Goa University

P.O. Goa University, Taleigao Plateau, Goa 403 206, India

Syllabus of B.Sc. (Physics) Programme

Approved by the Board of Studies and applicable for the

Academic Year 2012-2013

Goa University through its affiliated colleges offers a full-time three year (six semester) Bachelor's programme in Physics.

The programme aims at imparting undergraduate education in Physics and preparing those who intend to persue higher studies in Physics.

The prerequisites of the B.Sc. programme in Physics are a pass at Higher Secondary School Certificate Examination conducted by Goa Board or its equivalent.

In addition to the Physics syllabus given below, a student has to opt for two other subjects in Semesters I to IV. It is advised that one of these subjects be Mathematics. The course requirement also specifies additional courses like Environmental Science, Foundation Course, etc.

While laboratory experiments are linked to theory course in Semesters I to IV, Semester V and VI have two separate practical courses. In order to be eligible for B.Sc. degree, a student has to pass individually in all papers of Physics as well as other opted courses.

In this six semester programme, a student has to complete a Project in the sixth semester. He can also opt for two special skill based courses in semester V.

The table on the next page lists the courses under the programme. The semester-wise distribution of the courses is also given. Description of each of the courses is given in subsequent pages.

B. Sc. (Physics) List of Courses

Note: Papers indicated with '*' mark for students with three units.

Semester – I

Paper 1: MECHANICS AND PROPERTIES OF MATTER

Motion of a particle in one dimension [14]

Discussion of the general problem of one dimensional motion. Dependence of force in general on position, velocity and time. Motion under a constant force with illustrations-Atwood's machine, Free fall near the surface of the earth. Motion along a rough inclined plane. The equation of motion, momentum and energy conservation theorems. Motion under a force which depends on time-general approach to the solution. Illustration using force of the type $F = Fo\ Sin(\omega t + \varphi)$. Motion under a conservative force dependent on position, potential energy. Brief review of simple harmonic motion [Idea of first integral, energy integral, constant of motion and neutral equilibrium to be discussed]. Motion under damping force depending on velocity - general dependence of resistive force on velocity. Motion in a medium with resistive force proportional to first power of velocity [Ignoring gravity]. Body falling under gravity in a resistive medium near the surface of the earth.

Motion of a charged particle in Electro-magnetic field (Only perpendicular field) [4]

Motion of a charged particle in a uniform constant (1) electric field, (2) magnetic field. Motion of a charged particle in a uniform constant electric field and magnetic field (crossed) in mutually perpendicular directions. Lorentz force.

Motion in two dimension : [4]

Equations of motion in plane polar coordinates [Equations Nos.3.72- 3.80 from Mechanics, Symon]. Momentum and energy theorems. Plane and vector angular momentum theorems.

Motion of a particle in a plane: [4]

Projectile motion in a non-resistive and resistive medium, resistive force proportional to the first power of velocity.

Properties of Matter

Elasticity: [11]

Modulii of elasticity, Poisson's ratio and relationship between them. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Depression of a beam supported at the ends and loaded at the center. A vibrating cantilever. Torsion in a string-couple per unit twist, Torsional Pendulum.

Surface Tension: **[4]**

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Angle of contact. Capillarity-rise of liquid in a capillary tube.

Viscosity: **[4]**

Streamline flow, Turbulent flow, Critical velocity, Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube.

1. Mechanics (3 rd Ed.), by K. R. Symon Chapter 1, Section 1.7(eq:1.8 to 1.47), Chapter 2, Section 2.1, 2.2, 2.3 (up to eq:2.19), 2.4(eq:2.32 to 2.38), 2.5, 2.6(eq:2.64 to 2.72 and eq:2.76 to 2.86), 2.7 (Motion of a particle in one dimension)
2. Mechanics (3 rd Ed.) , by K. R. Symon Chapter 3, Section 3.17 (Motion of a charged particle in Electro-magnetic field (Only perpendicular field))
3. Mechanics (3 rd Ed.), by K. R. Symon Chapter 3, Section 3.4 (eq:3.72 to 3.80), 3.7, 3.8 (Motion in two dimension)
4. Mechanics (3 rd Ed.), by K. R. Symon Chapter 3, Section 3.11 (eq:3.154 to 3.175) (Motion of a particle in a plane)
5. Elements of Properties of Matter, by D. S. Mathur, Chapter 8, Section 8.8, 8.9, 8.12, 8.13, 8.14, 8.15, 8.16, 8.17, 8.18, 8.22, 8.26, 8.29, 8.30(a(i)), 8.32, 8.33(i) (for Elasticity)
6. Elements of Properties of Matter, by D. S. Mathur, Chapter 14, Section 14.1, 14.2, 14.3, 14.4 14.6, 14.8, 14.14, 14.15 and 14.17 (for Surface Tension).
7. Elements of Properties of Matter, by D. S. Mathur, Chapter 12, Section 12.1, 12.2, 12.7, 12.11 (for Viscosity).

Books

1. Introduction to Classical Mechanics, R. G. Takawale and P. S. Puranik, Tata McGraw-Hill (1997)
2. Properties of Matter, Brijlal and N. Subrahmanyam S. Chand (1999)
3. Mechanics, K. R. Symon, Addison Wesley (1971)
4. Berkeley Physics Course, Volume I, Mechanics, McGraw-Hill (1973) (C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer)
5. Properties of Matter, Starling H. S, Mcmillian and Co (1961).
6. Mechanics , H.S.Hans and S.P.Puri, Tata McGraw-Hill (2003)
7. Mechanics, D.S.Mathur, S.Chand & Co. (2005)

Experiments (minimum four)

1. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
2. Projectile Motion (computer simulation).
3. Cantilever: Determination of Young's modulus by vertical vibrations of a cantilever.

4. Torsional Pendulum: Determination of Rigidity Modulus of the material of a wire.
5. Jaeger's Method : Determination of Surface Tension.
6. Viscosity of a liquid by Poiseuilles method.
7. Bending of beams: determination of Young's modulus.
8: Capillarity: determination of Surface tension.

Paper – 2: ELECTRICITY

Circuit Analysis **[12]**

Concept of constant current and constant voltage source, Maxwell's cyclic current method for circuit analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (with proof).

Inductance **[5]**

Self Inductance, self inductance of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, Self Inductance of co-axial cables, Mutual inductance, Coefficient of coupling, Inductance in series and parallel.

Response of circuits containng L C and R to DC (transients) **[8]**

Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit and in a series L-C-R circuit.

Ballistic Galvanometer **[4]**

General theory of a suspended coil ballistic galvanometer, Expression for charge, Figure of merit, Current sensitivity and voltage sensitivity.

A.C. Circuits **[9]**

A.C. applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j operator and vector or phasor method (including LR and LCR)A.C. applied to L-C-R circuits, Series and parallel resonance. Q factor and Bandwidth. Graphic representation of resonance (Variation of resistance, inductive reactance, capacitance reactance with frequency)

Mutually Coupled L-R circuits **[5]**

A.C. applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer.

A. C. Bridges **[3]**

General A.C. bridge. Maxwell's bridge. Maxwell's L/C bridge. De-Sauty's capacitance bridge. Wein's frequency bridge.

Books

1. Fundamentals of Electricity and Magnetism. D. N. Vasudeva, S. Chand and Company Ltd. New Delhi (1995).

2. Electric Circuit and Theory. F. A. Benson and D. Harrison. E.L.B.S. (1995).

3. Electricity and Magnetism. J. Yarwood and J. H. Fewkes. University Tutorial Press (1991).

4. Electrical Technology, By Thereja

5. Electicity and Magnetism, Brijlal and Subramanian

6. Electrical Circuits : Schaum Series

Experiments (minimum four)

1. Verification of Thevenin's Theorem.
2. Verification of Norton's theorem.
3. Response of LR and CR circuits to A.C. - phasor diagrams.
4. Step Response of RC circuit / SLR Circuit.
5. L.D.R. Characteristics.
6. De Sauty's Bridge and Maxwells L/C Bridge.
7. LCR Series and parallel resonance –Resonant frequency,Q value and Bandwidth.
8. Resistance of Mirror Galvanometer / Table Galvanometer by Shunting.
9. Figure of Merit of Mirror Galvanometer and Determination of Current and Voltage Sensitivity.
10. Electrical Simulation of LR,CR,LCR Circuits : Computer Simulation by PSPICE / Electronics work bench.

Semester – II

Paper 1: WAVES AND ACOUSTICS

Waves and Oscillations **[18]**

Periodic oscillations and potential well, differential equation for harmonic oscillator and its solutions (case of harmonic oscillations), kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum, torsional pendulum, bifilar oscillations, Helmholtz resonator.

Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

Oscillatory Motion in a Resistive Medium: **[9]**

Damped harmonic oscillator, Damped forced harmonic oscillator. Displacement and velocity, Resonance, Sharpness of resonance, Phase relationships, Energy consideration in a forced harmonic oscillator. Harmonic oscillator with an arbitrary applied force.

Sound **[12]**

Velocity of longitudinal waves in fluids. Newton's formula for velocity of sound. Longitudinal vibrations in strings. Kundt's tube-determination of velocity of sound in a gas and in solids. Transverse vibrations in strings. Intensity level and Bel and Decibel. Production and detection of Ultrasonic waves and its applications.

Dppler effect. Source and listener in relative motion. (Normal incidence only)

Acoustics of Rooms and Musical Scales **[6]**

Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time (discussions only) , Acoustic requirements of an auditorium.

Musical interval, harmony, melody. Diatonic scale. Tempered scale. (only concepts)

Books

1.Text book of Sound. D. R. Khanna and R.S. Bedi, Atma Ram, New Delhi (1994).
2. Sound. F. G. Mee, Heinemann Ltd., London (1967)
3. Text book of Vibration and Waves , Mac Millon (2002)

Experiments (minimum five)

1. Frequency of AC mains (Sonometer).
2. Helmholtz Resonator : Determination of unknown frequency.
3. Lissajos Figures (as a demonstration exp.).
4. Coupled Oscillations: resonance pendulum.
5. Flat Spiral Spring: determination of elastic constants by vertical and torsional oscillations of a loaded spring.
6.Calculation of reverberation Time & absorption Coefficient of room/hall (Numerical).
7. Angular Oscillations of a Bar – Bar Pendulum.
8 Wave superposition : Computer Simulation.

Paper 2: OPTICS

Refraction through the lenses **[10]**

Introduction to Lenses, optical properties of lenses, thin lenses & thick lenses, Cardinal points of an optical system, Co-axial system of two thin converging lenses. Aberrations
Spherical & Chromatic aberrations in lenses (only conceptual), methods of minimizing Spherical & Chromatic Aberrations. Introduction to eyepieces, Ramsden and Huygens eyepieces (construction and their cardinal points)

Fundamentals of Reflection and Refraction **[2]**

Refractive index and optical path, Fermat's Principle of least time, Derivation of the laws of reflection & refraction using Fermat's Principle.

Interference **[11]**

Introduction, division of wavefront & division of amplitude.

Thin film Theory :- Formation of colors in thin film- reflected system, Transmitted system (only conceptual), wedge shaped film, Newton's Rings and its application to determine refractive index of liquid (Normal Incidence only)

Interferometery:- Michelson interferometer-its principle, working and its application to determine wavelength and difference between two wavelengths

Diffraction **[15]**

Concept of Diffraction, Fresnel and Fraunhoffer Diffraction, Division of cylindrical wave-front into half period strips, Fresnel's diffraction at straight edge (details) {Introduction of Chap 12 of B.K. Mathur, 12.3-12.5} Fresnel's diffraction at rectangular aperture and cylindrical wire (conceptual). Fraunhoffer diffraction at single slit and double slit (details), General N slit theory (Conceptual), Diffraction grating, width of principal maxima of plane diffraction grating. Resolving power of optical instruments:- Rayleigh's condition, Resolving power of telescope and grating.

Polarization **[7]**

Concept of polarization, Plane of polarization, Polarization by reflection, Brewster's law, Polarization by refraction, Double refraction, uniaxial and biaxial crystals, Nichol's Prism, Circularly and Elliptically polarized light - Theory and analysis, Retardation plates - Quarter wave plate and Half wave plate, Optical activity, specific rotation, simple Polarimeter, Laurent's half shade polarimeter.

Books

1.A text Book of Optics , N Subrahmayam and N.Brijlal, S. Chand & Company Ltd(1991)
2 Principles of Optics, B.K. Mathur, New Global Printing Press, Kanpur.
3. O.ptics, Ajoy Ghatak, Tata McGraw-Hill Publicashing Company Limited. (1977)
4. Fundamental of Optics, F.A.Jenkins and H.E. White, Tata McGraw-Hill Publishing Company Limited. (1981)
5. Contenprary Optics , Ghatak And Tyagrajan, Mc Millan 2003

Experiments (minimum five)

1) Wedge Shaped film / Newton's Rings.
2) Single Slit Diffraction.
3) Brewster's Law.
4) Diffraction Gratings.
5) Cardinals points of Two lenses.
6) Resolving Power of Telescope using Striped sheets.
7) Prism Spectrometer : Determination of Prism angle, minimum angle of deviation and dispersive power.
8) Optical Lever.

Semester – III

Paper 1 : MECHANICS II

Motion under a central force: [**13]**

Equivalent one body problem, general features of motion, qualitative discussions of orbits under inverse square law force field. Nature of orbits, elliptical orbits, Kepler's problem, hyperbolic orbits, classical scattering, definition of scattering cross section and angle of scattering, Rutherford's scattering cross section and its derivations.

Motion of a system of particles: [6]

Center of mass coordinates, conservation of linear momentum, angular momentum energy, Critique of conservation of laws, rockets, conveyor belts and planets. The collision problems, the two body problem.

Moving coordinate systems: [6]

Moving origin of coordinate system, rotating coordinate systems, laws of motion on the rotating earth, qualitative description of Foucault's pendulum, and Larmor's theorem.

Rigid bodies, Rotation about an axis: [6]

Rotation of an axis, Compound pendulum, equation of motion of a rigid body, calculation of centre of mass and moment of inertia.

Rotation of a rigid body: [7]

Motion of a rigid body in space, Euler's equation of motion for a rigid body and qualitative discussion of motion of a symmetrical top.

Mechanics of continues media: [7]

Equation of motion of a vibrating strings, normal modes of a vibrating string, wave propagation along a string. Kinematics of moving fluids, equation of continuity, equation of motion for an ideal fluid.

Books

1. Introduction to Classical Mechanics, R. G. Takawale and P. S. Puranik, Tata McGraw-Hill (1997)

2. Mechanics, K. R. Symon, Addison Wesley (1971)

Experiments (minimum five)

1. Kater's pendulum.
2. Double pendulum.
3. Bifilar suspension.
4. Log Decrement & Viscosity.
5. Study of motion of a top or a gyroscope.
7. Study of damping of a bar pendulum under various kinds of damping mechanics.
8. Numerical solution of equation of motion using a personal computer/calculator.
9. Motion of a particle in a central force field using numerical analysis and calculator/PC.

Paper 2 : ELECTRONICS

Rectifiers and Regulators: [10]

Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes without and with capacitive filters. Percentage regulation, Ripple factor and Rectification efficiency. Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation.

Transistors. [4]

Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains □and their interrelation, Leakage current in transistors.

Basic Amplifier Characteristics. [5]

Current gain, Voltage gain, Power gain, Input resistance, Output resistance, Conversion efficiency, Classes of amplifier operations, Decibel , Frequency response, Amplifier bandwidth.

C-E amplifier: Class A. [6]
Graphical analysis, Effect of adding A.C. load, Input and Output resistance, Conversion efficiency, Phase relationship between input and output.

Transistor Biasing. [6]
Bias stability, Stability factor, Different methods of biasing, Biasing compensation.

Feedback. [9]

Positive and negative feedback, Voltage and current feedback, series and shunt feedback.

Effect on negative feedback on gain, frequency response, input and output resistance and distortion. **Positive feedback,** Barkhausen criterion for oscillations, Phase shift oscillator, Wein bridge oscillator, LC tank circuit, Hartley oscillator and Colpitts oscillator.

Linear IC's and Operation Amplifiers. [5]

The Differential Amplifier, OP-Amp characteristics, Input and Output impedance, Input bias and offset currents, Input and output offset voltages. Differential and Common mode gains, CMRR, Slew rate, OP-Amp as inverting , Non Inverting amplifier and Difference amplifier.

Text Books/ References:
1. Electronic Principles – A.P.Malvino TMH 5th edition 1996.
2. Electronics Devices and Circuits An Introduction- Allen Mottershed 3rd edition PHI 97
3. Intergrated electronics-Millman and Halkias TMH 1972
4. Basic Electronics and Linear Circuits-Bhargava, Kulshrestha and Gupta. TMH

5. Op-amp and Linear Intergrated Circuits- Ramakant Gayakwad PHI

Experiments. (minimum five).

1) Half wave and Full wave rectifier using Junction Diode, Load regulation characteristics.
2) Bridge rectifier with capacitor filter- Ripple factor using CRO.
3) OP-Amp: Characteristics Input and Output impedance.
4) OP-Amp: Inverting and Non-inverting amplifier.
5) Zener Diode Regulation.
6) Colpitts Oscillator./ Wein's Bridge Oscillator.
7) C.E. Amplifier. Gain v/s Load, Input and Output Impedance.
8) C.E. Amplifier. Fequency response with and without negative feedback. Calculation of Gain Bandwidth product.

Semester – IV

Paper 1 : HEAT AND THERMODYNAMICS

Kinetic theory of gases. **[8]**

Review of Kinetic Theory of gases, Average kinetic energy of a gas molecule. Degrees of freedom. Law of equipartition of energy and its application to specific heats of gases. Mean free path: Zeroth and first order approximation. Transport phenomena: transport of energy, momentum and matter. Brownian motion: Einstein's equation, Determination of Avogadro's number.

Behavior of real gases. **[7]**

Deviation from a perfect gas behaviour. Discussion of results of Andrews Experiments on CO_2 and Amagat's experiment. Critical constants. Van der Waals' equation of state. Expression for Van der Waals' constants. Reduced equation of state. Relation between Boyle temperature and critical temperature.

Thermodynamics.

Zeroth and First law of Thermodynamics. **[8]**

Basic concepts of thermodynamics: Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes. Zeroth law of thermodynamics and concept of temperature. Internal energy and First law of thermodynamics. Relation between pressure, volume and temperature in adiabatic process. Work done in isothermal and adiabatic processes. Path dependence of heat and work.

Second law of Thermodynamics. **[8]**

Reversible and irreversible processes. Carnot's cycle. Second law of thermodynamics. Efficiency of heat engines. Carnot's theorem. Latent heat equations.

Thermodynamic scale of temperature, its identity with perfect gas scale.

Entropy. **[14]**

Entropy as a Thermodynamic variable. Entropy change in reversible and irreversible processes. Temperature - Entropy diagram of Carnot's cycle. Entropy of a perfect gas. Entropy of a mixture of gases. Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder. Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics) Maxwell's Thermodynamic Relations and its applications.

Text Books/References

1.Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press(1965)

2.Thermal Physics – S.C . Garg, R.M. Bansal and C. K. Ghosh, TMH (1993)

3.Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960)

4.Text Book of Heat – G.R. Noakes, Mcmilan & Co(1960)

5.Thermodynamics - William C .Reynolds (1968)

6.Heat and Thermodynamics – M.W. Zemansky and R.H. Ditman, McGraw Hill (1997)

Experiments (minimum five)

1) Resistance Thermometry.
2) Constant volume and constant pressure air thermometers.
3) Thermister characteristics.
4) Study of thermocouples for temperature measurements.
5) Study of Brownian motion.
6) Measurement of thermal conductivity of poor conductors.
7) Stefans Constant.
8) Calibration of Si diode as a temperature sensor

Paper 2: MODERN PHYSICS

Electrons, Nucleus and Atoms: **[4]**

Electric discharge through gases, Determination of e/m for cathode rays, Charge and mass of an electron, Rutherford's theory of nuclear of the atom, Qualitative discussion of alpha scattering experiment, Atomic masses, Energy and mass units.

Brief review of Atomic models: **[5]**

Review of Bohr's Hydrogen atom, Frank-Hertz experiment and atomic energy levels, Bohr-Sommerfeld model-attempt to explain fine structure, Finite nuclear mass model. Isotope effect – variation of Rydberg constant for different isotopes, Bohr's correspondence principle.

Atomic Physics: **[4]**

Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph.

Particle Accelerators: **[2]**

Linear accelerator and Cyclotron.

Crystal Structure: **[3]**
Crystal lattice, crystal planes and Miller indices, unit cells, typical crystal structures.

X-rays: **[5]**

Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays – Laue's pattern, Diffraction of X-rays by crystal Bragg's law, Bragg single crystal spectrometer Analysis of crystal structure - simple cubic crystal.

Properties of electromagnetic radiation: **[10]**

Qualitative discussion of Radiation from an accelerated charges, Brief review of the light phenomenon that demonstrates wave nature, Black Body Radiation, Photoelectric effect and Compton effect – observation, description, derivations of relevant equations and failure of classical physics to explain the same. Experimental verification of the Photoelectric effect by Millikan and Compton effect.

LASERS: **[12]**

Purity of a spectral line, Coherence length and coherence time, Spatial coherence, Eienstein's A and B coefficients, Qualitative discussion of population inversion, spontaneous emission, stimulated emission, Ruby lasers, He-Ne laser, semiconductor laser, Carbon dioxide laser,

Pulsed Nitrogen, Applications of lasers in Medicine, Industry and Science. Holography: Construction of holograms, Principle and application.

Optical fibres: Basic principle, Optical fiber communication, Losses in Optical fibres.

Text Books:

1.Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995).

2. H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics,V

Edition, Chapman and Hall

3. J.B.Rajam, Atomic Physics, S.Chand and Company ltd.

4. Introduction to Modern Physics, F.K. Richtmyer, E.H.Kennord, J.N. Cooper (6th Ed.)

5. Optics, A. Ghatak, Tata McGraw-Hill, 2nd Edition (1993).

6. Laser: Theory and Applications, K. Thyagrajan and A. Ghatak McMillan (1987)

7. Optical Electronics, K.Thyagarajan and A.Ghatak, Cambridge University Press (1997)

8. LASERs and Non-linear optics, B.B.Laud, Wiley Eastern (1985)

Experiments (minimum five)

1)Laser based experiment.
2)Laser based experiment (with one kit several experiments can be done, only two are suggested assuming one kit per college and two sets of experiments in the semester).
3)X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy and assigning transitions.
4)Calculation of lattice constant by of Copper – x-ray diffraction pattern is given and student calculates, d-spacing, miller indices and lattice constant.
5)Frank Hertz Experiment.
6)Characteristics of photo cell.
7)Measurement of Boltzmann constant using transistor.
8)Photocell (verification of Photoelectric effect)
9)e/m using cathode ray tube.

Semester V

Paper 1: ELECTRONICS

Analog Electronics:

Transistors Multivibrators. [6]

Transistor as a switch, switching times, Multivibrators – Astable, Monostable, Bistable and Schmitt Trigger.

Field Effect Transistors. [11]

Basic structure of the JFET, Principles of operation, Characteristic curves and parameters, Common source amplifiers, Common gate amplifier (only qualitative discussion), The MOSFET Depletion Mode and Enhancement mode, Dual-Gate MOSFET. FET Phase shift oscillator, FET as VVR and its applications in Attenuator, AGC and Voltmeter circuits.

Applications of OP-AMP. [9]

Active diode circuits, Intergrator, Differentiator, Comparator, Window comparator, Schmitt Trigger, Waveform generator –Square wave, Triangular and Ramp Generator and monostable.

Timers: [6]

The 555 Timer, Basic concept, 555 block diagram, Monostable, Astable, Bistable, Schmitt Trigger and Voltage controlled oscillator (VCO) using 555 timer.

Digital Electronics:

Number system Logic. [16]

Binary number system, Binary to Decimal and Decimal to Binary conversion, Basic logic gates, OR, AND, NOR, NAND, and EX-OR gates. De Morgan's Law's, Boolean Algebra, NAND and NOR gates as universal building blocks in logic circuits, Sum of Products methods and Product of Sum methods of representation of logical functions. Half adder and Full adder, Multiplexer and Demultiplexer.

Logic families – DTL, TTL Standard TTL NAND gate, Schottky TTL, ECL OR and NOR gate, MOS (inverter, NAND and NOR gates) and CMOS (inverter, NAND and NOR gates).

Flip Flops and Counters. [12]

Basic RS FF, Clocked RS FF, JK FF, D-type and T-type FF, Master Slave Concept, Shift register (shift left, shift right) Schmitt trigger, Applications of FF's in counters, binary ripple counter, Modulus of counter (3,5) BCD Decade Counter, Cascade BCD Decade counters, Principle of digital counter digital voltmeter, and digital clock. Encoders and decoders

Text Books/ References:

1.Electronic Principles: A.P. Malvino TMH 5th edition 1996.
2.Digital Principles and Applications: Malvino and Leach TMH 4th edition 1986.
3.Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 1997
4.Intergrated Electronics: Millman and Halkias TMH 1972
5.Electronic Devices and Circuits: Millman and Halkais Mc Graw Hill 1967
6.Modern Digital Electronics: R. P. Jain TMH 3rd edition 2003.
7.Principles of Electronics: V.K.Metha S.Chand & Company 8th edition 2003.

Paper 2: WAVE MECHANICS

Wave and particles: **[10]**

De Broglie's hypothesis, Review of the Bohr's postulate about stationary states in the light of De Broglie's hypothesis, The concept of quantum (particle) nature of radiation.

Demonstration of wave nature of particles-Davisson Germer experiment, electron diffraction experiment of G.P.Thomson, Dual nature of radiation/matter. Complimentary in Duality.

The Wave Function: **[6]**

Representation of a De Broglie wave, Velocity of De Broglie wave, Construction of a wave group, Wave packet and its motion in one dimension., Group velocity and particle velocity, Max Born's interpretation of the wave function, probability concept, Acceptable wave function, Normalization of wave function.

Heisenberg's Uncertainty Principle: **[6]**

Limitation of wave mechanics to predict the physical state of a particle/system accurately. Derivation of Heisenberg Uncertainty principle relation for p and x, E and t. Illustration by thought experiments (-ray microscope, single slit diffraction and double slit experiment), Applications of Heisenberg Uncertainty principle.

Schroedinger's Wave Equation: **[13]**

Derivation of the wave equation on a stretched string, Derivation of Schroedinger's time dependent wave equation, Postulates of Quantum mechanics, Extraction of information from solutions in terms of expectation values of physical variables/observable. Definition of operators & their necessity, Eigen value equation, Commutation relations, Expression for expectation values of momentum and energy in terms of operators. Operators as fundamental postulates of wave mechanics and establishment of Schroedinger's time dependent equation. Concept of stationary states. Schroedinger's time independent equation.

Application of Schrodinger's Steady State Equation: **[25]**

1)Free particle 2) One-dimensional infinite square well potential: Energy eigen functions and eigen values. Show how probability distribution changes as the quantum number m. Calculation of <x> and <px>.3) Particle in one and three dimensional box , Concept of degeneracy 4) One dimensional finite square well potential placed symmetric to origin, Energy eigen values and functions. Parity and parity operators. 5) One dimensional finite square step potential of height Vo: Comparison of classical and quantum mechanical results for particle energy E>Vo and E<Vo. 6) Rectangular potential barrier and penetration through it, tunnel effect, Qualitative discussion of alpha decay, tunnel diode & scanning tunneling microscope. 7) Harmonic Oscillator- One dimensional, Energy Eigen value and energy eigen functions, Zero point energy and its significance.

Books:

1.Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)

2.Introduction to Modern Physics, F.K. Richtmayer, E.H.Kennard, J.N. Cooper (6th Ed.)

3.Introduction to Atomic Physics, H.E.White H.Semat and J.R.Albright,

4.Introduction to Atomic and nuclear Physics,V Edition, Chapman and Hall

5.Introduction to Quantum Mechanics, P.T. Matthews, TATA McGRAWL-HILL Pub. Ltd.

6.Quantum Mechanics, Theory and Applications; Ghatak and Lokanathan.

PAPER 3 : NUCLEAR PHYSICS

Properties of the Nucleus: **[4]**

Basic Properties of the nucleus, Mass/size (radius), Nuclear spin, Magnetic dipole moment, Electric Quadrapole moment, Parity. Packing fraction, Binding energy, B.E versus A plot, Saturation of nuclear forces.

Nuclear forces: **[8]**

Main characteristics of Nuclear Forces. Meson theory of Nuclear forces, Estimation of the mass of a meson using Heidelberg's Uncertainty Principle, Yukawa potential.

Radioactivity: **[7]**

The law of Radioactivity Decay, Mean life, Half life & Decay constant. Successive radioactive transformation (A-B-C) type, Ideal transient & secular equilibrium. Radioactive series, Carbon dating, artificial radioactivity.

Radioactive decay: **[10]**

Alpha decay, Velocity and energy of alpha particles, Geiger-Nuttal law, alpha spectra and fine structure, short range and long range alpha particles, disintegration energy, Gamow's theory of alpha decay. (Qualitative treatment)

Beta Decay: Types of Beta decay, Energies of (Beta -decay, The continuous beta particle spectrum & difficulties in understanding it, Pauli's neutrino hypothesis, Fermi's theory of Beta decay, (Qualitative treatment,) K-capture. Gamma Decay : Origin of gamma decay, Internal Conversion, Nuclear isomerism.

Nuclear models: **[10]**

Liquid drop model of a nucleus. The Compound Nucleus theory, Analogy between liquid drop & a nucleus. Wiezsacker's semi empirical mass formula.

Mass Parabolas, Prediction of stability against (-decay for members of a isobaric family, Spontaneous & induced fission, Bohr – Wheeler theory for nuclear fission and the condition for spontaneous fission on the basis of Z/A. Symmetric fission from the semi-empirical formula.

Nuclear Shell Model: **[10]**

Experimental evidence for magic numbers. Evidences that lead to shell model, Main assumption of the single particle shell model, Jensen-Mayer Scheme (No derivation), Predictions of the shell model.

Nuclear Energy: **[7]**

Neutron induced fission, Mass yield in an asymmetrical fission, Energy released in the fission of U-235. Fission chain reaction, Principle of a nuclear reactor, Neutron cycle in a thermal nuclear reactor (The four factor formula), Principle of a breeder reactor.

Detection of Nuclear Radiation: **[4]**

Ionization chamber, Proportional counter, Geiger Muller counter, Photographic Emulsions.

Text Books / References:

1.Nuclear Physics, Irving Kaplan, Narosa Publishing House

2.Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)

3.Introduction to Modern Physics, F.K. Richtmyer, E.H. Kennord, J.N. Cooper (6th Ed.) McGraw Hill (1997).

4.Nuclear Physics – S.B. Patel – TMH

Paper 4 : ELECTROMAGNETIC THEORY-I

Vector Calculus **[15]**

Vector Algebra (brief revision of basic vector operations)

Vector Differentiation :- scalar fields, vector fields , the time derivative, del operator, Gradient of a scalar function, Divergence, curl and Lplacian operator with physical significance.

Integration of vector Functions :- Line integrals, surface integrals, volume integrals

Divergence Theorem due to Gauss, Curl Theorem due to Stoke's ,Green's Theorem (all theorems with proof). Differential vector Identities with proof. [Harper]

Electrostatics **[10]**

Coulomb's Law, Electric Field, Continuous charge distribution, field lines, flux, and Gauss' law with applications [Griffiths] , the electric dipole , multipole expansion of electric fields[Reitz and Milford], The Dirac Delta function [Griffiths].

Techniques to solve electrostatic problems **[8]**

The electrostatic potential, Poisson's equation, Laplace's equation in one independent variable, solutions to Laplace's equation in spherical co-ordinates (zonal harmonics), conducting sphere in a uniform electric field, electrostatic images, point charge and conducting sphere. [Reitz]

Electric Fields in matter **[10]**

Polarization, Fields outside of a dielectric dielectric medium, electric field inside a dielectric , Gauss's law in a dielectric, the electric displacement vector, electric susceptibility and dielectric constant. Boundary conditions on the field vectors , Boundary value problems involving dielectric, Dielectric sphere in a uniform electric field.[Reitz]

Microscopic Theory of Dielectrics **[8]**

Molecular field in a dielectric induced dipoles , A simple model, polar molecules, Langevin's Debye formula , permananent polarization, ferroelectricity. [Reitz]

Work and Energy in electrostatics **[9]**

The work done to move a charge, the energy of a point charge distribution, the energy of continuous charge distribution, Energy density of an electric field. Basic properties of conductors, Induced charges, capacitors. [Griffiths,Reitz]

BOOKS :-

1. Introduction to Mathematical Physics , Charlie Harper,

2. Introduction to Electrodynamics , David Griffiths, Prentice Hall of India Ltd,New Delhi (1995)

3. Foundations of Electromagnetic Theory , Reitz and Milford , Addision-Wesley Publishing Company.

4. Electricity and Magnetism, Mahajan and Rangawala , tata McGraw-Hill Publishing Company Ltd.

5. Electricity and Magnetism; Rakshit and Chatopadhaya

Paper 5 : PRACTICAL PAPER I [Experiments. (Minimum eight)]

Section I

1. Study and analysis transistorised Multivibrators- Astable, Monostable.
2. Study and analysis transistorised Multivibrators- Bistable, Schmitt trigger.
3. F.E.T Characteristics.
4. F.E.T Common Source Amplifier.
5. OP-amp as a differential amplifier and its application in temperature measurement.
6. Regulated power supply using IC LM 317 with external pass transistor.

Section II

7. Study of IC 555 as Astable, and its use as Voltage Controlled Oscillator.
8. Study of Timer as a mono-stable multivibrator.
9. Analog Multiplexer.
10. Digital Multiplexer.
11. Verification of De Morgan Law's and Boolean Identities. (Construction using Gates)
12. NAND and NOR gates as universal building blocks.
13. Binary addition- Half adder and Full adder using any gates.
14. Study of JK flip flop with JK FF IC's (Ripple counter and Decade counter).

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

Paper 6: PRACTICAL PAPER II [Experiments. (Minimum eight)].

Section I

1. Specific heat of graphite.
2. Resolving power of grating.
3. Resolving power of Prism.
4. Fraunhoffer diffraction at double slit.
5. Lloyd's mirror .
6. Absorption spectrum of a liquid (KI).

Section II

7. Polarimeter.
8. Transient response of L-C-R circuit using square wave generator and C.R.O.
9. Core losses and copper losses in a transformer.
10. Measurement of Dielectric constant of a liquid by capacitance method.
11. Susceptibility measurement by immersing a parallel plate capacitor in a dielectric Medium/ for disk capacitor as a function of temperature.
12. Capacitance of two co-axial metal tubes.
13. E and D field measurement for parallel plate capacitor and calculation of dielectric constant.

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

SKILL BASED PAPERS

PAPER-I: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

DC indicating Instruments: **5**

PMMC Galvanometer (D' Arsonal Movement) – Principle, Construction and working –Current Sensitivity, Voltage Sensitivity & Megohm Sensitivity – Advantages and Disadvantages – Conversion of Galvanometer in to ammeter, Voltmeter and Ohmmeter (Series and Shunt Types).

AC indicating Instruments: **4**

Electrodynamometer- Principle, Construction and working- Merits and Demerits- Rectifier Type Instruments- Thermocouple Instruments (Contact & Non – contact types)-Electrostatic Voltmeters- Principle, Construction and Working – Watt – hour Meter.

DC Bridges: **4**

Wheatstone bridge – Determination of resistance- Kelvin double Bridge- Determination of resistance. AC Bridges: Maxwell's Bridge – Determination of self –Inductance – Wien'[s Bridge- Determination of frequency – Schering's Bridge- Determination of Capacitance.

Power Supplies: **4**

Unregulated D.C. (full wave, bridge rectifier) power supplies. C- Filter and LC filter, Regulated power supplies, fixed voltage regulator, SMPS power supplies**.**

Oscilloscopes: **5**

Block Diagram – Deflection Sensitivity – Electrostatic Deflection – Electrostatic Focusing – CRT Screen – Measurement of Waveform Frequency, Phase difference and time intervals – Sampling Oscilloscope- Storage Oscilloscopes.

Instrumentation Amplifiers and Signal Analyser: **6**

Instrumentation amplifier, Electronic Voltmeter, Electronic Multimeter- Digital Voltmeter- Ohm meter- Function Generator ,Wave analyser- Fundamentals of Spectrum Analyser.

Practicals: **12**

1. Unregulated power supply with C- filter.
2. Regulated power supply.

3. Fixed voltage regulated power supply.
4. Standard low voltage SMPS power supply.

Books for study and Reference

1. Electronic Instrumentation and measurement Techniques- W.D. Cooper 7 A.D. Helfrik, Plentice Hall of India.
2. A course in Electrical and Electronic Measurements and Instrumentation – A.K. Sawhney, Dhanpat Rai and Sons.
3. Electronic Instrumentation & Measurements- P.B. Zbar, Mc. Graw Hill International.

Paper-II: COMPUTATIONAL PHYSICS

C Language Fundamentals: **8**

Constants, Variables, Keywords, rules for constructing integer constants, real constants, character constants. Types of C variables and rules for constructing variable names. Declaration instruction, arithmetic instruction, Integer and float conversion, type conversions in assignments, hierarchy of operation and associativity of operators.

Decision Structure: **3**

if statement, if-else, nested if-else. The logical operator: the if-else clause, the not operator, conditional operator.

Loop Control Structure: **3**

while loop, for loop, nesting of loop, multiple initializations in the for loop. The break statement, the continue statement and the do-while loop.

The Case Control Statement: **6**

Using switch statement. Functions & Pointers: definition of function, why use functions?, passing values between function, scope rule of functions, calling convention. Advanced features of functions: return type of function, call by value and call by reference. Introduction to pointers, pointer nation, recursion and stack. Adding function to library.

Programming : **20**

Simple pendulum, Bar pendulum, Project motion, surface tension, logirarithmic decrement, Nuclear decay, Wave motion, specific heat, Magnetic field in a straight wire, Diffusion equation, Ohms law, Kirchhoff's Rules, Network theorems, Boolean laws, Heat transfer & Kepler's Laws. Solution of first order differential equation. Solution of linear equation. Use of spread sheets for plotting graphs.

Reference Books:

1. An Introductory Course in Computational Physics-Richard Fitzpatrick.
2. Computational Physics-Nicholas Giordano & Hisao Nakanishi.
3. Introduction to computational Physics-Tao Pang.
4. Let Us C- Yashwant Kanetkar (8^{th} edition) BPB Publishers

SEMESTER VI

Paper-1: SOLID STATE DEVICES AND INSTRUMENTATION

Solid State Devices:

Two Terminal Devices. **[6]**

Tunnel diodes, Power diodes, Varicap diodes, Schottky Barrier diode, Semiconductor photoconductive cell, Photovoltaic cell, Photodiode, Light emitting diodes (LED), Liquid Crystal display (LCD), Solar cells and Photocouplers.

(Book: Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky. Chapter 1.13 to 1.22) Book – Electronic Principles – Malvino Chapter 7.14

Industrial Devices. **[12]**

Silicon controlled rectifier (SCR), SCR characteristics, rating, construction and terminal identification, SCR applications, Silicon controlled switch (SCS), Gate turn off switch (GTO), Light activated SCR (LASCR), Shockley diode, Diac, Triac, Typical Diac-Triac Phase control circuit, Unijunction transistor (UJT). Phototransistor, V-FET.

(Book: Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky. Chapter 9.1 to 9.15, 14.9) Book – Mottershead – Chapter 28.4

Image Capture Devices. **[5]**

Vidicon tube, Plumbicon, Silicon Diode Array Vidicon, Solid State Image scanners (CCD's).

(Book: Monochrome and Colour TV, R.R. Gulati).

Instrumentation:

Measuring Instruments. **[16]**

Analog DC ammeter, Multirange ammeter, Universal shunt, AC & DC voltmeter, Multirange voltmeter, Extending voltmeter range, Transistor voltmeter, Ohmmeter – Series and shunt type, Multimeter, Digital voltmeter, multimeter and frequency meter, Q meter.

(Book: Kalsi Electronic Instrumentation. Chapter 3.1 to 3.3, 4.2 to 4.7, 4.21, 4.22, 5.2, 6.2,6.3,10.7)

Oscilloscope: **[5]**

CRT, CRO block diagram (simple CRO), Vertical amplifier, horizontal deflection system, sweep generator, Delay line.

(Book: Kalsi Electronic Instrumentation. Chapter 7.2.1, 7.4, 7.5, 7.5.1,7.6,7.7.1,7.10)

Transducers: **[12]**

Introduction, Electrical transducer, selecting a transducer, Strain gauges, resistance wire gauge, type of strain gauge, foil strain gauge, semiconductor strain gauge, Thermistor, Inductor transducer, LVDT, Capacitive transducer, Piezo electric transducer and Hall effect transducers.

(Book: Kalsi Electronic Instrumentation. Chapter 13.1 to 13.3, 13.6, 13.6.1 to13.6.4, 13.6.8,13.9,13.9.1,13.11,13.13)

Signal Generator: **[4]**

Standard signal generator, AF sine and square wave generator, function generator.

(Book: Kalsi Electronic Instrumentation. Chapter 8.4,8.5,8.7,8.8)

Books/References

1. Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky.
2. Monochrome and Colour TV, R.R. Gulati).
3. Electronic Instrumentation: Kalsi TMH
4. Electronic Devices and Circuits: J. Millman and C. Halkias
5. Electronic Instrunentation and Measurement Techniques: William David Cooper
PHI 3rd edition
5. Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 3rd edition
Electronic Principles – Malvino
6. A course in Electrical and Electronic Measurement: A. K. Sawhney Dhanpat Rai and Com. 2001.

Paper-2: ATOMIC AND MOLECULAR PHYSICS

Hydrogen Atom: **[6]**

Schrodinger's equation for the H-atom, separation of variables, Quantum numbers-n, l, ml, spin, magnetic moment, J and mJ, Angular momentum, Magnetic moment and Bohr magneton.

Many Electron Atoms: **[9]**

Pauli exclusion principle and classification of elements in periodic table. Symmetric and Antisymmetric wave functions, Electron configuration, Hund's rule, Spin orbit interaction, Vector atom model, Total angular momentum, L-S coupling, J-J coupling.

Atomic Spectra: **[8]**

Spectroscopic rotation, Selection rules (derivation from transition probabilities), Alkali metal type spectra, Principal, Sharp, Diffused and Fundamental series, fine structure in alkali spectra.

Atoms in a Magnetic Field: **[8]**

Effects of magnetic field on an atom, Larmor Precession, The Normal Zeeman effect, Lande 'g' factor, Zeeman pattern in a weak field (Anomalous Zeeman effect), The Stern-Gerlach experiment.

X-ray Spectra: **[6]**

Characteristic spectrum, Moseley's law, Explanation of X-ray spectra on the basis of quantum mechanics, Energy levels and characteristic X-ray lines, X-ray absorption spectra, Fluorescence and Auger effect.

Spectra of Diatomic Molecules: **[15]**

Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibration-Rotation spectra, Fortrat Parabolas and explanation of band structure on its basis, Electronic spectra

.

Raman Effect: **[8]**

Quantum theory of Raman effect, Classical theory of Raman effect Pure rotational Raman spectra, Vibrational Raman spectra, Rotational fine structure, Experimental set up for Raman effect.

References:

1. Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)

2. Introduction to Modern Physics, F.K. Richtmyer, E.H.Kennord, J.N. Cooper (6th Ed.)

3. Introduction to Atomic Spectra, H.E.White, McGraw Hill Book Company

4. Introduction to Molecular Physics, Barrow

5. Spectrophysics, Anne P. Thorne, Chapman and Hall

Paper-3: THERMODYNAMICS AND STATISTICAL MECHANICS

Thermodynamics:

Power cycles. [5]

Internal Combustion Engines – The Otto cycle and its efficiency. Diesel cycle and its efficiency. Mean effective pressure in Carnot, Otto ad Diesel cycles.

Production of low temperature. [25]

Cooling by evaporation. Vapour compression machines. Refrigerators based on Vapour absorption. Cooling by sudden adiabatic expansion of compressed gases. Efficiency and performance of Refrigerating machines. Enthalpy and heat flow. Joule Kelvin effect. Expression for joule Kelvin coefficient and inversion temperature. Application to Van der Waals' gas. Principles of regenerative and cascade cooling. Liquifaction of hydrogen and helium. Production of temperatures below 4^{o} K. Properties of He I and He II. Cooling by Adiabatic Demagnetisation of paramagnetic substances.

Statistical Mechanics:

Probability [15]

Random Events, Probability, Probability and Frequency, Some basic rules of Probability theory, Continous random variables, Mean value of discrete and continous variables, Variance: Dispersion, Probability Distribution, Binomial distribution: Mean value and fluctuation, Stirlings Approximation, Poisson Distribution: Mean value and Standard deviation, Gaussian Distribution: Standard deviation, Random Walk,

Maxwell-Boltzmann Distribution [15]

The most probable distribution. Maxwell Boltzman Statistics. Molecular speeds: mean, most probable and rms speeds. Experimental verification of Maxwell Boltzman statistics. Probability and Entropy. Statistical interpretation of second law of Thermodynamics. Other statistical distributions (Bose Einstein and Fermi Dirac statistics: Only qualitative study) Phase Space.

Text Books/References

1.Thermodynamics and Statistical physics – D.P Khandelwal and A.K. Pande, Himalaya Publishing House

2.Introduction to Statistical Mechanics – B.B. Laud, New Age International (2003)

3. Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press(1965)

4. Thermal Physics – S.C Garg, R.M. Bansal and C. K. Ghosh, TMH (1993)

5. Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960)

6. Text Book of Heat – G.R. Noakes, Mcmilan & Co (1960)

7. Thermodynamics - William C .Reynolds (1968)

8. Heat and Thermodynamics – M.W. Zemansky and R.H. Ditman, McGraw Hill (1997)

9. Perspectives of modern physics – Arthur Beiser, 5^{th} edition, McGraw hill (1995)

Paper-4 :ELECTROMAGNETIC THEORY (II)

Magnetostatics and Relativity

Magnetic Field of Steady Currents **[10]**

Biot-savart's law and its applications, Ampere's circuital law, magnetic vector potential, magnetic field of a distant circuit, magnetic scalar potential.[Reitz]

Magnetic Field in material media **[14]**

Magnetization, magnetic field produced by magnetized material, magnetic scalar potential and magnetic pole density, sources of the magnetic field, magnetic intensity, The field equations, magnetic susceptibility and permeability, Hysteresis, Boundary conditions on the field vectors [Reitz], current circuits containing magnetic media, Magnetic circuits[Mahajan,Rangawala], Magnetic circuits containing permanent magnets.

Microscopic Theory of Magnetism **[6]**

Molecular field inside matter, Origin of Diamagnetism, Origin of Paramagnetism, theory of Ferromagnetism , Ferromagnetic domains.[Reitz,Griffiths]

Magnetic Energy **[3]**

Magnetic energy of coupled circuits, Energy density in the magnetic field, Hysteris Loss.[Reitz]

Maxwell's Equations **[8]**

Faraday's Law of electromagnetic induction, Generalization of Ampere's Law, Displacement current, Maxwell's equations and their empirical basis, Electromagnetic energy.[Reitz,Griffiths]

Relativity **[3]**

Michelson-Morley experiment, postulates of the theory of special Relativity.

Relativistic Kinematics **[8]**

Relativity of simultaneity, Derivation of Lorentz transformation equations, some consequences of Lorentz transformation equations, Relativistic addition of velocities, relativistic transformation of velocities and Doppler effect in Relativity .

Relativistic Mechanics **[8]**

Mechanics and Relativity, Redefining momentum, Relativistic momentum, Relativistic mass, Equivalence of mass and energy.

Reference Books : -

1. Introduction to Mathematical Physics , Charlie Harper,

2. Introduction to Electrodynamics, David Griffiths, Prentice Hall of India Ltd,New Delhi(1995)

3. Foundations of Electromagnetic Theory, Reitz and Milford, Addision-Wesley Publishing Company.

4.Electricity and Magnetism, Mahajan and Rangawala, Tata McGraw-Hill, Publishing Company Ltd.

Paper 5 : PRACTICAL PAPER I [Experiments. (Minimum eight)]

Section I

1. Energy band gap of a semiconductor .
2. Light emitting diode VI characteristics and dynamic range.
3. Photodiode/ Phototransistorl:Variation of current with Intensity (distance) and with wavelength.
4. UJT characteristics and its use in relaxation oscillator.
5. SCR characteristics and gate controlled ac half wave rectifier.
6. DIAC and TRIAC Characteristics, Gate triggering application.

Section II

7. Design of Simple Square / sine wave oscillator. Using XR 2206/ NE 566/ LM 8038
8. Construction and design of analog two ranges voltmeter.
9. Crystal Oscillator: Determination of velocity of ultrasonic waves in a liquid medium .
10. Determination of transition capacitance of Varactor diode as function of reverse bias voltage and use as a variable/tuning capacitor in any one application. (type CD91 or Bel 90 or equivalent).
11. Study of strain Gauges
12. Study of LVDT (including calibration) and its use in any one application.

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

Paper-6: PRACTICAL PAPER II [Experiments minimum eight]

Section I

1. Velocity of sound by forming stationary waves by using C.R.O.
2. Cylindrical obstacle.
3. Double refraction.
4. Searle's Goniometer.
5. Biprism.
6. Hysteresis by magnetometer.

Section II

7. Measurement of Hysteresis loss using CRO.
8. Michelson Morley Experiment.
9. Absolute capacity by ballistic galvanometer.
10. Mutual inductance by ballistic galvanometer.
11. Variation of mass with velocity. (Computer Simulation)
12. C1/C2 by ballistic galvanometer De Sauty's Method.
13. Measurement of emissivity of hot bodies, (various types of surfaces)

N.B.: Course instructor is advised to conduct 4 experiments from each Section.

PAPER VII: PHYSICS PROJECT:

Project title is expected to be finalized at the beginning of the fifth semester to be completed at the end of six semesters. Project should consist of either development / simulation of Physics Systems beyond the scope of practical syllabus wherein students have scope to understand, analyze and have hands on training in the field of Physics. The project may be undertaken in association with local industries.