Syllabus

For

B.Sc. (Honours) Electronics

Submitted to

KAZI NAZRUL UNIVERSITY

Under

Choice Based Credit System
(From Session 2019-2020)

Department of Electronics
Kazi Nazrul University
Asansol, Burdwan, W.B.

Semester-I

Core Course – I Credit - 6 (L-5 & T-1 Per Week)

MATHEMATICAL METHODS - I& SOLID STATE ELECTRONICS –I

Mathematical Methods-I (FM - 25) 30 Lectures

Vector Analysis

Basic operations vector addition and subtraction, Product of Vectors – Scalar (dot) & Vector (cross), important identities, Cartesian, Cylindrical and Spherical co-ordinates, Differentiation and integration of vectors, gradient, Divergence, Curl, Gauss', Stokes, and Green's theorems. [10]

Differential Equation

Solutions of homogeneous and inhomogeneous (first and second order) equations – constant and variable coefficients, Power series solution, illustration by Bessel, Special Partial differential equation, solution by separation of variables, Laplace transformation technique of solving differential equation [14]

Fourier Series

Set of functions – linear independence and completeness, Fourier's Theorem, Analysis of simple waveforms using Fourier series, Fourier Transform (Idea only).

[06]

Text and References:

Mathematical Methods: Vector analysis, Spiegel – TMH
Higher Engineering Mathematics – B S Grewal, Khanna pub.
Advanced Engineering Mathematics, Kreyszig, John Wiley
Mathematical methods for physicists, Weber and Arfken , and Harris, Elsevier.
Mathematical Physics, Ghatak, Goyal and Chua, Macmillan
Mathematical Methods, M.C. Potter and J. Goldberg, PHI

Solid State Electronics-I (FM-25) 30 lectures

Classification of solids as metals, insulators and semiconductor, intrinsic and extrinsic semiconductor, degenerate and non-degenerate, direct and indirect band gap, drift and diffusion process, elemental and compound semiconductors, donor and acceptor, ionization energy of impurity semiconductor, Fermi–Dirac Statics and electron distribution in solids, Density of states and Fermi energy, Fermi distribution function, Electron scattering and source of resistance in metals, Variation resistivity with temperature and pressure, Schottky effect. [12]

Photoconduction in semiconductors.

Semiconductor diodes - Band structure, Majority and minority carriers, Junction formation, Laws of Junction, Einstein relation,V-I Characteristics, junction capacitance, breakdown phenomena,Clipper and Clamper circuit, Voltage doubler, Diode as rectifier with and without filter (Half and Full wave), Zener diode, load and line regulations, regulated power supply. [18]

Text and References:

Introduction to Solid State Physics, C.Kittel, John Wiley

Integrated Electronics, Millman and Halkias , TMH

Foundations of Electronics ,Chattopadhyay and Rakshit, New Age

Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson

Basic Electronics & Linear Circuits, Bhargava, Kulashretha Gupta, TMH

Solid State electronic devices, Streetman & Banerjee, PHI

Solid State Electronic Devices- 2nd Edition, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Semiconductor Devices, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Core Course – II **Credit - 6 (L-5 & T-1 Per Week)**

CLASSICAL MECHANICS & THERMAL and STATISTICAL PHYSICS

Classical Mechanics (FM-25) **30 lectures**

Mechanics of single particle: Tangential and normal components of velocity and acceleration, radial and cross radial components, Time and path integral of force, work, energy, forces, potential, conservative and non-conservative forces, conservation laws, Motion under different types of forces. [6]

Mechanics of system of particles:Center of mass and its motion, Simple collision problems, Linear momentum, angular momentum, torque of system of particles, Energy of system of particles, conservation laws. [6]

Rotational motion: Conservation of angular momentum, Moment of inertia, radius of gyration, energy of rotating bodies, Central force, Kepler's laws of planetary motion. [6]

Kinetic Theory of Gases: Maxwell's law of velocity distribution, Mean free path and equipartition theorem, Degrees of freedom, Generalized Co-ordinates, Generalized motion, Variational Principle and Lagrangian formulation, Conservative and non conservative systems, Hamiltonian variational principal, Concept of Lagrange and equation of motion, Hamiltonian formulation of Mechanics, Phase space. [12]

Text and References:

Introduction to Classical Mechanics, Takwale and Puranik ,TMH
Classical Mechanics, Goldstein, Pearson
Theoretical Mechanics, Spiegel, TMH
Mechanics: Berkeley Physics Course, Vol-1, Berkeley, TMH
Mechanics-R K Shukla and Srivastava, New Age International

Thermal& Statistical Physics (FM-25) **30 lectures**

Thermal Physics

Heat conduction in solids, Conductivity and diffusivity, Steady state solution of one-dimensional and three dimensional, heat flow equation, Heat flow in spherical and cylindrical geometry,Ingen-Hausz experiment, Periodic flow of heat in one dimension, Wiedemann-Franz law. [6]

First law of thermodynamics and its applications, Equipartition of energy, Mean free path, Reversible and Irreversible processes, Isothermal and adiabatic changes, Carnot's cycle, Second law of thermodynamics, Entropy, Enthalpy, Joule-Thomson effect, Gibb's paradox, T-S diagrams. [10]

Statistical Mechanics

Macro and Micro states: thermodynamic probability, MB, BE and FD statistics, Classical limit of quantum statistics, Application of statistical mechanics of Plank's law, Rayleigh-Jean's law, Wien's law. [14]

Text and References:

Thermal Physics-Zimensky, TMH.
A treatise on Heat, Saha&srivastava, The India press.
Thermal Physics, A P Gupta & H P Roy, Books& allied Pub
Fundamentals of Statistical and thermal physics , Reif, Waveland Press.
Statistical Mechanics , Agarwal, B K , Eisner, M. , New Age.
Fundamentals of Statistical Mechanics ,B B Laud, New Age.
Statistical Mechanics ,Pathria and Beale ,Academic Press.

Interdisciplinary/Generic Elective (G.E.) for Other Departments

Sr. No.	Semester	Name of the Subject	Teaching Scheme in hour per week			Credit
			L	T	P	
1	I	Basic Electronics	5	1	0	6
2	I	Sensors and Transducers	5	1	0	6

GE - I: Basic Electronics (FM - 50) **60 lectures**

Kirchhoff's current and voltage laws, examples of loop and nodal analysis, Network theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Bisection theorem, Image impedance, T to Π and Π to T transformations. [20]

Direct currents: Growth and decay of current in LR circuit, charging and discharging of capacitors in CR and LCR Circuits, oscillation, discharge, time constant, measurement of high resistance, energy stored in inductance, induction coil, Ballistic Galvanometer, Problems on transients.

Alternating currents: LR, CR and LCR circuits in sinusoidal application of imaginary operator.

Structure and characteristics of p-n junction diode, breakdown in junction diodes, Zener diode. [20]

Bipolar Junction Transistor (BJT): Current flow mechanism, Current components, Ebers-Moll Model, Transistor as two port network, Z, Y and h parameters, CE, CB and CC configurations, comparison and their equivalent circuits, Determination of h-parameters from static characteristics, Transistor Biasing. [20]

References:

A Text book on electrical Technology Vol-I, B.L. Theraja& R. K. Theraja.

Network analysis, Van Valkenburg, Pearson.

Integrated Electronics, Millman and Halkias, TMH.

Foundations of Electronics,Chattopadhyay and Rakshit, New Age.

Basic Electronics Engineering, Jyoti Prasad Bandyopadhyay Vikas Publishing House Pvt. Ltd.

Basic Electrical and Electronics Engineering, Vols.1 &2 , Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson.

GE - I: Sensors and Transducers (FM - 50) **60 lectures**

Definition of sensors/ transducers, sensing principles, physical and chemical transduction principles, classification. Basic characteristics of sensors – static and dynamic characteristics. [10]

Characterization of sensors: electrical, mechanical, thermal, optical/biological characterization, castrophic failure of sensor, the buth-tub curve. [5]

Mechanical and electromechanical sensors: resistive potentiometers, strain gauge, strain gauge materials and their properties, semiconductor strain gauges, inductive sensor, sensitivity and linearity of the sensor, electromagnetic transducer, magnetostrictive transducers, capacitive sensors, electrostatic transducer, Tachometer. [10]

Piezo-electric crystals, piezo-electric materials, deformation modes and multimorphs, the PZT family, stress tensors using quartz resonators, ultrasonic sensors. [7]

Electroanalytical sensors: electrochemical cell, sensor electrodes – metal electrodes and membrane electrodes. Electroceramic in gas media: Zircomia, NASICON, β-alumina, titania (TiO_2), smart sensors (idea only). [13]

Recent trends in sensor technologies: introduction, film sensors, microelectromechanical systems (MEMS), nano sensors. [7]

Sensor – their applications, Home appliance sensor, sensor for manufacturing medical diagnostic sensor, sensor for environmental monitoring. [8]

References:

Sensors and Transducers (2nd Edn), D. Patranabi, PHI Learning Pvt. Ltd., New Delhi 2009.
Transducers and Instrumentation (2nd Edn), DVS Murty, PHI Learning Pvt. Ltd., New Delhi 2009.
Electrical engineering materials and electronic components, K.B. Raina, S.K. Bhattacharya, T. Joneja, S.K. Kataria& Sons, Delhi 2010.
Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

Semester-II

Core Course – III Credit - 6 (L-5 & T-1 Per Week)

Electromagnetics (FM-50) 60 lectures

Fundamental relations of the electrostatics field, Gauss law, Potential function, Equipotential Surfaces, Divergence theorem, Possion'sequation and Laplace equation, electric dipoles, Capacitance, Electrostatics Energy.

Theories of the Magnetic Field,Biot-Savart's law, Magnetic flux density, Electromagnetic Induction, Faraday's laws, motional emf, self and mutual inductance.

Permeability, Energy stored in Magnetic Field, Magnetic vector potential, Analogies between Electric and Magnetic field. [20]

Maxwell's Equations: Displacement current, Maxwell's equations in differential and integral forms , Poynting vector, Plane electromagnetic waves, wave equations in isotropic dielectrics and in conducting media, attenuation constants , reflection and refraction of plane waves at the boundary of two dielectrics. [20]

Waveguides: Propagation of waves in two parallel conducting plates, modes of waves, propagation of waves in rectangular cavity, resonator, Half wave antenna.[13]

Rayleigh scattering and Thompson scattering, examples of these scatterings. [7]

References:

Electricity and Magnetism, Rakshit & Chattapadhyay, Books& Allied Pub .
Electricity and Magnetism, B Ghosh, Books& Allied Pub.
Electricity and Magnetism, D C Tayal, Books& Allied Pub.
Introduction to Electrodynamics, D.J. Griffiths, PHI.

Core Course –IV **Credit - 6 (L-4 & P-4 Per Week)**

Network Analysis and Circuit Theory (FM-25) 30 lectures

DC Transient Analysis:Growth and decay of currents inRL circuit, RC Circuit- Charging and discharging with initial charge, DC Response of Series RLC Circuits, Problems of transients. [6]

AC Circuit Analysis:Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, Power Factor.
Energy stored in inductance, induction coil, Ballistic Galvanometer,Transformer - construction, equivalent circuit simple problems.
Sinusoidal Circuit Analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response,Quality Factor(Q) and Bandwidth, Selectivity.
Passive Filters: Low Pass, High Pass, Band Pass and Band Stop. [10]

Electronic Network:Kirchhoff's current and voltage laws, examples of loop and nodal analysis.
Network theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Bisection theorem, Image impedance , T to Π and Π to T transformations.
Generalized Wheat-stone bridge, Anderson bridge, Maxwell's bridge, Schering bridge, Wien bridge, simple problems.
Transmission lines: Line equation, Characteristic impedance and propagation constant. [14]

Text and References:

A Text book on electrical Technology Vol-I, BL Theraja& R K Theraja. S. Chand.
Network analysis, Van Valkenburg, Pearson.
Integrated Electronics,Millman and Halkias, TMH.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan, TMH .
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson.
Basic Electronics Engineering, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.
Basic Electrical and Electronics Engineering – Vols.1 & 2, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Electric Circuits and Electron Devices By Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Core Course - IV (Practical) : Network Analysis and Circuit Theory Lab – I

1.Verification of network theorems using resistive networks and D.C. sources -
a) Thevenin's theorem,
b) Norton's theorem,
b) Superposition theorem.
c) Maximum power transfer theorem.

2.Measurement of self-inductance by Anderson bridge. Determination of mutual inductance of two coils in series and estimation of the coefficient of coupling.

3.ToMeasure of magnetic flux by using a search coil and a Ballistic Galvanometer.

4. Investigation of inductance in ac circuits
i) to verify the current voltage relationship for an inductance in a.c.circuit and hence measure the value of the inductance.
ii) to measure the reactance of an inductance coil in LCR circuit
iii) to study the variation of reactance of an inductive coil withfrequency of the a.c. source and hence to measure its inductance.

5. i) Investigation of capacitance in an alternating current circuit – Tomeasure the reactance and loss factor of a Capacitor of a C-R circuit.
ii) to study the variation of reactance of a capacitor with frequencyof the alternating current source and hence to measure the capacitance.

6. To draw resonance curve of a series LCR circuit and hence todetermine the Q-factor of the circuit.

References:

Basic Electronics: A Text Lab Manual, Zbar, TMH.
Laboratory Manual for Electronic Devices and Circuits, Bell, PHI .
Laboratory Manual for Electric Circuits , Bell, PHI.
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH.
Practical Physics,Rakshit and Chattopadhyay.
Advanced Practical Physics, Volume II, B. Ghosh, New Central Book Agency.
Basic Electronics Engineering , Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Basic Electrical and Electronics Engineering, Vols.1 &2, Jyoti Prasad Bandyopadhyay, Vikas Publishing House Pvt. Ltd.

Interdisciplinary/Generic Elective (G.E.) to be taken by other Departments

Sr. No.	Semester	Name of the Subject	Teaching Scheme in hour per week			Credit
			L	T	P	
1	II	Circuit Theory	5	1	0	6
2	II	Electronic Measurements	5	1	0	6

GE – II: Circuit Theory (FM - 50) **60 lectures**

DC Transient Analysis:RC circuit-charging and discharging with initial charge, DC response of series RL and RLC circuits,Problems on transients. [12]

AC Circuit Analysis:Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits, Instantaneous Power, Average Power, Reactive Power, PowerFactor.
Alternating current: LR, CR and LCR circuits in sinusoidal application of imaginary operator, phase diagram, power factor, series and parallel resonant circuits, Q-factor, selectivity, Sinusoidal circuit analysis for RL, RC and RLC Circuits, Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits,Quality Factor(Q) and Bandwidth. [20]

Energy stored in inductance, induction coil, Ballistic Galvanometer, Transformer - construction, equivalent circuit, simple problems.
Passive Filters: Low Pass, High Pass, Band Pass and Band Stop. [8]

Electronic Network:Kirchhoff's current and voltage laws, examples of loop and nodal analysis.
Network theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. [20]

Text and References:

A Text book on electrical Technology Vol-I, BL Theraja& R K Theraja. S. Chand.
Network analysis, Van Valkenburg, Pearson Integrated Electronics.
Millman and Halkias , TMH.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan, TMH .
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson.

GE – II: Electronic Measurements (FM-50) 60 lectures

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 ofdata and curve fitting. [12]

Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter). [12]

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc. [7]

Measurement of Resistance and Impedance: Low Resistance by Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Measurement of Capacitance, Schering's bridge, Measurement of frequency, Wien's bridge. [15]

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, Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time). [14]

References :

Semiconductor Opto Electronic Devices, P. Bhattacharya .
Networks, Lines and Field , J. Ryder.
Electronic and Radio Engineering , F. E. Terman.

Semester III

(Discipline Centric Core Papers)

Core Course V : Mathematical Methods –II & Quantum Mechanics

(Credit – 6)

MATHEMATICAL METHODS-II 30 lectures

Matrix Algebra

Definitions and rules: Matrix inversion and diagonalisation, Eigen values and Eigen vectors of real symmetric matrix (Elementary concept only), Matrix notation of linear simultaneous equations and solution technique. (10)

Complex Variables

Complex numbers – polar form, Argand diagram, Functions of complex variables – single and multi valued functions; analytic functions, complex line integrals, Cauchy's integral theorem (no proof is required), Cauchy's integral formula (statement only), Singular points, Poles Essentials singularity, Residue as a pole of order m, Cauchy's residue theorem (statement), Evaluation of simple integrals.

(15)

Special Functions

The Gamma function and its characteristics, Beta functions, Relation between Gamma and Beta functions. (5)

References :

Mathematical Methods: Vector analysis, Spiegel - TMH
Higher Engineering Mathematics - B S Grewal, Khanna pub
Advanced Engineering Mathematics, Kreyszig, John Wiley

Mathematical methods for physicists, Weber and Arfken ,
Elsevier Mathematical Physics, Ghatak, Goyal and Chua, Macmillan
Mathematical Methods, M.C. Potter and J. Goldberg, PHI

QUANTUM MECHANICS 30 lectures

Plank's hypothesis, radiation formula, photoelectric effect, Compton scattering. Wave nature of material particles, de-Broglie hypothesis, phase and group velocity, wave particle duality in nature, de-Broglie wavelength, wave packet, Heisenberg's uncertainty principle. (10)

Concepts of wave function of particle system, postulates of quantum mechanics, time independent and dependent Schrödinger equation, probability current density, dynamical variables as operator, Hermitian operators, Stationary states, Superposition of States, Schrodinger representation of position, momentum and angular momentum operators, (10)

Schrodinger equations, Expectation values, Bound state wave functions. Discrete energy levels in one-dimensional box with rigid walls, (extension to three-dimensional box), free particle solution, one dimensional step potential, transmission of particles through a potential barrier, linear harmonic oscillator, wave functions and energy eigen values, Quantum mechanical Tunneling, application to potential problems, Unitary operator . (10)

References :

Quantum Physics, Eisberg and Reisnick, John Wiley,
Basic Quantum Mechanics, A. Ghatak, Macmillan India,
Quantum mechanics, G. S. Chaddha, New Age,
Quantum mechanics, J. Singh, John Wiley & sons.

Core course – VI : (Credit 6)

SOLID STATE ELECTRONICS –II 50 lectures

Transistors: Current flow mechanism, Current components, Ebers-Moll Model, Transistor as two port network, Z, Y and h parameters, CE, CB and CC configurations, comparison and their equivalent circuits, Determination of h parameters from static characteristics, Transistor Biasing and stabilization-different methods, h-parameter equivalent circuit, small signal amplifiers, Transistor amplifier analysis, frequency response: cut-off frequencies, emitter follower. Metal semiconductor contact, Schottky diode, JEFT structures and characteristics, Biasing of FET, Small signal AC Equivalent circuit of FET, FET as an amplifier, (25)

Amplifiers: Transistor as an amplifier, R-C coupled amplifier Feed back in Amplifier: General theory of feedback, negative and positive feedback, advantages of negative feedback, types of negative feedback intransistor amplifiers, current series, voltage series, current shunt - voltage amplifiers, Darlington amplifier. (15)

Tuned Amplifier: Frequency selective networks, LC circuits, single and double tuned amp1ifiers, Analysis of voltage gain and selectivity, RF and IF amplifiers. (10)

References :

Introduction to Solid State Physics, C.Kittel, John Wiley
Integrated Electronics, Millman and Halkias , TMH
Foundations of Electronics ,Chattopadhyay and Rakshit, New Age
Electronic Devices and Circuit Theory, R. L. Boylestad and L. Nashelsky, Pearson
Basic Electronics & Linear Circuits, Bhargava, Kulashretha Gupta, TMH
Solid State electronic devices-Streetman & Banerjee, PHI

Core course –VII : (Credit 6)

Analog Electronics –I : (Credit 4) 50 lectures

Power amplifiers: Class A, B, C and AB amplifiers, Direct coupled amplifier, Transformer coupled amplifier, Push pull amplifiers, Class A & B Push pull circuits, Harmonic distortion, complementary symmetry amplifier. (15)

Sinusoidal Oscillators: Positive feedback and oscillation, Barkhausen Principle, Hartley, Colpitt, Wien Bridge and phase shift oscillators, Crystal Oscillator. Collector Tuned Oscillator, (15)

Operational Amplifier: Ideal OPAMP characteristics, offset current and offset voltage, inverting and non-inverting amp1ifiers, Transfer characteristics, Differential amplifiers, CMRR, Basic OP-AMP applications, adder, phase shifter, scale changer, voltage to current and current to voltage converters, analog integration and differentiation, Comparator, Schmitt trigger, AC coupled amplifier, AC voltage follower. (20)

References :

Integrated Electronics, Millman and Halkias, TMH.
Electronic Principles, Malvino, TMH .
Electronic Devices and Circuit theory, Robert L. Boylestad& Louis Nashelsky, PHI.
Electronic Circuits, Schilling and Belove, TMH.
Electronic Devices and Circuits, Salivahanan , TMH .
OP-Amp and Linear Integrated circuits, Gaykwad, Pearson.
Foundations of Electronics ,Chattopadhyay and Rakshit New Age International.
Modern Electronic Instrumentation and Measurement Techs, Helfrik & Cooper, Pearson.

Analog Electronics : Devices and Circuits , B.C. Sarkar and S. Sarkar, Damodar Group, Burdwan.

Core course – VII , Practical .

Analog Electronics – I , Lab –II (Credit : 2)

1. To draw the static characteristics of P-N-P and N-P-N transistors in CB, CB, CC modes.

2. To find the hybrid parameters of BJTs in D. C. mode.

3. To measure the inductance and Capacitance using AC bridge circuit.

4. To draw resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.

5. To study JFET characteristics. (Static and frequency response) and measurement of FET parameters.

References:

Basic Electronics: A Text Lab Manual, Zbar, TMH
Laboratory Manual for Electronic Devices and Circuits, Bell, PHI
Laboratory Manual for Electric Circuits , Bell, PHI
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH.
Practical Physics ,Rakshit and Chattopadhyay
Advanced Practical Physics Volume II B. Ghosh, New Central Book Agency.

Generic Elective (GE –III) (Credit – 6)
(any one to be taken out of the following two courses)

I) ANALOG ELECTRONICS (Theory) (Credit 4) 40 lectures

Diode: PN junction diode, Zener diode, use of diode as rectifier, half and full wave rectifier, calculation of ripple factor and efficiency. Capacitor and inductor filter, Voltage regulation, Line and load regulation, Zener Diode as voltage regulator, Idea of power supply, Inverter and UPS. (20)

Transistor: Bipolar Junction Transistor (n-p-n and p-n-p), Concept of load line (DC & AC), operating point, idea of Biasing, h-parameter model of BJT, CE amplifier, voltage and power amplifiers (idea of Class A, B, C amplifiers), basic idea of feedback in amplifier, Positive and negative feedback, advantages of negative feedback, types of negative feedback intransistor amplifiers, principle of oscillation, Tuned collector, Crystal and RC phase shift oscillators (qualitative discussions only), JFET and its applications. (20)

References :

Integrated Electronics, Millman and Halkias, TMH.
Electronic Principles, Malvino, TMH .
Foundations of Electronics ,Chattopadhyay and Rakshit New Age International.
Analog Electronics : Devices and Circuits , B.C. Sarkar and S. Sarkar, Damodar Group, Burdwan.
Basic Electronics, Sanjay Sharma.
Electronics, B.Ghosh.
Electronics, V.K.Mehta.
Basic Electronics, B.L.Theraja

ANALOG ELECTRONICS (Practical), Lab. (Credit : 2)

1. To draw the static characteristics of P-N-P and N-P-N transistors in CB mode.

2. To draw the static characteristics of P-N-P and N-P-N transistors in CE mode.

3. To study the performance of a BJT amplifier in CE mode.

4. To study JFET characteristics.

References:

Basic Electronics: A Text Lab Manual, Zbar, TMH
Laboratory Manual for Electronic Devices and Circuits, Bell, PHI
Laboratory Manual for Electric Circuits , Bell, PHI
Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH.
Practical Physics,Rakshit and Chattopadhyay
Advanced Practical Physics Volume II B. Ghosh, New Central Book Agency.

SEMESTER - III

SKILL ENHANCEMENT COURSE : AEEC - I (Credit :2).

Design and fabrication of electronic circuits

1. Knowledge of electronic/ electrical components, resistor, capacitor, inductor, transformer, signal sources (ac and dc), transistor, FETs, op-amps.

2. Design of dc power supply with ICs, combination of 6V battery eliminator, design of CE AF amplifier on broadband, design of Zener regulator, FET audio amplifier, feedback amplifier, design of low frequency oscillator, various op-amp circuits, modulator and demodulator.

Semester - IV

Core course- VIII : ANALOG ELECTRONICS -II Credit - 4, 40 lectures

Non-sinusoidal Oscillators:, Multivibrators (using transistors and 555 timers), Saw tooth generator, Schmitt trigger. (10)

Modulation and Demodulations: Theory and Systems

Modulation technique, Classification - AM, FM, PM, Modulation index of AM, Frequency spectrum – AM-modulator, side bands and bandwidth, FM modulator - Frequency spectrum of FM and its bandwidth,Modulation index, Conversion of FM to PM and vice versa, AM demodulators linear and square law, FM-demodulator – limiter, discriminator, ratio detector, Comparison between AM and FM, Concept of phase-locked loop (PLL). (20)

Microwave Devices: Tunnel diode, Gunn diode, IMPATT diode, PIN diode, LED, Photo Diode , Solar Cell, Semiconductor Junction Laser. (10)

References :

Integrated Electronics, Millman and Halkias, TMH,

Electronic Principles, Malvino, TMH ,

Electronic Devices and Circuit theory, Robert L. Boylestad & Louis Nashelsky, PHI,

Electronic Circuits, Schilling and Belove, TMH,

Electronic Devices and Circuits, Salivahanan , TMH ,

Foundations of Electronics , Chattopadhyay and Rakshit New Age International,

Modern Electronic Instrumentation and Measurement Techs, Helfrik & Cooper,

Pearson.

Core course – VIII Practical, Analog Eletronics - II, Lab - III

Credit - 2

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.

Core course - IX :DIGITAL ELECTRONICS – I Credit – 4 40 lectures

Number Systems: Decimal numbers, binary number, octal numbers,hexadecimal numbers, BCD numbers (weighted and unweighted codes),Excess three code, Gray code, parity conversions, arithmetic operations,ASCII, Extended ASCII codes, 9's and 10's complement code. (15)

Boolean algebra: Boolean relations, commutative, associative anddistributive laws, OR, AND, and NOT operations, De Morgan theorems. (5)

Logic Gates: Inverters, OR, AND and NOR gates, EX-OR and EX-NORgates, Simplification of Boolean expressions using Boolean algebra andDe-Morgan's theorems, sum of products and products of sum forms,Karnaugh-map, NAND and NOR gates as universal building blocks. (12)

Logic Families : Digital integrated circuits, levels of integration, DTL andTTL circuits, DTL , TTL TTL, DCTL, RTL (comparisons only),7400series, TTL characteristics, TTL,CMOS comparison. (8)

References :

Digital Logic and Computer Design, Mano , Pearson ,

Digital Computer Electronics, Malvino and Brown, Tata McGraw Hill ,

Digital Principles, Leach and Malvino , TMH,

Modern Digital Electronics, Jain, TMH ,

Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers ,

A text book of Digital Electronics, Sedha, S. Chand.

Core course- IX Practical

Digital Electronics- I, Lab - IV Credit : 2

1. Study of Logic Gates.
2. Designing of complex digital logic using universal gates.
3. Verification of de Morgan's theorems.
4. Simplification of SOP & POS circuits.
5. Study of Karnaugh map.

References of Lab III and IV .

Basic Electronics: A Text Lab Manual, Zbar, TMH ,

Laboratory Manual for Electronic Devices and Circuits, Bell, PHI,

Laboratory Manual for Electric Circuits , Bell, PHI,

Electric Circuits: Schaum's Outlines, J. Edminister and M. Nahvi, TMH,

Practical Physics , Rakshit and Chattopadhyay ,

Advanced Practical Physics Volume II B. Ghosh, New Central Book Agency.

Laboratory Manual for Op-amp and Linear ICs, Bell, PHI.

Core course- X : Credit : 06

ELECTRONIC COMMUNICATION 50 lectures

Analogy between vectors and signals, orthogonal functions (Elementaryideas), Representation of a periodic function by Fourier series over thetime interval, The Fourier transform, Time-domain and frequency-domainrepresentations of a signal, Convolution theorem, time convolution,frequency convolution, convolution properties, Fourier transforms of someuseful functions (single sided exponential signal, double exponentialsignal, Gate function), Gaussian pulse, Triangular pulse, exponential pulse, sampling function, Fourier transforms for following cases : Impulsefunction, a constant, step function u(t), periodic functions Sinwt, Coswt,etc., properties of FT, symmetry property, linearity property, scalingproperty, frequency shifting property, time shifting property. Signaltransmission through 1inear systems, the filter characteristics of linearsystems, distortion less transmission, Bandwidth of system, ideal filters,the energy density spectrum, interpretation of energy density, the powerdensity spectrum, power density, and spectrum of a periodic signal. (30)

DIGITAL COMMUNICATION

Pulse modulation, PAM, transmission of PAM signal, other forms of pulse modulation.Baseband digital modulation, Pulse amplitude modulation, pulse time modulation, PCM, DM, ADM, Errorprobability, Signaling rate, Pass band digital modulation – ASK, FSK, PSK, QPSK, DPSK , Radiotelegraphy-transmitter.

(20)

References :

Communication Electronics, Control Theory, High frequency Devices: Electronic Communication Systems, Kennedy, TMH ,
Communication systems, Singh and Sapre, TMH ,
Communication systems, Haykin, John Wiley ,
Communication systems, Lathi, Oxford Electronic communication Systems, Roddy and Coolen, Pearson,
Microwave Devices and Circuits, Liao, Pearson ,
Microwave, Sisodia and Gupta, New Age,
Microwave Engineering, Das, TMH ,
Power Electronics, Bimbhra, Khanna Pub. .

Generic Elective (GE–IV) (Credit – 6)

DIGITAL ELECTRONICS (Theory) (Credit 4) 40 lectures

Number Systems: Decimal numbers, binary number, octal numbers,hexadecimal numbers, BCD numbers (weighted and unweighted codes),Excess three code, Gray code, parity conversions, arithmetic operations,ASCII, Extended ASCII codes, 9's and 10's complement code. (10)

Boolean algebra: Boolean relations, commutative, associative anddistributive laws, OR, AND, and NOT operations, De Morgan theorems. (5)

Logic Gates: Inverters, OR, AND and NOR gates, EX-OR and EX-NORgates, Simplification of Boolean expressions using Boolean algebra andDe-Morgan's theorems, sum of products and product of sums forms,Karnaugh-map, NAND and NOR gates as universal building blocks. (10)

Combinational Logic& Sequential Circuits: Binary adder, half adder, full adder, Decoder and Encoder, Multiplexer and Demultiplexer.

Latches, edge triggered flip-flops, R-S flip-flop, J-K flip-flop, Master -slave flip-flop, D flip-flop, T flip-flop. (15)

References :

Digital Logic and Computer Design, Mano , Pearson.
Digital computer electronics, Malvino and Brown, Tata McGraw Hill.
Digital Principles, Leach and Malvino , TMH.
Modern Digital Electronics, Jain, TMH.
Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers .
A text book of digital electronics, Sedha, S. Chand.

DIGITAL ELECTRONICS (Practical), Lab. (Credit : 2)

1. Study of basic logic gates.
2. Study of universal logic gates.
3. Simplification of SOP & POS circuits.
4. Study of Karnaugh map.

SKILL ENHANCEMENT COURSE: AEEC-II (Credit: 2).

Design and fabrication of electronic circuits

1. Study and construction of square wave generator.
2. Construction of radio receiver.

Semester - V

Core course - XI :DIGITAL ELECTRONICS – II Credit-4 40 lectures

Combinational Logic: Circuits of AND,OR,NOT, NAND, NOR gate using TTL and CMOS, Binary adder, half adders, full adders, BCD adder, half substractor, full substractor, Decoder and Encoder, Multiplexer and Demultiplexer, Comprator, Code converter (Binary to BCD, Binary to Gray, Gray to Binary, BCD to Excess three).

(15)

Sequential Circuits: Latches, edge triggered flip-flops, R-S flip-flop, J-K flip-flop, Master - Slave flip-flop, D-flip-flop, T flip-flop, registers, counter: Design of Asynchronous and synchronous counters, Different mod N counters, Ripple counters, ring counters, Johnson Counter (10)

Memory: RAM, ROM, PROM, EPROM (10)

Basics of Computer organisation (05)

References :

Digital Logic and Computer Design, Mano , Pearson ,

Digital Computer Electronics, Malvino and Brown, Tata McGraw Hill ,

Digital Principles, Leach and Malvino , TMH,

Modern Digital Electronics, Jain, TMH ,

Digital Circuits, Vol-I and II, D.RoyChaudhuri, Platinum publishers ,

A text book of Digital Electronics, Sedha, S. Chand.

Core course – XI Practical:

DIGITAL ELECTRONICS – II, Lab - V Credit-2

1. Study of half adder, and full adder.
2. Study of half subtractor.
3. Study of R-S flip flop, J-K flip flop.
4. Study of sequential counters.

Core Course XII : Credit : 06

OPTICAL COMMUNICATION 50 lectures

Optoelectronics : Characteristics of optical emission, electro-luminescence. LED: Power and efficiencycalculation, Structure of LED and its characteristics, Hetero-junctionLED,Photo diode: PIN photodiode, hetero junction diode, Avalanche Photo diode, Phototransistor. LDR, photovoltaic cells, photo emissive cells - types, materials, construction, response, opto-couplers – characteristics, noise figures, applications in analogue and digital devices. Semiconductor junction laser. (30)

Fiber optics: Optical fibre – materials, construction, step index and graded index fibres, ray propagation,attenuation. Modes in optical fibres, intermodal dispersion, singlemodefibre- working principle, attenuation, dispersion and bandwidth. Multimode fibre- attenuation, dispersion. Propagation of EM waves, Fibre coupling. (20)

References :

Semiconductor Opto Electronics Devices, P. Bhattacharya .
Optoelectronics and Fiber Optic Communication, D C Sarkar and C K Sarkar, New Age.
Photonics : A Yariv and P Yeh. Oxford.
Optical Electronics : By Ghatak and Thyagrajan , Cambridge University Press.

Discipline Specific Elective (DSE) Papers

Semester V : (Any two from following)

DSE – I & II: Each of credit 06

i) **Radio and television**
ii) **Basic Control systems**

iii) Microprocessor and Microcontroller

iv) Numerical analysis and computer

i) RADIO AND TELEVISION : Credit – 06 50 lectures

Radio Communications: Introduction, basic requirements of radio communications, communication systems, basic features of communication: transmitter, transmission circuit receiver, modulation, bandwidth, communication channel, classification of radio waves, ordinary receiver and super heterodyne receiver. (20)

Radio wave propagation: Introduction, electromagnetic or radio waves, free space propagation, modes of propagation, ground wave and surface wave, sky wave or ionospheric wave, space wave propagation, tropospheric scatter propagation, structure of atmosphere, characteristics of different ionized regions, sky wave propagation, effect of earth's magnetic field on ionospheric radio wave propagation, lowest usable frequency, maximum usable frequency, skip distance duct propagation. (20)

Television: Introduction – Historical development, television broadcasting, coverage of television, Basic television system and scanning principles, Essentials of colour television.

(10)

References:

Antenna and wave propagation, K D Prasad, SatyaPrakashan.

Electromagnetic field theory, K AGangadhar, P M Ramanathan, Khanna Publication.

Electromagnetic field theory, S P Ghosh, McGraw Hill.

Principles of electromagnetics, M.N.O. Sadiku, Oxford.

Monochrome and colour television, R.R. Gulati, New Age International.

Television and video engineering, A M Dhake, Tata McGraw Hill.

Colour television, principles and practice, R RGulati, New Age International.

Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

ii) BASICS of CONTROL SYSTEMS: Credit – 06

50 lectures

Introduction: Basic components of a control system, examples of control system applications, open loop and closed loop control systems. [6]

Feedback and its effects: effect of feedback on overall gain, effect of feedback on stability, effect of feedback on sensitivity, effect of feedback on noise. [6]

Mathematical foundation: complex variables, functions of a complex variable, analytic function, singularities and poles of a function, zeroes of a function. [6}

Differential equations : linear ordinary differential equations, non-linear differential equations, first order differential equations, state equations. [5]

Laplace transform: partial fraction expansion, application of α.T. to the solution of linear ordinary differential equations. [6]

Matrix algebra, difference equations, z transform, application of z transform to the solution of linear difference equations. [5]

Transfer functions, Block diagrams, signal flow graphs, impulse response. [6]

Control system components : error sensors, potentiometers, synchros, tachometer, servometers. [5]

Time domain analysis : standard input signals, impulse function, step function, ramp functions, parabolic function. [5]

References:

Automatic control systems, B.C. Kuo, PHI New Delhi 2004.

Control systems – P Purkait, Satpati, G.R. Mallik, U. Mondal, Tata McGraw HillEdn. Pvt Ltd., New Delhi
Control system engineering, I.J. Nagrath and M. Gopal, New Age International Publishers, New Delhi.
Control System, K.R. Varmach, Tara McGraw Hill, Edn. Pvt. Ltd., New Delhi.
Linear control systems with Matlab applications, B.S. Manke, Khanna Publishers, New Delhi, Ogata

iii) MICROPROCESSOR AND MICROCONTROLLER Credit – 06

50 lectures

Introduction: Word length of a computer/ µ processor, evaluation of µp, evolution of digital computer, computer generations, single chip µp, embedded µp, hardware, software and firmware. [6]

CPU: ALU, timing and control unit, registers, memory – semiconductor memory, magnetic memory, optical disks, CCD, cache, memory hierarchy, program and data memory, destructive and non-destructive read out, direct access storage device, serial access storage device, online and offline memory devices, real and virtual memory. [6]

Busses: memory addressing capacity of a CPU, Bus architecture operating systems – multiprogramming, multiusers or time shared system, multitasking, computer network LAN, MAN and WAN. [6]

Types of µp: Vector processor, array processor or SIMD processor, scalar or super scalar processor, RISC and CISC processors and EPIC, digital signal processor (DSP), symbolic processors, I/O processors, co-processors.
[6]

µp architecture: Intel 8085, ALU, timing and control unit, registers, data and address bus, pin configuration, Intel 8085 instructions, opcodes and operands, instruction word size, instruction cycle – fetch O/P, execute O/P, machine cycle and state, instruction and data flow, timing diagram. [6]

Instruction set of 8085 and programming of µp: address modes, status flags, assembly language, high level language, stacks, subroutines, system software. [5]

Peripheral devices and their applications, µp applications. [5]

Microcontrollers: Intel 8051 series µcontrollers (MCS-51), registers, pins of 8051, I/O lines, 8051 interrupts, timer/counter, Boolean processor, instruction set, pulse-width modulation (PWM), serial port, multiprocessor communication, power saving, brief description of some 8051 µcontroller, memory organization, addressing modes, 8051 instruction, data transfer, arithmetic and logical instructions, assembly language programme examples, Atmel µcontroller and PIC µcontrollers, Intel 8096 series of µcontroller (MCS-96). [10]

References:

Fundamentals of µprocessors and µcontrollers, B. Ram, Dhanpat Rai Publications.
µprocessor architechture, programming and applications with the 8085, R.C. Gaonkar, Penram International Publishing (India) Pvt. Ltd.
µcontrollers – architecture, programming interfacing and system design, Rajkamal – Pearson.
Advanced µprocessors and peripherals, A K Ray and K M Bhurchandi, Tata McGraw Hill.
µprocessors and interfacing – programming and hardware, Douglas V. Hall, Tata McGraw Hill.
µprocessors – principles and applications, Charles M Gilmore, Tata McGraw Hill.
µprocessors and interfacing, N Marriwala, S.K. Kataria & Sons.

The Intel µprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium & Pentium processor, architecture, programming & interfacing, Barry M Brey, Prentice Hall of India.

iv) NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING:

Credit – 06 50 lectures

Errors in numerical calculations: Introduction – Computer and numerical software, computer languages, software packages, mathematical preliminaries, errors and their computations. [4]

Solution of algebraic and transcendental equations: Introduction – bisection method, the method of false position, the iteration method, Newton Raphson method, Ramanujan's method, the secant method, the Muller method. [6]

Interpolation: errors in polynomial interpolation, finite differences – forward differences, backward differences, central differences, Newton's formula for interpolation, Gauss' central difference formula, Lagrange's interpolation formula, Newton's general interpolation formula. [6]

Least square curve fitting procedure, fitting a straight line, non-linear curve fitting, curve fitting by a sum of exponentials. [4]

Numerical differentiation and integration – errors in numerical differentiation, the cubic spline method, numerical integration, trapezoidal rule, Simpson's 1/3 rule. [6]

Introduction to computer system – computer organization, introduction to computer languages. [3]

Problem solving on a computer – analysis of the problem, mathematical modeling of the problem, development of suitable algorithm, algorithm, flowchart. [5]

Getting started, what is C, character set, constants, variables and keywords, rules for various construction of different constants, compilation and execution, C instructions, control instruction in C. [6]

Design control structure. [4]

Functions and pointers, Structures, Console input/output, File input/ output, Windows. [6]

References:

Introductory methods numerical analysis, S.S Sastry, PHI.
Numerical methods, Babu Ram, Pearson.
A text book of numerical analysis, D. C. Sayal and K.C. Das, U Dhar & Sons.
Numerical analysis and computational procedure, S A Mollah, Books & Allied (P) Ltd.
Numerical methods, E Balaguruswamy, Tata McGraw Hill.
Numerical Analysis, Kalyan Kr. Mukherjee, New Central Book Agency (P) Ltd.
Numerical methods for scientists, Rao, PHI.
Computer programming and numerical analysis – an integrated approach, N Datta, Universities Press.
Numerical methods with programs in C, T Veerarajan & T Ramachandran, Tata McGraw Hill.
Numerical analysis and algorithms, Pradip Neyogi, Tata McGraw Hill.
C Language and Numerical methods, C Xavier, New Age International.
Let us C, Yashavanta Kanitkar, BPB Publication.
Programming with C, B S Gottfired, TMH.

Computer fundamentals and programming in C, Pradip Dey and Manas Ghosh, Oxford.
Computer programming in C, V Rajaraman.
Programming in C. Reema Thareja, Oxford.

Semester - VI

Core course- XIII : INSTRUMENTATION & MEASUREMENTS

Credit – 04 **40 lectures**

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 ofdata and curve fitting. (5)

Basic Measuring Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, Ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter). (10)

Connectors and Probes: Low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc. (7)

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). (8)

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, (10)

References :

Modern Electronic Instrumentation and Measurement Techniques, Helfrick and Cooper,Prentice-Hall of India, Reprint 1988.

Instrumentation Measurement and Feedback, Jones, B.E., Tata McGraw-Hill, 1986.

Electrical Measurement and Measuring Instruments, Golding, E.W., 3rd Edition, Sir Issac Pitman and Sons,

t Systems: Application and Design, DoebelinE.O. , McGraw Hill Book - Fifth Edition (2003).

Principles of Electrical Measurements, Buckingham, H. and Price, E.N., 1961.Test and measuring instruments

Electronic Instrumentation, Kalsi, Tata McGraw Hill (2006)

A Course on Electrical and Electr*1960.*

Measuremen onic Measurements and Instrumentations, A K Sawhney, DhanpatRai& Sons

Core course - XIII (Practical) :

INSTRUMENTATION & MEASUREMENTS, LAB – VI, Credit - 2

1. Measurement of low resistance, inductance and capacitance by bridges.

2. Measurement of voltage, frequency and phase difference by CRO.

Core course – XIV : SENSOR, TRANSDUCER AND ELECTRONIC MATERIALS. Credit – 06 50 lectures

Introduction : Definition of sensors/ transducers, sensing principles, physical and chemical transduction principles, classification. Basic characteristics of sensors – static and dynamic characteristics. [7]

Characterization of sensors: electrical, mechanical, thermal, optical/ biological characterization, catastrophic failure of sensor, the buth-tub curve. [6]

Mechanical and Electromechanical Sensors : resistive potentiometers, stream gauge, strain gauge materials and their properties, semiconductor stream gauges, inductive sensor, sensitivity and linearity of the sensor, electromagnetic transducer, magnetostrictive transducers, capacitive sensors, electrostatic transducer, Tachometer. [15]

Piezo-electrics : Piezo-electric crystals, piezo-electric materials, deformation modes and multimorphs, the PZT family, stress tensors using quartz resonators, ultrasonic sensors. [5]

Electroanalytical Sensors: The electrochemical cell, sensor electrodes – metal electrodes and membrane electrodes. Electroceramic in gas media: Zircomia, NASICON, β-alumina, titania (TiO_2), Smart sensors (idea only). [10]

Materials : Classification of materials, conducting materials, semiconducting materials, insulating materials, dielectric materials, magnetic materials, materials for special purse.

[7]

References:

Sensors and Transducers (2nd Edn), D. Patranabis, PHI Learning Pvt. Ltd., New Delhi 2009.

Transducers and Instrumentation (2nd Edn), DVS Murty, PHI Learning Pvt. Ltd., New Delhi 2009.
Electrical engineering materials and electronic components, K.B. Raina, S.K. Bhattacharya, T. Joneja, S.K. Kataria & Sons, Delhi 2010.
Electrical engineering materials, A.J. Dekker, PHI Learning Pvt. Ltd., New Delhi 2010.

Discipline Specific Elective (DSE) Papers (Any one from following)

DSE – III Credit - 06

i) **Satellite communication**
ii) **Microwave and optoelectronic devices**
iii) **Antenna and wave propagation**
iv) **Power electronics**

i) SATELLITE COMMUNICATION : Credit – 06 50 lectures

Introduction: Background, A brief history of satellite communication, satellite communication in 2000, overview of satellite communication, orbital mechanism and launches, orbital mechanics, development of equation of the orbit, Kepler's laws of planetary motions, describing the orbit of a satellite, locating the satellite in the orbit, locating the satellite with respect to the earth orbital elements, examples. [10]

Geostationary satellites, visibility test, examples, orbital perturbations, orbital determination, launches and launch vehicles, placing satellite in geostationary

orbit, orbital effects in common system performance, Doppler shift, range variation, solar eclipse, sun transit outage. [15]

Satellites: Satellite subsystem, altitude and orbital control systems (AOCS), telemetry, tracking, command and monitoring (TTC&M), Paner system, communication subsystem, Description of communication subsystem, transponders, concept of satellite antennae [10]

Satellite link design – basic transmission theory,Ku band uplink design, Ku band downlink design, rain effect, path blockage at L band, Modulation and multiplexing techniques for satellite links, fm, analog fm transmission of satellites, digital transmission, digital modulation and demodulation, probability of a symbol error, BPSK/QPSK bit error rate, generation of QPSK. [10]

Digital transmission of analog signals sampling and quantization, compression and expansion, Time division multiplexing, low earth orbit and non geostationary satellite systems, basics of satellite navigation and GPS (Global Positioning System). [5]

References:

Satellite communications, Timothy Pratt, Charles W Bostian, Jeremy Allnutt, John Wiley & Sons.
Satellite communications, Anil K Maini, Varsha Agrawal, Wiley
Satellite communications, Dennis Roddy, McGraw Hill.
Digital satellite communication, Tri T Ha, McGraw Hill.
Satellite communication, DC Agarwal reviewed by A K Maini, Khanna Publisher.

ii) MICROWAVE AND OPTOELECTRONIC DEVICES:

Credit – 06 **50 Lectures**

Introduction: µwave frequencies, µwave devices, µwave system, µwave units of measure. [5]

Basic electromagnetics: Maxwell equations, wave equations (in free space), plane TEM waves in conducting and low-loss dielectric medium, poynting vector. [5]

Passive µwave devices: Terminators, attenuators, phase shifters, directional coupler, hybrid junctions (magic T), dividers, circulator. [6]

µwave vacuum tube devices: Klystron, TWT Amplifier, Backward wave oscillator, magnetron oscillator. [10]

Microwave solid state devices: Diodes, Gun diodes, Avalanche transit time devices, tunnel diodes, varactor diodes, parametric amplifiers IMPATT diode. [10]

Optical processes in semiconductors: Electron-hole pain formation and recombination, absorption, Franz-Keldysh and stark effects quantum confined stark effects, Kramers-Kronig relatins, radiation in semiconductors. [6]

Junction theory: p-n junctions, schottky barriers and ohmic contacts, semiconductor heterojunctions, light emitting diodes, laser operating principles and structure and properties, photodetection, solar cells, optoelectronic integrated circuits. [8]

References:

µwave engineering, David M Pozzar, Willey.
Foundation of µwave engineering, Robert E Collin, Willey.
µwave devices and circuits, Samuel Y Liao, PHI.
µwave circuits and passive devices, M.L. Sisodia & G.S. Raghuvansi, New Age International.
µwave enginering, Annapurna Das and Sisir K Das, Tata McGraw Hill.

Fundamentals of µwave and radar engineering, Er. K.K. Sharma, S. Chand.
Semiconductor Optoelectronic devices, Pallab Bhattachary, Pearson (Prentice Hall).
Optical fiber communications – principles and practice, John M Senior, Pearson Education.
Optical fiber communications, Gerd Keiser, McGraw Hill.
Solid state electronic devices, Ben G Streetman and Sanjay Banerjee, PHI.
µwave engineering, Monojit Mitra, Dhanpid Roy & Co.
Microwaves, K. C. Gupta, New Age International Publications.

iii) Antenna and Wave Propagation : **Credit – 06**

Introduction: radio communication, transmitter, transmission circuit, receiver, modulation, bandwidth. [4]

Antenna basics: Parameters, patterns, beam area, beam efficiency, directivity D and gain G, directivity and resolution, antenna aperture, effective height, radio communication link, fields from oscillating dipole, linear, elliptical and circular polarization, pointing vector. [6]

The antenna family: Loops, dipoles and slots, coaxial line antennas, aperture type antenna, flat-sleet reflector antenna, parabolic dish and dielectric lens antenna, end-fire antennas,Broad bandwidth antennas: conical, spiral and log periodic antenna, patch antenna. [10]

Electric dipoles, thin linear antennas and array of dipole and aperture. [4]

Loop, slot, patch and horn antennas, small loop, square loop, slot antennas, radiation efficiency, Q, bandwidth and signal to noise ratio. [6]

Electromagnetic fields and its radiation Maxwell equations, em waves in homogeneous medium, wave equations for free space/ loss less/ non conducting medium, em wave equation for a conducting medium, wave polarization. [10]

Radio wave propagation: fundamental equations, moods of propagation, structure of atmosphere, characteristics of different ionized regions, sky wave propagation, effect of earth's magnetic field on ionospheric radio wave propagation, lowest usable frequency, skip distance, ionospheric abnormalities, ionospheric absorption, multi-hop propagation, duct propagation, satellite communication. [10]

References:

Antenna and wave propagation, K.D. Prasad, Satya Prakashan, New Delhi.
Antenna for all applications, John D Kraus, Ronald J Marthefka, Ahmad S Khan, Tata McGraw Hill.
Principles of Electromagnetics, Matthew N. O., Sadiku, Oxford University Press.
Antenna Theory, analysis and design, Constantine, A. Balanis, Wiley.
Detailed solutions in Electronics and Communication for competitions, Satish K Karna, Galgotias.

iv) Power Electronics : Credit – 06 50

Lectures

Introduction: Concept of power electronics, Application of power electronics, power electronic systems, power semiconductor devices, power electronic modules. [5]

Power semiconductor diodes and transistors: The p-n junction, basic structure of power diodes, characteristics of power diode, types of power diodes power-transistors, bipolar junction transistors, steady state characteristics, BJT switching performance, safe operating area. [5]

Power MOSFET, insulated gate bipolar transistor (IGBT), static induction transistor (SIT), MOS controlled thyristor (MCT). [5]

Diode circuits and rectifiers: single phase half wave, full wave rectifier, three phase rectifier. [5]

Thyristor: Introduction, static IV characteristics of a thyristor, turn on methods, switching characteristics, thyristor gate characteristics, two transistor model of a thyristor, thyristor rating, thyristor protection, improvement of thyristor characteristics, healing, cooling and monitoring of thyristor, series & parallel operations of thyristor, other members of thyristor family (like PJT, SUS, SCS, light activated thyristor, diac, triac, etc.). [10]

Phase controlled rectifiers, converters half and full wave single phase, inverters: Single phase voltage source inverters, steady state analysis, force commutated thyristor inverters. [10]

AC voltage controller and cyclo converter principles &thyristor circuits. [5]

Application of thyristor:SMPS, UPS, DC transmission, static switches, circuit breaker, relays, induction heating. [5]

References:

Power ElectronicsP.S. Bimbhra, Khanna Publication.

Power Electronics, Circuits, Devices and Applications, Muhammad H Rashid, Pearson.

Power Electronics, P.C. Sen, Tata McGraw Hill.

Power Electronics Devices, Circuits & Industrial Applications, V.R. Moorthi, Oxford.

Power Electronics, M D Singh & K.B. Khanchandani, Tata McGraw Hill.

Power Electronics, VedamSubrahmanyam, New Age International.

DSE - IV: PROJECT/DISSERTATION Credit – 06