.		

3.7 Core T4 - Applied Physics

Applied Physics		
	Credits	4
Physics of Crystalline Solids		
Crystalline materials: Crystal Structure in solids, Concept of Lattice, Basis, Crystal axes and planes, Reciprocal lattice, Primitive cells. Bonding in solids: Metallic bonds, Ionic bonds, Covalent bonds		
Introduction Quantum Concepts		
Inadequacies of Classical physics (in relevance to) electron diffraction experiment, Compton's effect, Photo-electric Effect, Plank's Law etc. Introduction to Wave particle duality and Heisenberg's Uncertainty Principle. Basic postulates and formalism of quantum mechanics: Schrodinger wave equation, Eigen-values and Eigen functions in different cases; Tunnelling, Potential barrier problems [free electron, electron in an infinite well], Kronig-Penney Model and development of band structure. E-k diagram in solids, classification of conductors, insulators and semi-conductors.		
Mechanical Properties of Materials		
Mechanical Properties: Concept of Elastic and Plastic Deformations, Elastic Moduli, Brittle and Ductile Materials, Tensile Strength.		
Thermal Properties		
Specific heat in solids, Phonons, Heat Capacity, Debye's Law, Basic concept of Thermoelectricity. Thermodynamics: Laws of Thermodynamics, Concept of Entropy, Thermodynamic potentials, Helmholtz free energy, Enthalpy function, Gibb's free energy, Chemical potential. Relation of chemical potential with Fermi level.		

Statistical Mechanics

Macroscopic and Microscopic States: Concept of Phase space and Density of states. Statistical interpretation of entropy.

Quantum Statistics: Quantization of phase space. Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein distribution functions and their importance.

Electric and Magnetic Properties

Basic concept of free electron theory and evolution to Quantum theory: Conductivity of metals, Ohm's Law, relaxation time, collision time and mean free path, electron scattering and resistivity of metals, Fermi level- relationship with carrier concentration, and concept of Superconductivity.

Insulators: Dielectric properties, concepts of polarisation, permittivity, dielectric constant.

Conductors: Bonding, conductivity, resistivity, relaxation time; scattering, heat developed in current carrying conductor.

Insulators: Dielectric properties, concepts of polarisation, permittivity, dielectric constant.

Semi-conductors: Bonding in elemental and compound semiconductors, Intrinsic, extrinsic, concept of holes, computation of carrier concentrations, Fermi level in semi-conductors, E-k diagrams to explain direct and in-direct band-gap semiconductors.

Magnetic Materials: Magnetic moment, dia, para, ferro and antiferro magnetism, Ferrimagnetic materials, Curie temperature

Reference Books

- ▶ W.E.Callister , Material Science and Engineering Wiley India
- ▶ Bransden Quantum Mechanics, 2e Pearson
- ▶ Griffiths Introduction to Quantum Mechanics, 2e Pearson
- ▶ Majumdar Quantum Mechanics in Physics and Chemistry with Applications to Biology, 2nd ed. PHI
- ▶ Lokanathan & Gambhir, Statistical and Thermal Physics: An Introduction PHI
- ▶ Eisberg, Quantum Physics of Atoms, Molecules, Solids, Nuclei
- ▶ S.O.Pillai, Solid State Physics, New Age
- ▶ S. Kasap, Principles of Electrical Engineering Materials and Devices, Mcgraw Hill
- ▶ Roy, Fundamentals of Classical and Statistical Thermodynamics, Wiley

3.8 Core P4 - Applied Physics Lab

Applied Physics		
	Credits	2
List of Practical		
1. To measure the resistivity of a Ge crystal with temperature by four -probe method from room temperature to 200°C). 2. To determine the value of Boltzmann Constant by studying forward characteristics of diode. 3. To determine the value of Planck's constant by using LEDs of at least 4 different wavelengths. 4. Simulation Studies a. Find lowest Energy Eigen values for 1 D Schrodinger equation b. Plotting tunnelling probability as a function of barrier width c. Plot Energy Band-diagram corresponding to different potential profile		

3.9 Core T5 - Electronics Circuits

Electronics Circuits		
	Credits	4
Diode Circuits		
Piece-wise linear characteristics of diode, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers - DC power supply, Regulation, Filters.		
Circuits using Bipolar Junction Transistor		
Review of CE, CB Characteristics and regions of operation. Hybrid parameters./re model Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor. Transistor as a switch; Types of Amplifier, BJT in an amplifier circuit: Voltage and Power amplifier, Classes of amplifiers, BJT amplifiers.		
Feedback Amplifiers		
Concept of feedback, negative and positive feedback, Types of feedback circuits Barkhausen criteria for oscillations, Oscillators; Regulated power supply: series and shunt (using BJT)		
MOSFET Circuits		
Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits. Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits.		
Reference Books		
► Electronic Devices and circuit theory, Robert Boylestad and Louis Nashelsky, 9th Edition, 2013, PHI		

- ▶ Electronic devices, David A Bell, Reston Publishing Company
- ▶ D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
- ▶ Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
- ▶ J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- ▶ J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
- ▶ Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation
- ▶ Sedra, Microelectronic Circuits, 6/E Oxford
- ▶ Bogart Electronic Devices and Circuits, 6e Pearson
- ▶ Jyoti Prasad Bandyopadhyay, Solid State Electronics Devices Vikas Publication

3.10 Core P5 - Electronics Circuit Lab

Electronics Circuit		
	Credits	2
List of Practical		
1. Study of the half wave rectifier and Full wave rectifier. 2. Study of power supply using C filter and Zener diode. 3. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation 4. Study of clipping and clamping circuits. 5. Study of Fixed Bias, Voltage divider and Collector-to-Base bias Feedback configuration for transistors. 6. Designing of a Single Stage CE amplifier. 7. Study of Class A, B and C Power Amplifier. 8. Study of the Colpitt's Oscillator. 9. Study of the Hartley's Oscillator. 10. Study of the Phase Shift Oscillator 11. Study of the frequency response of Common Source FET amplifier.		

3.11 Core T6 - Digital Electronics and Verilog/VHDL

Digital Electronics and Verilog/VHDL		
	Credits	4
Number System & Codes, Logic Gates and Boolean Algebra, Digital Logic Families		
Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems - base conversions and arithmetic. Logic Gates and Boolean algebra: Basic postulates and fundamental theorems of Boolean algebra, Switching equivalents of Basic gates, Circuit representation using Universal gates. Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison		
Combinational Logic Analysis and Design		
Standard representation of logic functions, Karnaugh map, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor, Comparator, Parity Checker		
Sequential Logic Design & Programmable Logic devices		
Sequential logic design: Latches and Flip flops, Registers, Counters (synchronous and asynchronous and modulo-N), State Table, State Diagrams, counter design using excitation table and equations, Register counter. Programmable Logic Devices: Basic concepts- ROM, PLA, PAL, CPLD, FPGA Memory -Memory technology, types of memory-volatile & non-volatile, ROM, PROM, EPROM, EEPROM, Flash memory, SRAM, DRAM, SDRAM, Concept of Primary, Secondary and Cache memory		
VHDL Programming		
Introduction to VHDL: History, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, data flow style, behavioural style, structural style, mixed design style, simulating design. Introduction to Language Elements, entity, architectures, concurrent signal assignment, process statements, process declarative region, process statement region, process		

execution, sequential statements, architecture selection.

Behavioural Modelling: Introduction to behavioural modelling, Sequential Processing: Process statement, sensitivity list, signal assignment vs variable assignment, sequential statements, IF, CASE ,LOOP, NEXT, EXIT and ASSERT statements, assertion BNF, WAIT ON signal, WAIT UNTIL expression, WAIT FOR time expression, multiple wait conditions, WAIT Time-Out, Sensitivity List vs WAIT Statement Concurrent Assignment, Passive Processes.

Data types: Object types-signal, variable, constant, Data types -scalar types, composite types, incomplete types, File Type caveats, subtypes, Subprograms and functions

Reference Books

- ▶ M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
- ▶ Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
- ▶ W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
- ▶ Anand Kumar Fundamentals of Digital Circuits, 4th ed. ▶ PHI
- ▶ Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.
- ▶ Pedron,i Circuit Design and Simulation with VHDL, 2nd ed. PHI
- ▶ D. Roychowdhury, Digital Circuits Vol 1&2 Platinum Publishers
- ▶ Jayaram Bhasker, A VHDL Primer, 3e Pearson
- ▶ S. Salivahanan & S. Pravin Kumar, Digital Circuits and Design, Vikas Publishing
- ▶ Fletcher, An Engineering Approach to Digital Design
- ▶ Wakerly, Digital Design: Principles and Practices, 4e

3.12 Core P6 - Digital Electronics and Verilog/VHDL Lab

Digital Electronics and Verilog/VHDL		
	Credits	2
Hardware		
1. To verify and design AND, OR, NOT and XOR gates using NAND gates. 2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's. 3. Design a Half and Full Adder. 4. Design a Half and Full Subtractor. 5. Design a seven segment display driver. 6. Design a 4 X 1 Multiplexer using gates. 7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type). 8. Design a counter using D/T/JK Flip-Flop. 9. Design a shift register and study Serial and parallel shifting of data.		
Experiments in VHDL		
1. Write code to realize basic and derived logic gates. 2. Half adder, Full Adder using basic and derived gates. 3. Half subtractor and Full Subtractor using basic and derived gates. 4. Clocked D FF, T FF and JK FF (with Reset inputs). 5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates. 6. Decoder (2x4, 3x8), Encoders and Priority Encoders. 7. Design and simulation of a 4 bit Adder. 8. Code converters (Binary to Gray and vice versa). 9. 2 bit Magnitude comparator. 10. 3 bit Ripple counter.		

3.13 Core T7 - C Programming and Data Structures

C Programming and Data Structures		
	Credits	4
C Programming Language		
Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays- concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays. Input output statement and library functions (math and string related functions)		
Decision Making, branching & looping, Structures & Introduction to C++		
Decision making, branching & looping: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions. Structures: defining and declaring a structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Pointers. Introduction to C++: Object oriented programming, characteristics of an object-oriented language		
Data Structures		
Definition of stack, array implementation of stack, conversion of infix expression to prefix, postfix expressions, evaluation of postfix expression. Definition of Queue, Circular queues, Array implementation of queues. Linked List and its implementation, Link list implementation of stack and queue, Circular and doubly linked list		
Searching and Sorting		
Searching and sorting: Insertion sort, selection sort, bubble sort, merge sort, linear Search,		

binary search. Trees : Introduction to trees, Binary search tree, Insertion and searching in a BST, preorder, postorder and inorder traversal (recursive)

Reference Books

- ▶ Yashavant Kanetkar, Let Us C , BPB Publications
- ▶ Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
- ▶ Byron S Gottfried, Programming with C , Schaum Series
- ▶ Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Prentice Hall
- ▶ Yashavant Kanetkar, Pointers in C, BPB Publications
- ▶ Tanenbaum: "Data Structures using C", Pearson/PHI.
- ▶ Ellis Horowitz and Sartaz Sahani "Fundamentals of Computer Algorithms", Computer Science Press.
- ▶ Samanta, Classic Data Structures, 2nd ed. ▶ (CD)
- ▶ Thareja, Data Structure Using C, ,2E Oxford
- ▶ Thareja, Introduction to C Programming, 2/E Oxford

3.14 Core P7 - C Programming and Data Structures Lab

C Programming and Data Structures

Credits

2

C Programming and Data Structures Lab

The list of programs given below is indicative only. Students should do programs which make use of the different programming techniques and data structures.

1. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series.
2. Find minimum and maximum of N numbers.
3. Find the GCD of two integer numbers.
4. Calculate factorial of a given number.
5. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non - zero coefficients A, B and C. Else report error.
6. Calculate the value of $\sin(x)$ and $\cos(x)$ using the series. Also print $\sin(x)$ and $\cos(x)$ value using library function.
7. Generate and print prime numbers up to an integer N.
8. Sort given N numbers in ascending order.
9. Find the sum & difference of two matrices of order MxN and PxQ.
10. Find the product of two matrices of order MxN and PxQ.
11. Find the transpose of given MxN matrix.
12. Find the sum of principle and secondary diagonal elements of the given MxN matrix.
13. Calculate the subject wise and student wise totals and store them as a part of the structure.
14. Maintain an account of a customer using classes.
15. Implement linear and circular linked lists using single and double pointers.
16. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list
17. Create circular linked list having information about a college and perform Insertion at front, Deletion at end.
18. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
19. Implement polynomial addition and subtraction using linked lists.
20. Implement sparse matrices using arrays and linked lists.

21. Create a Binary Tree to perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
22. Implement binary search tree using linked lists. Compare its time complexity over that of linear search.
23. Implement Insertion sort, Merge sort, Bubble sort, Selection sort.

3.15 Core T8 - Operational Amplifiers and Applications

Operational Amplifiers and Applications		
	Credits	4
Basic Operational Amplifier & Op-Amp Parameters		
Basic Operational Amplifier: Ideal OPAMP and its characteristics, Stages of OPAMP, block diagram of an operational amplifier (IC 741), Op-Amp parameters;, Deviations for a real OPAMP from ideal behaviour.		
Op-Amp Circuits, Closed and Open Loop Applications		
Op-Amp Circuits: Open and closed loop configuration, Inverting and Non-inverting modes, Mathematical operation and Instrumentation; Voltage to current converter, Current to voltage converter. Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. Signal generators: Sinusoidal and Relaxation		
Timers circuits and Other Fixed & Variable IC regulators		
Multivibrators (IC 555): Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astablemultivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565. Fixed and variable IC regulators: IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation.SMPS-Principle of DC-TO-DC conversion, block diagram representation of smps module Voltage controlled oscillator (IC 566).		
Signal Conditioning circuits		
Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.		
Reference Books		
▶ R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003) ▶ R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)		

- ▶ A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
- ▶ K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011).
- ▶ Bel, Operational Amplifiers & Linear ICS, 3/E Oxford
- ▶ Jacob , Analog Integrated Circuit Pearson
- ▶ Ganesh Babu et.al., Linear Integrated Circuits - 5th Edn. Scitech Publication

3.16 Core P8 - Operational Amplifiers and Application Lab

Operational Amplifiers and Application		
	Credits	2
List of Practical		
1. Study of op-amp characteristics: CMRR and Slew rate. 2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op- amp. 3. Designing of analog adder and subtractor circuit. 4. Designing of an integrator using op-amp for a given specification and study its frequency response. 5. Designing of a differentiator using op-amp for a given specification and study its frequency response. 6. Designing of a First Order Low-pass filter using op-amp. 7. Designing of a First Order High-pass filter using op-amp. 8. Designing of a RC Phase Shift Oscillator using op-amp. 9. Study of IC 555 as an astable multivibrator. 10. Study of IC 555 as monostable multivibrator. 11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series		

3.17 Core T9 - Signals & Systems

Signals & Systems		
	Credits	4
Signals and Systems		
Continuous and discrete time signals: Types of signals (periodic-aperiodic, deterministic-nondeterministic, single and multiple valued, Signals in time, spatial and frequency domain), Transformations.		
Fourier Series Representation of Periodic Signals & Fourier Transform		
Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series. Frequency-Selective filters, Fourier Transform: Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs.		
Linear Time -Invariant Systems (LTI):		
Discrete Time LTI systems: Continuous time LTI system, Properties of LTI systems, Convolution, Commutative, Distributive, Associative. LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response. Differential and Difference equation formulation, Block diagram representation of first order systems.		
Z Transform		
Introduction to Z-Transform- relevance in discrete domain ,relation with Laplace & Fourier Transforms, condition of stability,properties of Z-Transforms, Inverse Z-Transforms, application of Z-Transforms.		
Reference Books		
▶ Anand Kumar Signals and Systems, 3rd ed. PHI ▶ Rawat, Signals & Systems, Oxford ▶ Lathi, Signals and Systems Oxford ▶ Proakis, Signals and Systems, 4e Pearson		

- ▶ Rabiner, Theory and Application of Digital Signal Processing, 1/e Pearson.
- ▶ Haykin, Signals & Systems.

3.18 Core P9 - Signals & Systems Lab

Signals & Systems Lab		
	Credits	2
(Scilab/MATLAB/ Other Mathematical Simulation software)		
List of Practical		
1. Generation of Signals: continuous time 2. Generation of Signals: discrete time 3. Time shifting and time scaling of signals. 4. Convolution of Signals 5. Solution of Difference equations. 6. Fourier series representation of continuous time signals. 7. Fourier transform of continuous time signals. 8. Laplace transform of continuous time signals. 9. Introduction to Xcos/similar function and calculation of output of systems represented by block diagrams		

3.19 Core T10 - Electronic Instrumentation

Electronic Instrumentation		
	Credits	4
Qualities of measurement, Basic Measurement Instruments & Connectors and Probes		
Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting. Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital measurement systems (voltmeter, multimeter, frequency meter) Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors - audio and video, RF/Coaxial, USB etc		
Measurement of resistance and Impedance & A-D and D-A Conversion		
Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge. A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).		
Oscilloscope & Signal Generators		
Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time). Signal Generators: Audio oscillator, Pulse Generator, Function generators.		
Transducers and Sensors		

Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge - Theory, types), Capacitive (Different types), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational). Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Instrumentation Amplifier - circuit, transfer function and advantage.

Reference Books

- ▶ H. S. Kalsi, Electronic Instrumentation, TMH(2006)
- ▶ W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).
- ▶ Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
- ▶ E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
- ▶ Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
- ▶ David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
- ▶ Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
- ▶ Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann- 2008).
- ▶ A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007).
- ▶ C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).

3.20 Core P10 - Electronic Instrumentation Lab

Electronic Instrumentation		
	Credits	2
List of Practical		
1. Design of multi range ammeter and voltmeter using galvanometer. 2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity. 3. Measurement of Capacitance by de'Sautys. 4. Measure of low resistance by Kelvin's double bridge. 5. Design and implementation of Instrumentation Amplifier using 741 OOPAMP. 6. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.) 7. To determine the Characteristics of LVDT. 8. To determine the Characteristics of Thermistors. 9. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type. 10. To study the Characteristics of LDR, Photodiode, and Phototransistor: a. Variable Illumination. b. Linear Displacement. 11. Design and Implementation of a Temperature Controller.		

3.21 Core T11 - Microprocessor and Microcontrollers

Microprocessor and Microcontrollers		
	Credits	4
Introduction to Microprocessor		
Introduction to Microprocessor: Introduction, Applications, Basic block diagram, Speed, Word size, Memory capacity, Classification of microprocessors (mention of different microprocessors being used) Microprocessor 8085: Features, Architecture -block diagram, General purpose registers, register pairs, flags, stack pointer, program counter, and types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085. Basic interfacing concepts, Memory mapped I/O and I/O mapped I/O, Partial/full memory decoding,DMA 8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Assembly language programming examples. Interfacing with PPI (8255), ADC (0808 etc.) Stack operations, subroutine, and call and return instructions. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay. Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts		
Introduction to Microcontrollers		
Microcontrollers: Introduction, different types of microcontrollers, embedded microcontrollers, processor architectures. Harvard vs. Princeton, CISC vs. RISC architectures, microcontroller memory types, microcontroller features, clocking, I/O pins, interrupts, timers, peripherals. PIC16F887 PIC16F887 Microcontroller: Core features, Architecture, pin diagram, memory organization- Program and data memory organization, I/O Ports, oscillator module, Timer modules (Timer 0, Timer 1 and Timer 2), comparator module, analog-to-digital converter (ADC) module, data EEPROM, Enhanced capture/compare/PWM module, EUSART, master synchronous serial port		

(MSSP) module, special features of the CPU, interrupts, addressing modes, instruction set.

Interfacing to PIC16F887: LED, Switches, Solid State Relay, Seven Segment Display, 16x2 LCD display, 4x4 Matrix Keyboard, Digital to Analog Converter, Stepper Motor and DC Motor. Interfacing program examples using C language.

Reference Books

- ▶ Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
- ▶ Fundamentals of Microprocessor & Microcomputer: B. Ram–Danpat Rai Publications.
- ▶ Microchip PIC16F87X datasheet
- ▶ PIC Microcontrollers, Milan Verle, ,mikroElektronika, 1st edition (2008)
- ▶ Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006.
- ▶ Mathur Microprocessor 8085 and Its Interfacing, 2nd ed. ▶ PHI
- ▶ Krishna Kant Microprocessors and Microcontrollers: Architecture, Programming and System Design, 2nd ed. ▶ PHI
- ▶ Mazidi AVR Microcontroller and Embedded Systems: Using Assembly and C ,Pearson
- ▶ Mazidi PIC Microcontroller And Embedded Systems ,Pearson

3.22 Core P11 - Microprocessor and Microcontrollers Lab

Microprocessor and Microcontrollers		
	Credits	2
Assembly language programs		
1. Program to transfer a block of data. 2. Program for multibyte addition 3. Program for multibyte subtraction 4. Program to multiply two 8-bit numbers. 5. Program to divide a 16 bit number by 8 bit number. 6. Program to search a given number in a given list. 7. Program to generate terms of Fibonacci series. 8. Program to find minimum and maximum among N numbers 9. Program to find the square root of an integer. 10. Program to find GCD of two numbers. 11. Program to sort numbers in ascending/descending order. 12. Program to verify the truth table of logic gates.		
PIC Microcontroller Programming		
1. LED blinking with a delay of 1 second. 2. Solid State Relay Interface 3. Interfacing of LCD (2X16). 4. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control. 5. To test all the gates of a given IC74XX is good or bad. 6. Generate sine, square, saw tooth, triangular and staircase waveform using DAC interface. 7. Display of 4- digit decimal number using the multiplexed 7-segment display interface. 8. Analog to digital conversion using internal ADC and display the result on LCD. 9. Implementation of DC-Volt meter (0-5V) using internal ADC and LCD 10. Digital to analog conversion using PWM (pulse delay to be implemented using timers). 11. Speed control of DC motor using PWM (pulse delay to be implemented using timers). 12. Interfacing of matrix keyboard (4X4).		

13. Serial communication between microcontroller and PC.

3.23 Core T12 - Electromagnetics

Electromagnetics		
	Credits	4
Vector Analysis, Poisson's Equation and Laplace Equation		
Vector Analysis: Scalars and Vectors, Vector Algebra and Operators in different coordinate systems; Poisson's Equation and Laplace's Equation: Derivation of Poisson's and Laplace's equation, Uniqueness Theorem, Examples of Solution of Laplace's Equation: Cartesian, Cylindrical and Spherical Coordinates.		
Electrostatics		
Laws of Electrostatics their applications; Electric Potential for different charge distributions, Electric Fields in different materials; Polarization, Dielectric Constant, Isotropic and Anisotropic dielectrics, Boundary conditions, Capacitance and Capacitors. Electrostatic Energy and Forces. Energy density.		
Magnetostatics		
Laws of Magnetostatics and their applications; Magnetic Flux; Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic materials, Magnetic Boundary Conditions, Inductors and Inductances, Magnetic Energy, Magnetic Circuits. Inductances and Inductors, Magnetic Energy, Forces and Torques.		
Time-Varying Fields and Maxwell's Equations		
Faraday's Law of Electromagnetic Induction, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in differential and integral form and Constitutive Relations. Potential Functions, Lorentz gauge and the Wave Equation for Potentials, Retarded Potentials (basic concepts).		
Electromagnetic Wave Propagation		
Electromagnetic Wave Propagation: Time-Harmonic Electromagnetic Fields; Electromagnetic		

Spectrum, Wave Equation in a source free isotropic homogeneous media, Uniform Plane Waves in Lossless and Lossy unbounded homogeneous media, Wave Polarization, Concept of Phase and Group velocity, Electromagnetic Power (Poynting Vector).

Guided Electromagnetic Wave Propagation: Waves along Uniform Guiding Structures, TEM, TE and TM waves, Electromagnetic Wave Propagation in Parallel Plate and Rectangular Metallic Waveguides.

Reference Books

- ▶ Murray. R. Spiegel, Vector Analysis, Schaum series, Tata McGraw Hill (2006)
- ▶ Nathan Ida Engineering Electromagnetics Springer
- ▶ M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press (2001)
- ▶ W. H. Hayt and J. A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
- ▶ D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
- ▶ J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
- ▶ N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Edu, (2006)
- ▶ Introduction to Electrodynamics, D.J. Griffiths, Pearson Education (2012)

3.24 Core P12 - Electromagnetics Lab

Electromagnetics			
Lectures	60	Credits	2
(Scilab/MATLAB/ Other Mathematical Simulation software)			
List of Practical			
1. Understanding and Plotting Vectors. 2. Transformation of vectors into various coordinate systems. 3. 2D and 3D Graphical plotting with change of view and rotation. 4. Representation of the Gradient of a scalar field, Divergence and Curl of Vector Fields. 5. Plots of Electric field and Electric Potential due to charge distributions. 6. Plots of Magnetic Flux Density due to current carrying wire. 7. Programs and Contour Plots to illustrate Method of Images 8. Solutions of Poisson and Laplace Equations - contour plots of charge and potential distributions 9. Introduction to Computational Electromagnetics: Simple Boundary Value Problems by Finite Difference/Finite Element Methods.			

3.25 Core T13 - Communication Electronics

Communication Electronics		
	Credits	4
Electronic Communication		
Block diagram of an electronic communication system, electromagnetic spectrum-band designations and applications, need for modulation, concept of channels and base-band signals. Concept of Noise, Types of Noise, Signal to noise ratio, Noise Figure, Noise Temperature, Friss formula. Need for modulation.		
Amplitude Modulation		
Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Linear and Non Linear Methods), Amplitude Demodulation (diode detector), Concept of Double side band suppressed carrier, Single side band suppressed carrier (Chopper, Balanced Modulation), other forms of AM (Pilot Carrier Modulation, Vestigial Side Band modulation, Independent Side Band Modulation). Block diagram of AM Transmitter and Receiver (Super heterodyne receiver - advantages over TRF , utility of heterodyning, different stages) Angle modulation: Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM (direct and indirect methods), FM detector (PLL). Block diagram of FM Transmitter and Receiver Comparison between AM, FM and PM. Pulse Analog Modulation & Pulse Code Modulation Pulse Analog Modulation: Channel capacity, Sampling theorem, PAM, PDM, PPM modulation and detection techniques, Multiplexing, TDM and FDM. Pulse Code Modulation: Need for digital transmission, Quantizing, Uniform and Non- uniform Quantization, Quantization Noise, Companding, Coding, Decoding, and Regeneration.		
Digital Carrier Modulation techniques		
Digital Carrier Modulation Techniques: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK)		

and Quadrature Phase Shift Keying (QPSK)

Reference Books

- ▶ Kennedy, Electronic communication systems- 3rd edition, McGraw international publications
- ▶ Frenzel, Principles of Electronic communication systems 3rd edition, McGraw Hill
- ▶ S. Haykin, Communication Systems, Wiley India (2006)
- ▶ Tomasi, Advanced electronic communications systems 6th edition, PHI.
- ▶ S. Haykin, Communication Systems, Wiley India (2006)
- ▶ Kundu, Analog and Digital Communications, Pearson Education (2009)
- ▶ Couch, Digital & Analog Communication Systems, 8e

3.26 Core P13 - Communication Electronics Lab

Communication Electronics		
	Credits	2
Hardware and Circuit Simulation Software		
List of Practical		
1. Study of Amplitude Modulation 2. Study of Amplitude Demodulation 3. Study of Frequency Modulation 4. Study of Frequency Demodulation 5. Study of Pulse Amplitude Modulation 6. AM Transmitter/Receiver 7. FM Transmitter/Receiver 8. Study of TDM, FDM 9. Study of Pulse Width Modulation 10. Study of Pulse Position Modulation 11. Study of Pulse Code Modulation 12. Study of Amplitude Shift Keying 13. Study of Phase Shift Keying 14. Study of Frequency Shift Keying		

3.27 Core T14 - Photonics

Photonics		
	Credits	4
Light as an Electromagnetic Wave		
Light as an Electromagnetic Wave: Plane waves in homogeneous media, concept of spherical waves. Reflection and transmission at an interface, total internal reflection, Brewster's Law, Stoke's law Interaction of electromagnetic waves with dielectrics: origin of refractive index, dispersion. Interference : Necessary conditions (Concept of coherence) techniques using division of wavefront and Division of Amplitude Diffraction: Fresnel and Fraunhofer approximations. Fraunhofer Diffraction by a single slit, rectangular aperture, double slit, Resolving power of microscopes and telescopes; Diffraction grating: Resolving power and Dispersive power		
Polarization		
Linear, circular and elliptical polarization, polarizer-analyzer and Malus' law; Double refraction by crystals, Interference of polarized light, Wave propagation in uniaxial media. Half wave and quarter wave plates. Faraday rotation and electro-optic effect. LED, Laser, Photodetectors and LCD displays		
LED, Laser, Photodetectors and LCD displays		
Construction, materials and operation, concept of quantum efficiency Lasers: Interaction of radiation and matter, Einstein coefficients, Condition for amplification, laser cavity, threshold for laser oscillation, line shape function. Examples of common lasers. The semiconductor injection laser diode.		
Photodetectors		
Bolometer, Photomultiplier tube, Charge Coupled Device. Photo transistors and Photodiodes (p-i-n, avalanche), quantum efficiency and responsivity. LCD Displays: Types of liquid crystals, Principle of Liquid Crystal Displays, applications,		

advantages over LED displays.

Guided Waves and the Optical Fiber

TE and TM modes in symmetric slab waveguides, effective index, field distributions, Dispersion relation and Group Velocity. Step index optical fiber, total internal reflection, concept of linearly polarized waves in the step index circular dielectric waveguides, single mode and multimode fibers, attenuation and dispersion in optical fiber.

Basic idea of OEIC(Optoelectronic Communication system)

Reference Books

- ▶ Ajoy Ghatak, Optics, Tata McGraw Hill, New Delhi (2005)
- ▶ E. Hecht, Optics, Pearson Education Ltd. (2002)
- ▶ J. Wilson and J. F. B. Hawkes, Optoelectronics: An Introduction, Prentice Hall India (1996)
- ▶ S. O. Kasap, Optoelectronics and Photonics: Principles and Practices, Pearson Education (2009)
- ▶ Ghatak A.K. and Thyagarajan K., "Introduction to fiber optics," Cambridge Univ. Press. (1998)
- ▶ Kushal Roy, Advanced Optical Fibre Communications (HB) Scitech

3.28 Core P14 - Photonics Lab

Photonics		
	Credits	2
List of Practical		
1. To verify the law of Malus for plane polarized light. 2. To determine wavelength of sodium light using Michelson's Interferometer. 3. To determine wavelength of sodium light using Newton's Rings. 4. To determine the resolving power and Dispersive power of Diffraction Grating. 5. Diffraction experiments using a laser. 6. Study of Faraday rotation. 7. Study of Electro-optic Effect. 8. To determine the specific rotation of scan sugar using polarimeter. 9. To determine characteristics of LEDs and Photo- detector. 10. To measure the numerical aperture of an optical fiber.		

4. Department Specific Electives Subjects Syllabus

4.1 DSE T1 - Power Electronics

Power Electronics		
	Credits	4
Power Devices and SCR		
Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors. Silicon Controlled Rectifier (SCR): structure, two transistor analogy, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR, Gate-triggering circuits, dv/dt triggering circuits, Control circuits design and Protection circuits, Snubber circuit		
Diac & Triac, IGBT, Application of SCR and Power MOSFETs		
Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a Triac. Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc. Application of SCR: SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR and Triac as a switch. Power MOSFETs: operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.		
Power Inverters and Choppers		
Power Inverters: Need for commutating circuits and their various types, d.c. link invertors, Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors. Choppers: basic chopper circuit, types of choppers (Type A-D), step-down chopper, step-up chopper, operation of d.c. chopper circuits using self-commutation (A & B-type commutating		

circuit), cathode pulse turn-off chopper(using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper

Electromechanical Machines

DC Motors, Basic understanding of field and armature, Principle of operation, EMF equation, Back EMF, Factors controlling motor speed, Thyristor based speed control of dc motors, AC motor (Induction Motor only), Rotor and stator, torque & speed of induction motor, Thyristor control of ac motors(block diagrams only)

Reference Books

- ▶ Power Electronics, P.C. Sen, TMH
- ▶ Power Electronics & Controls, S.K. Dutta
- ▶ Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
- ▶ Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education
- ▶ Power Electronics, Applications and Design, Ned Mohan, Tore.
- ▶ Power Electronics, K. HariBabu, Scitech Publication.
- ▶ Power Electronics, M.S. Jamil Asghar, PHI.
- ▶ A Textbook of Electrical Technology-Vol-II, B.L. Thareja, A.K. Thareja, S.Chand

4.2 DSE P1- Power Electronics Lab

Power Electronics		
	Credits	2
List of Practical		
1. Study of I-V characteristics of DIAC 2. Study of I-V characteristics of a TRIAC 3. Study of I-V characteristics of a SCR 4. SCR as a half wave and full wave rectifiers with R and RL loads 5. AC voltage controller using TRIAC with UJT triggering. 6. Study of parallel and bridge inverter. 7. Design of snubber circuit 8. VI Characteristic of MOSFET and IGBT (Both) 9. Study of chopper circuits		

4.3 DSE T2- Numerical Techniques

Numerical Techniques		
	Credits	4
Numerical Methods and Study of Transcendental & Polynomial Equation $f(x)=0$		
Numerical Methods: Floating point, Round-off error, Error propagation, Stability, Programming errors. Solution of Transcendental and Polynomial Equations $f(x)=0$: Bisection method, Secant and Regula Falsi Methods, Newton Raphson method, Rate of convergence, General Iteration Methods, Newton's Method for Systems, Method for Complex Roots , Roots of Polynomial Equations.		
Interpolation and Polynomial approximation and Curve fitting		
Interpolation and Polynomial Approximations: Taylor Series and Calculation of Functions, Lagrange Interpolation, Newton Divided Difference Interpolation (forward and backward difference formulae), Truncation errors. Curve Fitting: Least square fitting, Curve fitting, Interpolation by Spline functions.		
Numerical Integration, Numerical Differentiation and Numerical methods for first order differential equations		
Numerical Integration: Trapezoidal Rule, Error bounds and estimate for the Trapezoidal rule, Simpson's Rule, Error of Simpson's rule. Numerical Differentiation: Finite difference method and applications to electrostatic boundary value problems. Numerical methods for first order differential equations: Euler-Cauchy Method, Classical Runge Kutta method of fourth order. Methods for system and higher order equations.		
Numerical Methods in Linear Algebra and Matrix Eigenvalue		
Numerical Methods in Linear Algebra: Linear systems $Ax=B$, Gauss Elimination, Partial Pivoting, Matrix Inversion, Gauss-Jordon, and Iterative Methods: Gauss-Seidel Iteration, Jacobian Iteration.		

Matrix Eigenvalue: Power Method.

Reference Books

- ▶ E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons (1999).
- ▶ V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall India, Third Edition.
- ▶ S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India (2008).
- ▶ M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, New Age International (2007).
- ▶ B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C and C++, Khanna Publishers (2012).
- ▶ Thangaraj Computer-Oriented Numerical Methods, PHI

4.4 DSE P2- Numerical Techniques Lab

Numerical Techniques		
	Credits	2
C language/ Scilab/MATLAB/Other Mathematical Simulation software		
List of Practical		
1. Program to implement Bisection Method 2. Program to implement Secant Method 3. Program to implement Regula falsi method 4. Program to implement Newton Raphson Method 5. Program to implement Trapezoidal rule 6. Program to implement Simpson's rule 7. Program to implement Runge Kutta Method 8. Program to implement Euler-Cauchy Method 9. Program to implement Gauss-Jordon Method 10. Program to implement Gauss-Seidel Iteration		

4.5 DSE T3 - Modern Communication Systems

Modern Communication Systems		
	Credits	4
Advanced Digital Modulation Technique		
DPCM, DM, ADM. Binary Line Coding Technique, Multilevel coding, QAM (Modulation and Demodulation)		
Optical Communication		
Block Diagram of optical communication system, optical power budgeting.		
Switching systems and Traffic Engineering		
Basic overview of different electro-mechanical switching system, Digital Switching system (time and space division).		
Traffic Engineering : Blocking network, blocking probability ,grade of service, traffic load, Erlang formula , congestion control strategies		
Cellular Communication		
Concept of cellular mobile communication - cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts. Concept of WLL.		
Satellite Communication and LAN		
Satellite communication: Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system - space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station. Satellite access, TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish		

antenna), GPS-services like SPS & PPS.

Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX. Concept of Li-Fi

Reference Books

- ▶ W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education, 3rd Edition
- ▶ Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3rd Edition
- ▶ Modern digital and analog Communication systems- B. P. Lathi, 4rd Edition 2009 Oxford University press.
- ▶ ThiagarajanVishwanathan, Telecommunication Switching Systems and Networks, Prentice Hall of India.
- ▶ Theodore S. Rappaport, Wireless Communications Principles and Practice, 2nd Edition, Pearson Education Asia.

4.6 DSE P3 - Modern Communication Systems Lab

Modern Communication Systems		
	Credits	2
List of Practical		
1. Modulation of LED and detection through Photo detector. 2. Calculation of the transmission losses in an optical communication system. 3. Study of 16 QAM modulation and Detection with generation of Constellation Diagram 4. Study of DPCM and demodulation. 5. Study of DM, ADM 6. Study of architecture of Mobile phone.-Real Time study of GSM 07.05 & 07.07 commands in various categories 7. Study of Satellite Communication System. 8. Study of Optical Fiber Communication System 9. Studies on satellite communication system - to set up active and passive satellite communication link, to set up an FM / FDM satellite link, to measure the path loss and propagation delay in a satellite link, to communicate voice signal through satellite link 10. Use different combinations of uplink and downlink frequencies to check the communication link, to transmit and receive various waveforms from a function generator through a satellite link 11. Studies on Blue tooth system - to understand concept of Blue tooth technology, to study RF module, RS- 232C serial communication, Blue tooth protocol, different types of Blue tooth network 12. Studies on wireless LAN		

4.7 DSE T4 - Semiconductor Fabrication and Characterization

Semiconductor Fabrication and Characterization		
	Credits	4
Introduction of Semiconductor Process Technology, Epitaxy deposition, and Characterization		
Introduction of Semiconductor Process Technology (Line width - 10 nm technology), Semiconductor materials, single crystal, polycrystalline and amorphous, Crystal growth techniques: Si from the Czochralski technique, starting material, Distribution of dopants, Effective Segregation Coefficient. Silicon Float Zone Process, GaAs from Bridgman techniques. Wafer preparation. Epitaxy Deposition: Epitaxial growth by vapor phase epitaxy (VPE) and molecular beam epitaxy (MBE). Characterization: Various characterization methods for structural, electrical and optical properties. Basic idea of X-ray diffractometer, Scanning electron microscope, Transmission electron microscope and UV-VIS-NIR spectrophotometer.		
Oxidation and Diffusion		
Oxidation: Thermal Oxidation Process: Kinetics of Growth for thick and thin Oxide, Dry and Wet oxidation. Effects of high pressure and impurities, Impurity Redistribution during Oxidation, Masking property of Silicon Oxide, Oxide Quality. Chemical vapour deposition of silicon oxide, properties of silicon oxide, step coverage, P-glass flow. Diffusion: Basic Diffusion Process: Diffusion Equation, Diffusion Profiles. Extrinsic Diffusion Concentration Dependent Diffusivity. Lateral Diffusion. Doping through Ion Implantation and its comparison with diffusion.		
Lithographic Processes and Etching		
Lithographic Processes: Clean room, Optical lithography, exposure tools, masks, Photoresist, Pattern Transfer, and Resolution Enhancement Technique. Electron Beam Lithography, X-ray Lithography and Ion Beam Lithography. Comparison between various lithographic techniques. Etching: Wet Chemical Etching-basic process and few examples of etchants for semiconductors, insulators and conductors; Dry etching using plasma etching technique, lambda rule, scaling		

rules.

Metallization: Uses of Physical Vapor Deposition and Chemical Vapor Deposition technique for Aluminum and Copper Metallization.

Process Integration

11 Lectures

Passive components- Integrated Circuit Resistor, Integrated Circuit Inductor, Integrated Circuit Capacitor. Bipolar Technology: Basic fabrication process, Isolation techniques. MOSFET Technology: Basic fabrication process of NMOS, PMOS and CMOS technology.

Reference Books

- ▶ Gary S. May and S. M. Sze, Fundamentals of Semiconductor Fabrication, John Wiley & Sons (2004)
- ▶ Ludmila Eckertova, Physics of Thin films, 2nd Edition, Plenum Press (1986).
- ▶ Ghandhi, VLSI Fabrication Principles Wiley
- ▶ S. M. Sze, Semiconductor Devices: Physics & Technology 3e Wiley.
- ▶ Plummer, Silicon VLSI Technology Pearson
- ▶ Weste, CMOS VLSI Design: A Circuits and Systems Perspective, 4e Pearson
- ▶ Campbell, Science & Engineering Of Microelectronic Fabrication 2e Oxford

4.8 DSE P4 - Semiconductor Fabrication and Characterization Lab

Semiconductor Fabrication and Characterization		
	Credits	2
List of Practical		
1. To measure the resistivity of semiconductor crystal with temperature by four -probe method. 2. To determine the type (n or p) and mobility of semiconductor material using Hall- effect. 3. Oxidation process Simulation 4. Diffusion Process Simulation 5. To design a pattern using photolithographic process and its simulation 6. Process integration simulation 7. Fabrication of thin film using Spin Coating/Thermal Coating System. 8. Determination of Optical Bandgap through transmission spectra. [expensive]		

In case of non-availability of equipment simulation studies may be done in lieu of the last two experiments

4.9 DSE T5 - Electrical Machines

Electrical Machines		
	Credits	4
DC Machines, Generators and Motors		
DC Machines: Basic constructional features and physical principles involved in electrical machines, armature winding (ac and dc), lap and wave connections, different types of pitches D.C. Generators: Construction and principles of operation, brief idea about armature reaction and commutation, E.M.F. Equation, Methods of excitation, and Characteristics of Self excited and separately (Shunt and Series) excited generators, Losses and efficiency, applications. D.C. Motors: Comparison of generator and motor action & interchangeability, principle of operation, significance of back EMF, maximum power, Torque and speed relation, Characteristics of series, shunt and excited motors & applications, losses & efficiency, necessity of motor starters, Three point starter, Speed control of DC motors, electronic speed control of DC motors. Single phase transformer Principle, construction and operation, phasor diagrams, equivalent circuits, parameters from open and short circuit tests, load tests, temperature rise, different losses, efficiency, regulation) These should added.		
Poly Phase Induction Motors and Single Phase Motors		
Poly Phase Induction Motors: General constructional features, Types of rotors, Rotating magnetic field, Induction motor as a generalized transformer, equivalent circuit, Production of torque, Slip, Torque equation, Torque-slip characteristics. Comparison with DC motor Single Phase Motors: Single phase induction motors, double revolving field theory, Split phase motors, capacitor start motors, capacitor start & run motors, Stepper Motor, Universal motor, Brush less DC motor and PMDC motor.		
Synchronous Machines		
Synchronous Machines: Brief construction details of three phase synchronous generators, E.M.F. equation, excitation system for synchronous generator.		

Reference Books

- ▶ I. J. Nagrath and D. P. Kothari, Electrical Machines, Tata McGraw Hill
- ▶ G. Mc. Pherson, An introduction to Electrical Machines & Transformers, John Wiley & Sons
- ▶ H. Cotton, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi
- ▶ S. Ghose, Electrical Machines, Pearson Education
- ▶ N. K. De and P. K. De, Electric Drives, Prentice Hall of India
- ▶ Ashfaq Husain, Electrical Machines, Dhanpat Rai & Co.
- ▶ B.L. Thareja, A.K. Thareja, A Textbook of Electrical Technology-Vol-II, S.Chand

4.10 DSE P5 - Electrical Machines Lab

Electrical Machines		
	Credits	2
List of Practical		
1. Study of characteristics of DC Series motor. 2. Speed control of DC Shunt motor. 3. Study of load characteristics of single phase induction motor. 4. Study of load characteristics of three phase squirrel cage induction motor. 5. Study of speed control of shunt DC motor using SCR. 6. Study of Open Circuit Test on single phase transformer. 7. Study of Short Circuit Test on single phase transformer.		

4.11 DSE T6 - Basic VLSI Design

Basic VLSI Design		
	Credits	4
Metal Oxide Semiconductor (MOS):		
Introduction to basic principle of MOS transistor, large signal MOS models (long channel) for digital design. MOS SPICE model, MOS device layout: Transistor layout, Inverter layout, CMOS digital circuit layout; Effects of scaling on MOS behaviour		
MOS Inverter		
Inverter principle, Depletion and enhancement load inverters, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, Dynamic behavior, Propagation Delay and Power Consumption.		
Combinational MOS Logic Design		
Static MOS design, Pass Transistor logic, complex logic circuits. Sequential MOS Logic Design - Static latches, Flip flops & Registers, Dynamic Latches & Registers, CMOS Schmitt trigger, Monostable sequential Circuits, Astable Circuits. Concept of BICMOS circuits		
Memory Design		
ROM & RAM cells design. Dynamic MOS design- Dynamic logic families and performances. Interconnect & Clock Distribution- Interconnect delays, Cross Talks, Clock Distribution.		
Reference Books		
▶ Kang & Leblebici "CMOS Digital IC Circuit Analysis & Design"- McGraw Hill, 2003. ▶ Rabey, "Digital Integrated Circuits Design", Pearson Education, Second Edition, 2003. ▶ Weste and Eshraghian, "Principles of CMOS VLSI design" Addison-Wesley, 2002. ▶ Basic VLSI design: Douglas A Pucknell, Kamran Eshraghian, PHI, 3rd edition ▶ Angsuman Sarkar et.al. VLSI Design and EDA Tools 2nd Ed , Scitech ▶ Ken Martin Digital Integrated Circuit Design		

4.12 DSE P6 - Basic VLSI Design Lab

Basic VLSI Design		
	Credits	2
Implementation using hardware and/or circuit simulation software		
List of Practical		
1. To plot the output characteristics & transfer characteristics of an n-channel and p-channel MOSFET. 2. To design and plot the static (VTC) and dynamic characteristics of a digital CMOS inverter. 3. To design and plot the output characteristics of a 3-inverter ring oscillator. 4. To design and plot the dynamic characteristics of 2-input NAND, NOR, XOR and XNOR logic gates using CMOS technology. 5. To design and plot the characteristics of a 4×1 digital multiplexer using pass transistor logic 6. To design and plot the characteristics of a positive and negative latch based on multiplexers. 7. To design and plot the characteristics of a master-slave positive and negative edge triggered registers based on multiplexers		

4.13 DSE T7 - Digital Signal Processing

Digital Signal Processing		
	Credits	4
Discrete Time systems		
Discrete sequences, linear coefficient difference equation, Representation of DTS, LSI Systems. Stability and causality, frequency domain representations and Fourier transform of DT sequences.		
Z-transform and System Function		
Concept of pole-zero, properties of pole-zeroes Synthesis of two terminal reactive networks, Foster's Reactance Theorem, Network realization of reactance function, Canonic Networks, Continued fraction Networks (Cauer Networks), numerical. Synthesis of Two terminal R-C & R-L networks, Positive Real Functions, numerical.		
Discrete Fourier Transform		
DFT assumptions and Inverse DFT. Matrix relations, relationship with FT and its inverse, circular convolution, DFT theorems, DCT. Computation of DFT. FFT Algorithms and processing gain, Discrimination, interpolation and extrapolation. Gibbs phenomena. FFT of real functions interleaving and resolution improvement. Word length effects.		
Digital Filters		
Analog filter review-Concept of Filters in signal processing,filter parameters ,Concept of LP, HP, BP, Notch Filter ,types of filters - Butterworth, Chebyshev. System function for IIR and FIR filters, network representation. Canonical and decomposition networks. IIR filter realization methods and their limitations. FIR filter realization techniques. Discrete correlation and convolution; Properties and limitations		
Reference Books		
▶ A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989. ▶ John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.		

- ▶ Anand Kumar Digital Signal Processing, 2nd ed. ▶ PHI
- ▶ Udayashankara Modern Digital Signal Processing includes Signals and Systems, MATLAB Programs, DSP Architecture with Assembly and C Programs, 3rd ed. ▶ PHI
- ▶ Ramesh Babu Digital Signal Processing - 6th Edn. Scitech

4.14 DSE P7 - Digital Signal Processing Lab

Digital Signal Processing		
	Credits	2
Scilab/MATLAB/Other Mathematical Simulation software		
List of Practical		
1. Generation of unit sample sequence, unit step, ramp function, discrete time sequence, real sinusoidal sequence. 2. Generate and plot sequences over an interval. 3. Given $x[n]$, write program to find $X[z]$. 4. Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform 5. Design of a Butterworth analog filter for low pass and high pass. 6. Design of digital filters.		

4.15 DSE T8 - Control Systems

Control Systems		
	Credits	4
Introduction to Control Systems		
Open loop and Closed loop control systems, Mathematical modeling of physical systems (Electrical, Mechanical and Thermal) block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems		
Time Domain analysis & Concept of Stability		
Time Domain Analysis: Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, Performance indices. Concept of Stability: Asymptotic stability and conditional stability, Routh - Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.		
Frequency Domain Analysis:		
Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.		
State Space Analysis, Controllers and Compensation Techniques		
State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties. Controllers and Compensation Techniques: Response with P, PI and PID Controllers, Concept of compensation, Lag, Lead and Lag-Lead networks		
Reference Books		
▶ J. Nagrath & M. Gopal, Control System Engineering, New Age International, 2000 ▶ K. Ogata, Modern Control Engineering, PHI 2002 ▶ B. C. Kuo, "Automatic control system", Prentice Hall of India, 2000 ▶ Nise Control System Engineering Wiley		

► B.Manke Control System Khanna Publishers

4.16 DSE P8 - Control Systems Lab

Control Systems		
	Credits	2
Implementation using Hardware and circuit simulation software		
List of Practical		
1. To study characteristics of: a. Synchro transmitter receiver, b. Synchro as an error detector 2. To study position control of DC motor 3. To study speed control of DC motor 4. To find characteristics of AC servo motor 5. To study time response of type 0, 1 and 2 systems 6. To study frequency response of first and second order systems 7. To study time response characteristics of a second order system. 8. To study effect of damping factor on performance of second order system 9. To study frequency response of Lead and Lag networks. 10. Study of P, PI and PID controller.		

4.17 DSE T9 - Computer Networks

Computer Networks		
	Credits	4
Data Communication and Switching		
Data Communications : Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview ,topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media- guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching		
Data Link Layer and Medium Access Sub layer		
Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to -Point Access: PPP Point -to- Point Protocol, PPP Stack, Error Detection and Correction codes (Parity, Checksum, CRC and Hamming) Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for Ethernet LAN and WLAN, introduction to high-speed LANs (Gigabit Ethernet, Jumbo Frames), Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.		
Network layer		
Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6, ICMPV6.		
Transport Layer and Application Layer		
Transport Layer: Process to Process Delivery: UDP; TCP		

Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Introductory Concepts of Security: Authentication and Encryption

Reference Books

- ▶ S. Tannenbum, D. Wetherall, "Computer Networks", Prentice Hall, Pearson, 5th Edition
- ▶ Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, 4th Edition
- ▶ Douglas Comer, "Internetworking with TCP/IP", Pearson
- ▶ Jim Kurose, "Computer Networking: A Top-down Approach Featuring the Internet" Pearson.
- ▶ Gupta Data Communications and Computer Networks, 2nd ed.▶
- ▶ Peterson Davie, Computer Networks - A Systems Approach, Harcourt Butler
- ▶ Kundu, Fundamentals of Computer Networks, 2 Ed, PHI

4.18 DSE P9 - Computer Networks Lab

Computer Networks		
	Credits	2
List of Practical		
1. Setting up off LAN a. Identification of networking components: i. Newtork Cables (CAT 5,6) ii. Network Jack and Crimping Process iii. Understading the NIC b. Setting up of Local LAN (in windows and LINUX) using switch in a client server mode. c. Creating workgroups in the same LAN d. Setting up a system as a Gateway (this should have at least two NIC interfaces) and making two LANs with the Gateway machine as the router (this should be done in LINUX). 2. Introduction to Discrete Event Simulation - Discrete Event Simulation Tools - ns2/ns3, Omnet++ 3. Using Free Open Source Software tools for network simulation of telnet and ftp between N sources - N sinks (N = 1, 2, 3). Evaluate the effect of increasing data rate on congestion. 4. Using Free Open Source Software tools for network simulation for http, ftp and DBMS access in networks 5. Using Free Open Source Software tools for network simulation to study effect of VLAN on network performance - multiple VLANs and single router. 6. Using Free Open Source Software tools for network simulation to study the performance of wireless networks		

4.19 DSE T10 - Nanoelectronics

Nanoelectronics		
	Credits	4
Introduction to Nanoelectronics		
Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-Technology. Introduction to Physics of Solid State: Size dependence of properties, bonding in atoms and giant molecular solids, Electronic conduction, Systems confined to one, two or three dimension and their effect on property Quantum Theory for Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials. Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Coulomb Blockade, Density of States for confinement in one, two and three dimension, Infrared detectors; Quantum dot laser Superconductivity. Ballistic transport		
Growth Techniques of Nanomaterials		
Synthetic aspects: bottom up and top down approaches, Lithographic and Nonlithographic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO₂ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition (CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid-Solid (VLS) method of nanowire growth		
Methods of Measuring Properties and Characterization techniques:		
Microscopy: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) including energy dispersive X-ray (EDX) analysis, low energy electron diffraction (LEED),		

reflection high energy electron diffraction (RHEED)

Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy

Application of Nanoelectronics

Carbon nanotubes, nano cuboids, graphene, carbon quantum dots: Fabrication, structure. Electrical, mechanical, and vibrational properties and applications. Use of nano particles for biological application, drug delivery and bio-imaging, Impact of nanotechnology on the environment.

Reference Books

- ▶ Hanson Fundamentals of Nanoelectronics Pearson
- ▶ Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
- ▶ Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.
- ▶ Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
- ▶ Chattopadhyay & Banerjee, Introduction to Nanoscience and Nanotechnology PHI
- ▶ Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.
- ▶ Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.
- ▶ Quantum dot heterostructures, Wiley, 1999.
- ▶ Modern magnetic materials: principles and applications, John Wiley & Sons, 2000.
- ▶ Nano: The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
- ▶ Nanobiotechnology, concepts, applications and perspectives, Wiley-VCH, 2004.

4.20 DSE P10 - Nanoelectronics Lab

Nanoelectronics		
	Credits	2
List of Practical		
1. Synthesis of at least two different sizes of Nickel Oxide/ Copper Oxide/ Zinc Oxide Nano Particles Using Sol-Gel Method 2. Polymer synthesis by suspension method / emulsion method 3. Electrical Characterisation of nanomaterials. 4. Magnetoresistance of thin films and nanocomposite, I-V characteristics and transient response. 5. Particle size determination by X-ray diffraction (XRD) and XRD analysis of the given XRD spectra 6. Determination of the particle size of the given materials using He-Ne LASER. 7. Selective area electron diffraction: Software based structural analysis based on TEM based experimental data from published literature. (Note: Later experiment may be performed in the lab based on availability of TEM facility). 8. Surface area and pore volume measurements of nanoparticles (a standard sample and a new sample (if available)). 9. UV-VIS Spectroscopic characterization of metallic, semiconducting and insulating nanoparticles		

4.21 DSE T11 - Embedded Systems

Embedded Systems		
	Credits	4
Introduction to Embedded Systems:		
Overview of Embedded Systems, Features, Requirements and Applications. Range of embedded systems : CPU size and complexity; memory size; I/O handling variations; use of OS-es with single or multitasking Recent Trends in the Embedded System Design, Common architectures for the Embedded System Design, Embedded Software design issues. Introduction to microcontrollers, Overview of Harvard architecture and Von Neumann architecture, RISC and CISC microcontrollers		
AVR RISC Microcontrollers:		
Introduction to AVR RISC Microcontrollers, Architecture overview, status register, general purpose register file, memories, Instruction set, Data Transfer Instructions, Arithmetic and Logic Instructions, Branch Instructions, Bit and Bit-test Instructions, MCU Control Instructions. Simple programs in Assembly Language / C Language. Use of Cross-Compiler.		
Interrupts and Timer		
Introduction to System Clock, Reset sources, Introduction to interrupts, External interrupts, IO Ports, 8-bit and 16-bit Timers, introduction to different modes, Input Capture and Compare Match.		
Peripherals:		
Analog Comparator, Analog-to-Digital Converter, Serial Peripheral Interface (SPI, The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART), Two Wire Interface (TWI) / I2C bus, USB Concepts.		
Reference Books		
▶ AVR Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, PHI ▶ Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002		

- ▶ Programming and Customizing the AVR Microcontroller by D V Gadre, McGraw- Hill
- ▶ Atmel AVR Microcontroller Primer: Programming and Interfacing by Steven F. Barrett, Daniel J. Pack, Morgan & Claypool Publishers
- ▶ An Embedded Software Primer by David E Simon, Addison Wesley
- ▶ AVR Microcontroller Datasheet, Atmel Corporation, www.atmel.com
- ▶ Chattopadhyay Embedded System Design, 2nd ed.▶ .
- ▶ Kenneth J. Ayala, The 8051 Microcontroller, Third Edition, Thomson.
- ▶ Lewis Fundamentals of Embedded Software with the ARM Cortex-M3, Pearson

4.22 DSE P11 - Embedded Systems Lab

Embedded Systems		
	Credits	2
List of Practical		
AVR trainer kit based Experiments Lab is based on AVR (as covered in the theory course) but same experiments can be done with any other 16/32 bit Microcontroller like PIC. Flash LED at an observable rate. 1. Display custom characters on LCD using AVR Microcontroller 2. Interfacing AVR microcontroller with PC using USART 3. Interfacing SD Card with AVR Microcontroller 4. Phase Correct PWM (Pulse Width Modulation) Mode of AVR microcontroller Timer 5. Waveform Generation using AVR Microcontroller (Atmega16) Timers 6. Interfacing Servo Motor with AVR Microcontroller 7. Using I2C / TWI (Two Wire Interface) in AVR ATmega32 8. Designing Audio Tone Generator using AVR Microcontroller 9. Speed and Direction Control of Stepper Motor using AVR Microcontroller 10. Designing Watchdog System Monitor		

4.23 DSE T12 - Biomedical Instrumentation

Biomedical Instrumentation		
	Credits	4
Biomedical signals & Physiological transducers		
Source of biomedical signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG & EEG .Physiological transducers: Pressure, Temperature, photoelectric & ultrasound Transducers. Measurement in Respiratory system: Physiology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators & Respirators , Humidifiers , Nebulizers Aspirators, Biomedical recorders: ECG, EEG & EMG. MEMS based biosensors		
Patient Monitoring systems & Audiometers:		
Cardiac monitor, Bedside patient monitor, measurement of heart rate, blood pressure, temperature, respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity. Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyzers.		
Modern Imaging systems		
Introduction, Basic principle & Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR), ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, surgical diathermy machine.		
Patients safety & Computer Applications in Biomedical field & Physiotherapy		
Patients safety & Computer Applications in Biomedical field: Precaution, safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Use of microprocessors in medical instruments, Microcontrollers, PC based medical instruments, Computerized Critical care units, Planning & designing a computerized critical care unit. Physiotherapy: Software Diathermy, microwave diathermy, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.		
Reference Books		

- ▶ Joseph J. Carr & John M. Brown, "Introduction to Biomedical Equipmen Technology", Pearson.
- ▶ Shakti Chatterjee, "Textbook of Biomedical Instrumentation System", Cengage Learning
- ▶ Ananda Natarajan Biomedical Instrumentation and Measurements, 2nd ed. ▶ PHI
- ▶ Bertil Jacobson & John G. Webster - Medicine and Clinical Engineering, PHI
- ▶ Prof. S.K.VenkataRam-Bio-Medical Electronics and Instrumentation, Galgotia Publications
- ▶ John G.Webster- Medical Instrumentation-Application and Design Wiley Student Edition)
- ▶ L.Cromwell et al- Biomedical Instrumentation and Measurements PHI

4.24 DSE P12 - Biomedical Instrumentation Lab

Biomedical Instrumentation		
	Credits	2
List of Practical		
1. Characterization of bio potential amplifier for ECG signals. 2. Study on ECG simulator 3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator 4. Study of pulse rate monitor with alarm system 5. Determination pulmonary function using spirometer (using mechanical system). 6. Measurement of respiration rate using thermister /other electrodes. 7. Study of Respiration Rate monitor/ apnea monitor 8. Study on ultrasound transducers based on medical system 9. Study of a Pacemaker. 10. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.		

4.25 DSE T13 - Transmission Lines, Antenna and Wave Propagation

Transmission Lines, Antenna and Wave Propagation		
	Credits	4
Electromagnetic Wave Propagation		
Radio wave propagation : modes of propagation ,ionosphere refractive index, MUF,critical frequency,virtual height, ducting Propagation in Good Conductors, Skin Effect, Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection at Oblique Incidence, Wave propagation in dispersive media, concept of phase velocity and group velocity.		
Transmission Lines:		
Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanar and Slot Lines, Transmission Line Parameters, Transmission Line Equations, Wave propagation in Transmission lines, lowloss, lossless line, Distortionless line, Input Impedence, Standing Wave Ratio ,Power. and lossy lines, Shorted Line, Open-Circuited Line, Matched Line, Smith Chart, Transmission Line Applications.		
Waveguides and Waveguide Devices:		
Wave propagation in waveguides, Parallel plate waveguides, TEM, TM and TE modes, Rectangular waveguides, circular waveguides, Power transmission and attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator.		
Radiation of Electromagnetic waves and Types of Antenna		
Radiation of electromagnetic waves: Concept of retarded potentials, Antenna Parameters: Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance Antenna Radiation Efficiency, Effective Length and Equivalent Areas, Maximum Directivity and Maximum Effective Area, Friis Transmission Equation and Radar Range Equation Types of Antenna: Hertzian dipole, Half wave dipole, Quarter-wave dipole, Yagi-Uda, microstrip,		

Parabolic antenna, Helical antenna, Antenna array.

Reference Books

- ▶ M. N. O. Sadiku, Principles of Electromagnetics, Oxford University Press (2001)
- ▶ Karl E. Longren, Sava V. Savov, Randy J. Jost., Fundamentals of Electromagnetics with MATLAB, PHI
- ▶ W. H. Hayt and J.A. Buck, Engineering Electromagnetics, Tata McGraw Hill (2006)
- ▶ D. C. Cheng, Field and Wave Electromagnetics, Pearson Education (2001)
- ▶ J. A. Edminster, Electromagnetics, Schaum Series, Tata McGraw Hill (2006)
- ▶ N. Narayan Rao, Elements of Engineering Electromagnetics, Pearson Education (2006)
- ▶ G. S. N. Raju, Antennas and Propagation, Pearson Education (2001)
- ▶ Pramanik, Electromagnetism: Problems with Solutions, 3rd ed. PHI

4.26 DSE P13 - Transmission Lines, Antenna and Wave Propagation Lab

Transmission Lines, Antenna and Wave Propagation		
	Credits	2
Scilab/MATLAB/Other Mathematical Simulation Software		
List of Practical		
1. Program to determine the phasor of forward propagating field 2. Program to determine the instantaneous field of a plane wave 3. Program to find the Phase constant, Phase velocity, Electric Field Intensity and Intrinsic ratio 4. Program to find skin depth, loss tangent and phase velocity 5. Program to determine the total voltage as a function of time and position in a loss less transmission line 6. Program to find the characteristic impedance, the phase constant and the phase velocity 7. Program to find the output power and attenuation coefficient 8. Program to find the power dissipated in the lossless transmission line 9. Program to find the total loss in lossy lines 10. Program to find the load impedance of a slotted line 11. Program to find the input impedance for a line terminated with pure capacitive impedance 12. Program to determine the operating range of frequency for TE₁₀ mode of air filled rectangular waveguide 13. Program to determine Directivity, Bandwidth, Beamwidth of an antenna 14. Program to determine diameter of parabolic reflector 15. Program to find out minimum distance between primary and secondary antenna 16. Simple problems using Smith Chart		

4.27 DSE T14 - Nanoelectronics, Science and Growth Technologies

Nanoelectronics, Science and Growth Technologies		
	Credits	4
Definition		
Definition of Nano-Science and Nano Technology, distinction between micro, meso and nano domain. Applications of Nano- Technology. Moore`s empirical law and limitation in nano domain. Semiconductor device road map.		
Introduction to Physics of Solid State at Low Dimension		
Overview of Quantum Mechanics of Free and confined electrons; Size dependence of transport properties; hetero-junction, Superlattice, Quantum and Nano-structures structures (Quantum Wells, Wires and Dots); Size dependent DOS, Coulomb Blockade and Quantum Capacitance. Impact of nanotechnology on the environment health.		
Low dimensional structures		
Basic idea of graphene and Carbon nanotubes, nano cuboids. Nano-bio interface.		
Applications Nano structures		
HBTs, NW-FET, CNT-FET, Spintronics, SET, Memristors etc.		
Nano-Fabrication Technology		
Concept of “top down” and “bottoms up” approach. Top down and bottoms-up approach. Lithographic/non-lithographic techniques.		
Top-down Approach- Necessity of clean a room. Si processing methods: Crystal growth techniques, epitaxial deposition methods ; Wafer preparation - Cleaning , Etching Techniques ; Oxidation: Thermal Oxidation Process: Kinetics of Growth , Dry and Wet oxidation; Diffusion: Basic Diffusion Process: Diffusion Equation, Diffusion Profiles, Ion Implantation, different lithographic techniques, lambda rule, scaling rules , Metallization approaches.		
Bottom - up approach - I Self-assembly - mono layers, layer-by layer assembly, control of position and diameter. Sputtering and film deposition , Thermal evaporation technique, E-beam		

evaporation, Chemical Vapour deposition(CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Chemical bath deposition, Ion beam deposition system.

Reference Books

- ▶ Hanson Fundamentals of Nanoelectronics Pearson
- ▶ Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
- ▶ Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.
- ▶ Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
- ▶ Chattopadhyay & Banerjee, Introduction to Nanoscience and Nanotechnology PHI
- ▶ Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.
- ▶ Quantum dot heterostructures, Wiley, 1999.
- ▶ Modern magnetic materials: principles and applications, John Wiley & Sons, 2000.
- ▶ Nano: The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
- ▶ Nanobiotechnology, concepts, applications and perspectives, Wiley-VCH, 2004.
- ▶ Ghandhi VLSI Fabrication Principles Wiley
- ▶ Sze Semiconductor Devices : Physics & Technology 3e Wiley.
- ▶ Plummer Silicon VLSI Technology Pearson
- ▶ Weste CMOS VLSI Design: A Circuits and Systems Perspective, 4e Pearson
- ▶ Campbell Science & Engineering Of Microelectronic Fabrication 2e Oxford

4.28 DSE P14 - Nanoelectronics, Science and Growth Technologies

Nanoelectronics, Science and Growth Technologies		
	Credits	2
List of Practical		
1. Synthesis of at least two different sizes of Nickel Oxide/ Copper Oxide/ Zinc Oxide nano-particles using Sol-Gel method. 2. Polymer synthesis by suspension method / emulsion method. 3. Selective area electron diffraction: Software based structural analysis based on TEM based experimental data from published literature. (Note: Later experiment may be performed in the lab based on availability of TEM facility). 4. To measure the resistivity of semiconductor crystal with temperature by four - probe method. 5. To determine the type (n- or p-) and mobility of semiconductor material using Hall-effect. 6. Oxidation process Simulation. 7. Diffusion Process Simulation. 8. To design a pattern using photolithographic process and its simulation process integration simulation		

5.Skill Enhancement Subjects Syllabus

5.1 SEC T1 - Design and Fabrication of Printed Circuit Boards

Design and Fabrication of Printed Circuit Boards		
	Credits	2
PCB Fundamentals		
PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD). Classification of PCB - single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards.		
Schematic & Layout Design:		
Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding.		
Technology OF PCB:		
Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper clad laminates materials of copper clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls.		
PCB Technology:		
Trends, Environmental concerns in PCB industry.		
Reference Books		
▶ Printed circuit Board - Design & Technology by Walter C. Bosshart, Tata McGraw Hill. ▶ Printed Circuit Board -Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGraw Hill Publisher.		

5.2 SEC T2 - Robotics

Robotics		
	Credits	2
Programming Environments:		
Integrated Development Environment (IDE) for AVR microcontrollers, free IDEs like AVR Studio, WIN AVR. Installing and configuring for Robot programming, In System Programmer (ISP), loading programmes on Robot		
Actuators:		
DC Motors, Gearing and Efficiency, Servo Motors, Stepper motors, Motor Control and its implementations		
Sensors:		
White line sensors, IR range sensor of different range, Analog IR proximity sensors, Analog directional light intensity sensors, Position encoders, Servo mounted sensor pod/Camera Pod, Wireless colour camera , Ultrasound scanner , Gyroscope and Accelerometer , Magnetometer, GPS receiver, Battery voltage sensing, Current Sensing		
LCD interfacing and other operations of robotics		
LCD interfacing with the robot (2 x 16 Characters LCD) Other indicators: Indicator LEDs, Buzzer Timer/Counter operations: PWM generation, Motor velocity control, Servo control, velocity calculation and motor position Control, event scheduling Communication: Wired RS232 (serial) Communication, Wireless ZigBee Communication, USB Communication, Simplex infrared Communication (IR remote to robot)		
Reference Books		
▶ Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014 ▶ Niku Introduction to Robotics Wiley ▶ GHOSAL ROBOTICS Oxford		

- ▶ Murphy Introduction to AI Robotics PHI
- ▶ Craig Introduction to Robotics: Mechanics and Control, 3e Pearson

5.3 SEC T3 - Mobile Application Programming

Mobile Application Programming		
	Credits	2
Introduction to Mobile Application Programming		
Introduction: What is mobile Application Programming, Different Platforms, Architecture and working of Android, iOS and Windows phone 8(operating system, Comparison of Android, iOS and Windows phone 8.functions)		
Android		
Android Development Environment: What is Android, Advantages and Future of Android, Tools and about Android SDK, Installing Java, Eclipse, and Android, Android Software Development Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs: Smartphone Emulators, Image Editing, Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: The AndroidManifest.xml File, Creating Your First Android Application. Android Framework Overview: The Foundation of OOP, The APK File, Android Application Components, Android Activities: Defining the User Interface, Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications, Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components. Views and Layouts, Buttons, Menus, and Dialogs, Graphics Resources in Android: Introducing the Drawables, Implementing Images, Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android Handling User Interface(UI) Events: An Overview of UI Events in Android, Listening for and Handling Events , Handling UI Events via the View Class, Event Callback Methods, Handling Click Events, Touchscreen Events, Keyboard Events, Context Menus, Controlling the Focus. Content Providers: An Overview of Android Content Providers, Defining a Content Provider, Working with a Database.		

Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers

Advanced Android: New Features in Android 4.4.

iOS and Windows

iOS Development Environment: Overview of iOS, iOS Layers, Introduction to iOS application development.

Windows phone Environment: Overview of windows phone and its platform, Building windows phone application.

Reference Books

- ▶ Beginning Android 4, Onur Cinar , Apress Publication
- ▶ Professional Android 4 Application Development, Reto Meier, Wrox
- ▶ Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, Apress
- ▶ Pradhan Composing Mobile App. Learn-Explore - Apply using Android Wiley
- ▶ RAJKAMAL MOBILE COMPUTING, 2/E Oxford
- ▶ Professional Windows 8 Programming: Application Development with C# and XML, Allen Sanders and Kevin Ashley, Wrox Publication
- ▶ Programming with Mobile Applications: Android, iOS, and Windows Phone 7 , Thomas Duffy, Course Technology, Cengage Learning 2013

5.4 SEC T4 - Internet and Java Programming

Internet and Java Programming		
	Credits	2
Internet		
Introduction, Understanding the Internet, Internet Addressing, Hardware Requirements to Connect to the Internet.		
Data types, Arrays, Operators, Flow control		
Branching, Looping. Classes, New Operator, Dot Operator, Method Declaration and Calling, Constructors, Inheritance, Super, Method Overriding Final, Finalize, Static, Package and Import Statement, Interface and Implements		
Exception Handling		
Exception Types, Uncaught and Calling, Nested Try Statements, Java Thread Model, and Thread, Runnable, Thread Priorities, Synchronization, Deadlock		
File Handling		
Input Stream, Output Stream, and File Stream. Applets-Tag, Order of Applet Initialization, Repainting, Sizing Graphics- Abstract Window Tool Kit Components		
Reference Books		
▶ Harley Hahn, The internet complete reference, Tata McGraw publicity,2nd Edition, 1997 ▶ Patrick Naughton, The Java hand book, Tata McGraw,1997 ▶ Rohit Khurana Programming with Java Vikas		

5.5 SEC T5 - Programming with Matlab

Programming with Matlab		
	Credits	2
MATLAB Basics		
The MATLAB environment - Basic computer programming - Variables and constants, operators and simple calculations - Formulas and functions - MATLAB toolboxes		
Matrices and vectors		
Matrix and linear algebra review - Vectors and matrices in MATLAB - Matrix operations and functions in MATLAB		
Computer programming		
Algorithms and structures - MATLAB scripts and functions (m-files) - Simple sequential algorithms - Control structures		
MATLAB programming and Numerical Simulations		
Matlab Programming		
Reading and writing data, file handling - Personalized functions - Toolbox structure - MATLAB graphic functions		
Numerical simulations		
Numerical methods and simulations - Random number generation - Montecarlo methods		
Reference Books		
▶ Hanselman Mastering Matlab. Pearson ▶ Rudrapratap Matlab Oxford ▶ Bansal Matlab Pearson ▶ Navas Lab Primer through Matlab PHI		

5.6 SEC T6 - Networking and Mobile Communications

Networking and Mobile Communications		
	Credits	2
Networking		
Concepts of networking: network layers, network hardware components. Layered protocol architecture-OSI : TCP .Physical media-topology, switching mechanism (circuit and packet switched systems) Comparison of various transmission media. Transport layer-Connection less and connection oriented protocols. Policies on flow control, error control, MAC-Ethernet, CSMA .. CD, ALOHA, FDDI Network layer-IPV4, ICMP, IGMP, introduction to routing and sub netting		
Mobile communication		
Evolution from PSTN, Cellular concept, frequency reuse, channel assignment strategies, system capacity, trucking and grade of service GSM-architecture, protocols, handover, security Physical layer-Wireless media-characteristics, modes of propagation, various loss mechanisms Multiplexing and multiple access techniques-FDM, TDM, FDMA,TDMA,CDMA,WCDMA NETWORKING-Mobile IP, dynamic host configuration protocol , wireless LAN technology standards,		
Studies on Blue tooth system		
To understand concept of Blue tooth technology, to study RF module, RS- 232C serial communication, Blue tooth protocol, different types of Blue tooth network		
Hands On		
Realtime Remote Monitoring System of Mobile Base Station using Quad-band GSM/GPRS modem. Understanding of GSM technology, its network, GSM capability & data services.Understanding RF environment & study of GSM network by actually connecting to the GSM environment by any service provider.		

Command Level Study

Real Time study of GSM 07.05 & 07.07 commands in various categories : Command concerning modem & sim card hardware, Network registration, Call control, Call setting, Call information, Phone Book, Serial link control, Message setting, Storing/restoring, Error message handling & survey

Reference Books

- ▶ Garg Mobile Computing Pearson
- ▶ Garg Principles and Applications of GSM Pearson
- ▶ Schiller Mobile Communications, 2e Pearson

5.7 SEC T7 - Circuit Modelling using PSPICE

Circuit Modelling using PSPICE		
	Credits	2
Introduction		
Introduction to PSpice software, file types, netlist commands.		
Basic Analysis		
DC, AC, Transient. Analog behavioral models (ABM): equations setup, IF statement, voltage/current/ frequency dependent sources. Advanced analyses: noise, Monte-Carlo.		
Circuit Modelling		
▶ I-V characteristic ▶ Temperature Effects ▶ Iterative solution of simple series circuit ▶ Solution of simple series circuit using an equation solver ▶ PSpice solution of simple series circuit ▶ PSpice I-V Characteristic ▶ PSpice I-V Characteristic with temperature dependence ▶ Thevenin solution ▶ Diode Models ▶ Diode Circuits ▶ Rectifier ▶ Clipping ▶ Zener Circuits ▶ Clipping ▶ MOSFETS ▶ PSpice AC, DC, transient, and bias point simulations ▶ MOSFET as a switch ▶ Resistive pull-up. ▶ Active pull-up. ▶ Drive an LED. ▶ Basic NMOS gate. ▶ Ohmic and SAT regions ▶ Bias with Current Source ▶ MOSFET Small-Signal Analysis ▶ Small-signal model. ▶ Common-source amplifier. ▶ Source-follower. ▶ Input and output impedance. ▶ Bipolar Junction Transistors ▶ PSpice AC, DC, transient, and bias point simulations ▶ BJT as a switch ▶ Drive an LED ▶ Drive a relay ▶ Biasing with Current Sources ▶ BJT Small-Signal Analysis ▶ Hybrid-pi model. ▶ Common-emitter amplifier. ▶ Emitter-follower. ▶ Input and output impedance. ▶ OPAMPS - analysis using subcircuits		
Reference Books		
▶ Rashid Programming with Pspice Pearson ▶ Sedra Pspice Oxford		

6. General Elective Subjects Syllabus

6.1 GE T1 - Electronic Circuits and PCB Designing

Electronic Circuits and PCB Designing		
	Credits	4
Network theorems (DC analysis only)		
Review of Ohms law, Kirchhoff's laws, voltage divider and current divider theorems, open and short circuits. Thevenin's theorem, Norton's theorem and interconversion, superposition theorem, maximum power transfer theorem.		
Semiconductor Diode and its applications and Zener diode regulator		
Semiconductor Diode and its applications: PN junction diode and characteristics, ideal diode and diode approximations. Block diagram of a Regulated Power Supply, Rectifiers: HWR, FWR- center tapped and bridge FWRs. Circuit diagrams, working and waveforms, ripple factor & efficiency(no derivations). Filters: circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator: circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.		
BJT & Small Signal amplifier, Transistor biasing, Voltage divider bias and Small Signal CE amplifier		
BJT and Small Signal amplifier: Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration: CE, CB, CC. Definition of α, β and γ and their interrelations, leakage currents. Study of CE Characteristics, Hybrid parameters. Transistor biasing: need for biasing, DC load line, operating point, thermal runaway, stability and stability factor. Voltage divider bias: circuit diagrams and their working, Q point expressions for voltage divider biasing. Small signal CE amplifier: circuit, working, frequency response, re model for CE configuration, derivation for A_v, Z_{in} and Z_{out}.		

Types of PCB, Layout and Artwork, Basic Artwork, Laminates and Photoprinting, Etching and Soldering

Types of PCB, Plated through holes technology, Surface Mount Technology (SMT).

Layout and Artwork: Layout Planning: General rules of Layout, Supply and Ground Conductors, Component Placing and mounting, Cooling requirement and package density, Layout check.

Basic artwork approaches, Artwork taping guidelines, General artwork rules: Artwork check and Inspection.

Laminates and Photoprinting: Properties of laminates, Types of Laminates, Manual cleaning process, Basic printing process for double sided PCB's, Photo resists, wet film resists, Coating process for wet film resists, Dry film resists

Etching and Soldering: Introduction, Etching machine, Etchant system. Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes. Soldering, Desoldering tools and Techniques.

Reference Books

- ▶ Electronic Devices and circuit theory, Robert Boylestad and Louis Nashelsky, 9th Edition, 2013, PHI
- ▶ Electronics text lab manual, Paul B. Zbar.
- ▶ Electric circuits, Joseph Edminister, Schaum series.
- ▶ Basic Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshrestha and D.C Gupta - TMH.
- ▶ Electronic devices, David A Bell, Reston Publishing Company/DB Tarapurwala Publ.
- ▶ Walter C. Bosshart "PCB DESIGN AND TECHNOLOGY" Tata McGraw Hill Publications, Delhi. 1983
- ▶ Clyde F. Coombs "Printed circuits Handbook" III Edition, McGraw Hill.

6.2 GE P1 - Electronic Circuits and PCB Designing Lab

Electronic Circuits and PCB Designing		
	Credits	2
List of Practical		
1. Verification of Thevenin's theorem 2. Verification of Super position theorem 3. Verification of Maximum power transfer theorem. 4. Half wave Rectifier - without and with shunt capacitance filter. 5. Centre tapped full wave rectifier - without and with shunt capacitance filter. 6. Zener diode as voltage regulator - load regulation. 7. Transistor characteristics in CE mode - determination of r_i, r_o and β. 8. Design and study of voltage divider biasing. 9. Designing of an CE based amplifier of given gain 10. Designing of PCB using artwork, its fabrication and testing. 11. Design, fabrication and testing of a 9 V power supply with zener regulator		

6.3 GE T2 - Digital System Design

Digital System Design		
	Credits	4
Number Systems and Boolean Algebra		
Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families		
Combinational Logic		
Combinational logic analysis and design: Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)		
Sequential Logic		
Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)		
VHDL		
VHDL: A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design. Language Elements, Introduction, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars		

and vector nets, Register type, Parameters. Operands, Operators, types of Expressions

Gate level modeling, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

Reference Books

- ▶ M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
- ▶ Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
- ▶ W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
- ▶ R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
- ▶ A Verilog HDL Primer - J. Bhasker, BSP, 2003 II Edition
- ▶ Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

6.4 GE P2 - Digital System Design Lab

Digital System Design		
	Credits	2
Hardware and Circuit Simulation Software		
List of Practical		
1. To verify and design AND, OR, NOT and XOR gates using NAND gates. 2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's. 3. Design a Half and Full Adder. 4. Design a Half and Full Subtractor. 5. Design a seven segment display driver. 6. Design a 4 X 1 Multiplexer using gates. 7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type). 8. Design a counter using D/T/JK Flip-Flop. 9. Design a shift register and study Serial and parallel shifting of data.		
VHDL		
1. Write code to realize basic and derived logic gates. 2. Half adder, Full Adder using basic and derived gates. 3. Half subtractor and Full Subtractor using basic and derived gates. 4. Clocked D FF, T FF and JK FF (with Reset inputs). 5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates. 6. Decoder (2x4, 3x8), Encoders and Priority Encoders. 7. Design and simulation of a 4 bit Adder. 8. Code converters (Binary to Gray and vice versa). 9. 2 bit Magnitude comparator. 10. 3 bit Ripple counter.		

6.5 GE T3 - Instrumentation

Instrumentation		
	Credits	4
DC and AC Indicating Instruments:		
Accuracy and precision, Types of errors, PMMC galvanometer, sensitivity, Loading effect, Conversion of Galvanometer into ammeter, Voltmeter and Shunt type ohmmeter, Multimeter.		
Oscilloscopes and Signal Generators		
Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronisation, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).		
Signal Generators: Audio oscillator, Pulse Generator, Function generators, Transducers		
Basic requirements of transducers, Transducers for measurement of non- electrical quantities: Types and their principle of working , measurement of Linear displacement, Acceleration, Flow rate, Liquid level, strain, Force, Pressure, Temperature.		
Data Acquisition Systems and Bio-Medical Instrumentation		
Data acquisition systems: Block diagram, brief description of preamplifier, signal conditioner, instrumentation amplifier, waveform generator, A/D and D/A converter blocks, computer controlled test and measurement system.		
Bio-medical instrumentation: Bio-Amplifiers: Bio potentials - Bio-electricity - Necessity for special types of amplifiers for biological signal amplifications - Different types of Bio-OP - Amps. Electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs.		
Reference Books		
▶ Electrical Measurement in Measuring Instruments. Goldwing E.W. and Widdies ▶ Electrical and Electronics Measurement and Instrumentation Sahwany A.K. ▶ Instrumentation devices and systems: Rangan, Sarma, Mani, TMH		

- ▶ Instrumentation measurement and analysis: Nakra B C, Chaudry K K, TMH
- ▶ Handbook of biomedical instrumentation: Khandpur R S, TMH
- ▶ Measurement systems applications and design: Doebelin E O, McGraw Hill, 1990.
- ▶ Electron measurements and instrumentation techniques: Cooper W D and Helfric A D, PHI, 1989.
- ▶ Biomedical instrumentation and measurements: Leslie-Cromwell, Fred J Weibell, Erich A Pfeiffer, PHI, 1994.
- ▶ Mechatronics - principles and applications, Godfrey C Onwubolu, Elsevier, 2006.

6.6 GE P3 - Instrumentation Lab

Instrumentation		
	Credits	2
List of Practical		
1. Design of multi range ammeter and voltmeter using galvanometer. 2. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge). 3. To determine the Characteristics of LVDT. 4. To determine the Characteristics of Thermistors. 5. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type. 6. Characterization of bio potential amplifier for ECG signals. 7. Study on ECG simulator. 8. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator. 9. Study of pulse rate monitor with alarm system. 10. Measurement of respiration rate using thermistor /other electrodes.		

6.7 GE T4 - Practical Electronics

Practical Electronics		
	Credits	4
Timer and PLL and Phase Locked Loop		
Timer and PLL: Functional block diagram of 555 timer, Monostable operation and its Application, Astable operation and its Applications, Phase Locked Loop: Functional block diagram - Phase detector / Comparator, Voltage Controlled Oscillator, Low pass filter, Applications: Frequency multiplier/ Division, AM detection		
Operational Amplifier		
Inverting and non-inverting amplifier, Op-amp parameters, Summing Amplifier, Difference Amplifier, Integrator, Differentiator, Instrumentation Amplifier, Audio Amplifier(LM386), Voltage to current converter, Current to Voltage converter, Sample and Hold circuits. First order active filters (Circuit diagram and formula only): low pass, high pass, band pass, band reject and all pass filters. Phase-shift & Wein bridge oscillator using op-amp.		
Transducers and A-D & D-A Conversion		
Transducers (Basic Working): Displacement transducers - Resistive (Potentiometric, Strain Gauges - Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge) Capacitive (diaphragm), Hall effect sensors, magneto-strictive transducers, Microphone, Touch Switch, Piezoelectric sensors, light(photo-conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature(electrical and non-electrical), Pressure sensor. A-D and D-A Conversion: D-A conversion: 4 bit binary weighted resistor type, circuit and working. Circuit of R-2R ladder- Basic concept. A-D conversion characteristics, successive approximation ADC. (Mention the relevant ICs for all).		
Data Acquisition using Arduino		
Arduino: Birth, Open Source community, Functional Block Diagram, Functions of each Pin, Arduino Development Boards: IDE, I/O Functions, Looping Techniques, Decision Making		

Techniques, Designing of 1st sketch, Programming of an Arduino (Arduino ISP) , Serial port Interfacing, Basic Interfacing and I/O Concept,

Interfacing LED, Switch, 7seg LED, and different sensors.

Reference Books

- ▶ Measurement Systems, 4/e, Doebelin McGraw Hill, New York, 1992.
- ▶ Electrical Measurements & Electronic Measurements by A.K. Sawhney
- ▶ Instrumentation- Devices and Systems By Rangan, Sarma, and Mani, Tata-McGraw Hill
- ▶ Electronic Instrumentation by H.S Kalsi, McGraw Hill
- ▶ Instrumentation measurements and analysis by Nakra & Choudhary
- ▶ Measurement & Instrumentation- DVS Murthy
- ▶ R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
- ▶ Electronic Sensor Circuits and Projects, III Volume, Forrest M Mims, Master Publishing Inc.
- ▶ Timer, Op Amp, and Optoelectronic Circuits & Projects, Forrest M Mims, Master Publishing Inc.
- ▶ Exploring Arduino, Jeremy Blum, Wiley
- ▶ Beginning Arduino, Michael McRoberts, Technology in Action
- ▶ Beginning Arduino Programming, Brian Evans ,Technology in Action
- ▶ Practical Arduino Engineering, Harold Timmis, Technology in Action
- ▶ Practical Arduino : Cool Projects for open source hardware, Jonathan Oser, Hugh Blemings, Technology in Action

6.8 GE P4 - Practical Electronics Lab

Practical Electronics		
	Credits	2
List of Practical		
1. Study of basic Monostable Multivibrator. 2. Study of basic Astable Multivibrator. 3. Light detection using 555 timer. 4. Rain alarm using 555 timer. 5. Motor control by PWM using 555 timer. 6. LED flasher circuit using 555 timer. 7. Analog lightwave Transmitter/Receiver using 555 timer. 8. Study of basic inverting and non-inverting amplifier. 9. Study of basic integrator circuit. 10. Study of basic differentiator circuit. 11. Study of Instrumentation Amplifier circuit 12. Design of first order LPF. 13. Study of first order HPF. 14. Designing of fiber optic based Transmitter /Receiver using LM386. 15. Temperature to voltage converter using 741. 16. Shadow sensing using 741 and LDR 17. Light based PWM using 741 and V-F converter. 18. Test the different Arduino Boards, Open-Source and Arduino Shields. 19. Install Arduino IDE and its development tool. 20. Develop a program to Blink LED for 1second. 21. Develop a program to interface Input Switches and output LEDs with development board (Arduino). 22. Interface 7 segment display with development board (Arduino). 23. Interface LM35 temperature sensor with Arduino and monitor temperature on serial monitor. 24. Interface DC motor using L293D Motor Driver. 25. Interfacing of various sensors with Arduino development board.		

6.9 GE T5 - Communication Systems

Communication Systems		
	Credits	4
Unit 1		
Noise and Transmission lines: Noise-Introduction, internal and external noises, signal to noise ratio and noise figure Amplitude Modulation/demodulation techniques: Block diagram of electronic communication system. Modulation-need and types of modulation-AM, FM & PM. Amplitude modulation - representation, modulation index, expression for instantaneous voltage, power relations, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only). Limitations of AM. Demodulation- AM detection: principles of detection, linear diode, principle of working and waveforms. Block diagram of AM transmitter and Receiver.		
Unit 2		
Frequency Modulation/demodulation techniques: Frequency Modulation: definition, modulation index, FM frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator. FM detector - principle, slope detector-circuit, principle of working and waveforms. Block diagram of FM transmitter and Receiver. Comparison of AM and FM.		
Unit 3		
Digital communication: Introduction to pulse and digital communications, digital radio, sampling theorem, types- PAM, PWM, PPM, PCM - quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits - Shannon limit for information capacity, bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer, MODEM- modes, classification, interfacing (RS232). TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA		

Unit 4

Cellular Communication: Concept of cellular mobile communication - cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

Satellite communication: Introduction, to Orbit, types of orbits, Block diagram of satellite transponder.

Reference Books

- ▶ Electronic Communication, George Kennedy, 3rd edition, TMH.
- ▶ Electronic Communication, Roddy and Coolen, 4th edition, PHI.
- ▶ Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.
- ▶ Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education

6.10 GE P5 - Communication Systems Lab

Communication Systems		
	Credits	2
List of Practical		
1. Amplitude modulator and Amplitude Demodulator. 2. Study of FM modulator using IC8038. 3. Study of VCO using IC 566. 4. Study of Time Division Multiplexing and Demultiplexing. 5. Study of AM Transmitter/Receiver. 6. Study of FM Transmitter/Receiver. 7. ASK modulator and Demodulator. 8. Study of FSK Modulation. 9. Study of PWM and PPM. 10. Study of PAM Modulator and Demodulator		

6.11 GE T6 - Microprocessor and Microcontroller System

Microprocessor and Microcontroller System		
	Credits	4
Unit 1		
Number systems: Binary, hexadecimal - conversion from binary to decimal and vice-versa, binary to hexadecimal and vice-versa, decimal to hexadecimal and vice versa, addition and subtraction of binary numbers and hexadecimal numbers. Subtraction using 2's complement, signed number arithmetic. Introduction to Microprocessor: Introduction, applications, basic block diagram, speed, word size, memory capacity, classification of microprocessors (mention different microprocessors being used) Microprocessor 8085: Features, architecture -block diagram, internal registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pin description of microprocessor 8085.		
Unit 2		
8085 Instructions: Operation code, Operand & Mnemonics. Instruction set of 8085, instruction classification, addressing modes, instruction format. Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions, branch instructions and machine control instructions. Stack operations, subroutine calls and return operations. Delay loops, use of counters, timing diagrams-instruction cycle, machine cycle, T- states, time delay Interrupt structure of 8085A microprocessor, processing of vectored and non-vectored interrupts, latency time and response time Interfacing of memory chips, address allocation technique and decoding; Interfacing of I/O devices, LEDs and toggle-switches as examples, memory mapped and isolated I/O structure; Input/output techniques: CPU initiated unconditional and conditional I/O transfer.		

Unit 3

Introduction to Microcontrollers: Basic block diagram, comparison of microcontroller with microprocessors, comparison of 8 bit, 16 bit and 32 bit microcontrollers.

MICROCONTROLLER 8051- architecture -internal block diagram, key features of 8051, pin diagram, memory organization, Internal RAM memory, Internal ROM. General purpose data memory, special purpose/function registers, external memory.

Counters and timers: 8051 oscillator and clock, program counter, TCON, TMOD, timer counter interrupts, timer modes of operation. Input / output ports and circuits/ configurations, serial data input / output - SCON, PCON, serial data transmission modes.

Unit 4

8051 Interrupts, Addressing modes and Instruction set: Interrupts - IE, IP, time flag interrupts, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations & software generated interrupts.

Addressing modes, immediate addressing, register addressing, direct and indirect addressing, Data transfer instructions, internal data move, external data move, code memory read-only data move, Push and Pop and data exchange instructions.

Logical Instructions, byte level logical operations, bit level logical operations, rotate and swap operations.

Arithmetic Instructions, flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic, simple programs in assembly language.

Timer/Counter Programming in 8051: Programming 8051 timers, counter programming, programming timers 0 and 1 in 8051 C

Reference Books

- ▶ Microprocessor Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
- ▶ Fundamentals of Microprocessor & Microcomputer: B. Ram-Danpat Rai Publications.
- ▶ Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. MCKinlay "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education 2008.
- ▶ Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006

6.12 GE P6 - Microprocessor and Microcontroller System Lab

Microprocessor and Microcontroller System		
	Credits	2
Microprocessor and Microcontroller System Lab		
1. Program to transfer a block of data. 2. Program for multibyte addition 3. Program for multibyte subtraction 4. Program to multiply two 8-bit numbers. 5. Program to divide a 16 bit number by 8 bit number. 6. Program to search a given number in a given list. 7. Program to generate terms of Fibonacci series. 8. Program to sort numbers in ascending/descending order. 9. Program to find the square root of an integer. 10. To study interfacing of IC 8255. 11. Program to verify the truth table of logic gates.		
8051 Microcontroller Programming		
1. Program to find the sum of N 8-bit numbers. 2. Program to find largest of N numbers. 3. Program to find smallest of N numbers 4. Program to find whether the given data is palindrome. 5. Program to arrange the numbers in ascending order. 6. Interfacing of stepper motor and Rotating stepper motor by N steps clockwise/anticlockwise with speed control. 7. LCD interfacing. 8. Speed control of DC motor using PWM (pulse delay to be implemented using timers).		

7. Appendix I - Scheme for CBCS Curriculum for Pass Course

7.1 Credit Distribution across Courses

Credits				
Course Type		Total Papers	Theory + Practical	Theory*+Tutorials
Core Courses	4 papers each from 3 disciplines of choice	12	12*4 =48	12*5 =60
			12*2 =24	12*1=12
Elective Courses	2 papers each from 3 discipline of choice including interdisciplinary papers	6	6*4=24	6*5=30
			6*2=12	6*1=6
Ability Enhancement Language Courses		2	2*2=4	2*2=4
Skill Enhancement Courses		4	4*2=8	4*2=8
Totals		24	120	120

*Tutorials of 1 Credit will be conducted in case there is no practical component

- All Pass courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from discipline of choice including Electronics as one of the disciplines. The details for core courses available in Electronics have been detailed in Section 3 of this document
- Student will select 2 core courses each from discipline of choice including Electronics as one of the disciplines. The details for elective courses available in Electronics have been detailed in Section 4 and 6 of this document
- Student may also chose Skill Enhancement courses in Electronics. The details for skill enhancement courses available in Electronics have been detailed in Section 5 of this document

7.2 Scheme for CBCS Curriculum

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course-I	English communication / Environmental Science	2
	Core course-I	Core Course 1A from Electronics	4
	Core course-I Practical	Core Course 1A Practical from Electronics	2
	Core course-II	Core Course 2A from other chosen discipline	4
	Core course-II Practical	Core Course 2A Practical from other chosen discipline	2
	Core course - III	Core Course 3A from other chosen discipline	4
	Core course - III Practical	Core Course 3A Practical from other chosen discipline	2
II	Ability Enhancement Compulsory Course-II	English communication / Environmental Science	2
	Core course-IV	Core Course 1B from Electronics	4
	Core course-IV Practical	Core Course 1B Practical from Electronics	2
	Core course-V	Core Course 2B from other chosen discipline	4
	Core course- V Practical	Core Course 2B Practical from other chosen discipline	2
	Core course - VI	Core Course 3B from other chosen discipline	4
	Core course - VI Practical	Core Course 3B Practical from other chosen discipline	2
III	Core course VII	Core Course 1C from Electronics	4
	Core course-VII Practical	Core Course 1C Practical from Electronics	2
	Core course - VIII	Core Course 2C from other chosen discipline	4
	Core course - VIII Practical	Core Course 2C Practical from other chosen discipline	2
	Core course-IX	Core Course 3C from other chosen discipline	4
	Core course-IX Practical	Core Course 3C Practical from other chosen discipline	2
	Skill Enhancement Course-1	TBD	2

IV	Core course-X	Core Course 1D from Electronics	4
	Core course - X Practical	Core Course 1D Practical from Electronics	2
	Core course-XI	Core Course 2D from other chosen discipline	4
	Core course-XI Practical	Core Course 2D Practical from other chosen discipline	2
	Core course-XII	Core Course 3D from other chosen discipline	4
	Core course-XII Practical	Core Course 3D Practical from other chosen discipline	2
	Skill Enhancement Course-2	TBD	2
V	Skill Enhancement Course - 3	TBD	2
	Discipline Specific Elective 1	DSE 1A from Electronics	4
	Discipline Specific Elective 1 Practical	DSE 1A Practical from Electronics	2
	Discipline Specific Elective 2	DSE 2A from other chosen discipline	4
	Discipline Specific Elective 2 Practical	DSE 2A Practical from other chosen discipline	2
	Discipline Specific Elective 3	DSE 3A from other chosen discipline	4
	Discipline Specific Elective 3 Practical	DSE 3A Practical from other chosen discipline	2
VI	Skill Enhancement Course - 4	TBD	2
	Discipline Specific Elective 4	DSE 1B from Electronics	4
	Discipline Specific Elective 4 Practical	DSE 1B Practical from Electronics	2
	Discipline Specific Elective 5	DSE 2B from other chosen discipline	4
	Discipline Specific Elective 5 Practical	DSE 2B Practical from other chosen discipline	2
	Discipline Specific Elective 6	DSE 3B from other chosen discipline	4
	Discipline Specific Elective 6 Practical	DSE 3B Practical from other chosen discipline	2

