F.Y.B.Sc.Paper I: Mechanics and Properties of Matter

SEM I Paper I	Mechanics and Properties of Matter

Course Objectives

- Explain one dimensional motion and dependence of force on position, velocity and time
- Explain the two-dimensional motion like that of projectile motion.
- Explain three important properties of matter.

Theory	
Motion of a particle in one dimension 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 $F = F_o \sin(\omega t + \varphi)$. 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.	**14L**
Motion of a charged particle in Electro-magnetic field (Only perpendicular field) 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.	**4L**
Motion in two dimension 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.	**4L**
Motion of a particle in a plane: Projectile motion in a non-resistive and resistive medium, resistive force proportional to the first power of velocity.	**4L**
Properties of Matter **Elasticity:** 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.	**11L**
Surface Tension: 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.	**4L**

Viscosity: Streamline flow, Turbulent flow, Critical velocity, Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube.	**4L**
Learning Outcome **Learner will be able to** • Apply the equation of motion to one or two dimensions of the system in order to understand kinematics of the body under the various conditions of applied force. • Apply the knowledge in construction of beams, bridges etc, • Apply knowledge in understanding the flow of liquid and surface tension applied on the surface of liquid	
Reference 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, 5.W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer) 6.Properties of Matter, Starling H. S, Mcmillian and Co (1961). 7.Mechanics , H.S.Hans and S.P.Puri, Tata McGraw-Hill (2003) 8.Mechanics, D.S.Mathur, S.Chand & Co. (2005)	
Practical **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	

F.Y.B.Sc. Physics Paper II: ELECTRICITY

SEM I Paper II	ELECTRICITY

Course Objectives

1. To use the concept of current & voltage source in circuit analysis, apply network theorems to relevant circuits.
2. To explain response of LR and CR circuits to Dc and AC and to explain the design of resonant circuits and filters.
3. To illustrate the use of choke as a watt less component
4. To explain the theory of mutually coupled LR circuits
5. To explain the working of transformer & effect of loading.
6. To explain the operation of AC bridges and their applications

Theory

Circuit Analysis 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).	**12L**
Inductance 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.	**5L**
Response of circuits containng L C and R to DC (transients) 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.	**8L**
Ballistic Galvanometer General theory of a suspended coil ballistic galvanometer, Expression for charge, Figure of merit, Current sensitivity and voltage sensitivity.	**4L**
A.C. Circuits 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)	**9L**
Mutually Coupled L-R circuits A.C. applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer.	**5L**
A. C. Bridges	**3L**

General A.C. bridge. Maxwell's bridge. Maxwell's L/C bridge. De-Sauty's capacitance bridge. Wein's frequency bridge.	
Learning Outcome Learner will be able to : • Students learn to appreciate and use network theorems for analysing complex electrical networks • Students learn to analyse Dc and AC response of LR and CR circuits and use them in applications such as amplifiers and oscillators • Students learn to design filter circuits such as Low Pass, High Pass and band Pass. • Students learn to design a transformer. • Students learn measurements using AC bridges. • Students learn about related experiments to be conducted in Lab.	
Reference Books **Books** Fundamentals of Electricity and Magnetism. D. N. Vasudeva, S. Chand and Company Ltd. New Delhi (1995). Electric Circuit and Theory. F. A. Benson and D. Harrison. E.L.B.S. (1995). Electricity and Magnetism. J. Yarwood and J. H. Fewkes. University Tutorial Press (1991). Electrical Technology, By Thereja Electicity and Magnetism, Brijlal and Subramanian Electrical Circuits : Siam Series	
Practical **Experiments (minimum four)** 1. Verification of Thevenin's and Norton's theorem 2. Response of LR and CR circuits to A.C. - phasor diagrams 3. Step Response of RC circuit / SLR Circuit 4. L.D.R. Characteristics / and application like switch 5. De Sauty's Bridge and Maxwells L/C Bridge 6. LCR Series and parallel resonance –Resonant frequency,Q value and Bandwidth 7.Resistance of Mirror Galvanometer / Table Galvanometer by Shunting and Figure of Merit of Mirror Galvanometer and Determination of Current and Voltage Sensitivity 8.Electrical Simulation of LR,CR,LCR Circuits : Computer Simulation by PSPICE / Electronics work bench	

F.Y.B.Sc. Physics Paper I: WAVES AND ACOUSTICS

SEM II Paper I	WAVES AND ACOUSTICS
Course Objectives 1. To explain waves and oscillations and wave propagations in a medium . 2. To explain basic properties of ultrasonic waves and generation detection and applications of ultrasonic waves. 3. To explain Doppler effect in sound and problem solving. 4. To explain acoustics of buildings and optimization of reverberation using sabine's formula . 5. To explain the design of musical scales.	
Theory	
Waves and Oscillations 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.	**18L**
Oscillatory Motion in a Resistive Medium: 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.	**9L**
Sound 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. Doppler effect. Source and listener in relative motion. (Normal incidence only)	**12L**
Acoustics of Rooms and Musical Scales 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)	**6L**
Learning Outcome **Learner will be able to** • Students learn and appreciate the relationship between oscillations and waves. • Students learn to solve problems related to wave propagation in fluid medium and apply Newton's formula for calculation of wave velocity. • Students learn to use Kundt's tube for determination of velocity of sound in fluids. • Students learn to solve problems related to Doppler effect in sound.	

• Students learn acoustic design of an auditorium. • Students learn design of musical instruments. • Students learn about related experiments to be conducted in Lab.	
Reference Books Text book of Sound. D. R. Khanna and R.S. Bedi, Atma Ram, New Delhi (1994). Sound. F. G. Mee, Heinemann Ltd., London (1967)	
Practical **Experiments (minimum four)** 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. Bifilar suspension: determination of Moment of Inertia. 9. Wave superposition : Computer Simulation	

F.Y.B.Sc. Physics Paper II: Optics

SEM II Paper II	Optics
Course Objectives • Explain properties and application of lenses • Explain the fundamentals of optical phenomenon.	

Theory	
Refraction through the lenses 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)	**10L**
Fundamentals of Reflection and Refraction Refractive index and optical path, Fermat's Principle of least time, Derivation of the laws of reflection & refraction using Fermat's Principle	**2L**
Interference 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	**11L**
Diffraction 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	**15L**
Polarization 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.	**7L**

Learning Outcome **Learner will be able to** • Apply knowledge in selecting correct lenses for different uses • Apply knowledge to differentiate the spectra obtained from different phenomena	
Reference 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. Optics, 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)	
Practical **Experiments (minimum four)** 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	

S.Y.B.Sc. Physics Paper I: MECHANICS II

SEM III Paper I	MECHANICS II	

Course Objectives: This course will provide students with :

1. Understanding of motion under the influence of a central force
2. Understanding of Kepler's Laws
3. Understanding of motion of a system of particles
4. Understanding of translational and rotational motion of a rigid body
5. Understanding of motion in continuous medium
6. Knowledge of corioli's and centrifugal force

Theory

Motion under a central force: 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 Laws, hyperbolic orbits, classical scattering, definition of scattering cross section and angle of scattering, Rutherford's scattering cross section and its derivations.	13L
Motion of a system of particles: 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.	6L
Moving coordinate systems: 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.	6L
Rigid bodies, Rotation about an axis: Rotation of an axis, Compound pendulum, equation of motion of a rigid body, calculation of centre of mass and moment of inertia.	6L
Rotation of a rigid body: 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.	7L
Mechanics of continues media: 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.	7L

Learning Outcome: At the end of the course learners will be able to:
1. Formulate the equations of motion for the motion in central force field
2. Understand the equivalent one body problem.
3. Understand and state Kepler's laws of planetary motion.
4. Solve problems related to the concepts of classical mechanics.

References:

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 four)
1. Kater's pendulum,
2. Double pendulum,

3. Bifilar suspension 4. Log Decrement & Viscosity, 5. Frequency of AC mains (Sonometer) 6. 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	

S.Y.B.Sc. Physics Paper II: **ELECTRONICS**

SEM III.Paper II	**ELECTRONICS**	
Course Objectives: This course will provide students with knowlege: 1. To gain knowledge of basic devices such as diodes, transistors, thermister etc. 2. Apply them to various circuits such as rectifiers, amplifiers. 3. Understand the effect of temperature on performance of devices such as transistors. 4. Device methods for effective performance of these devices under various conditions. 5. Apply them to solve various circuit problems.		
Theory		
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.		**10L**
Transistors. **[4]** Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains □□□□□□and their interrelation, Leakage current in transistors.		4L
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		5L
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.		6L
Transistor Biasing. [6] Bias stability, Stability factor, Different methods of biasing, Biasing compensation.		6L
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		9L
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.		5L

Learning Outcome: At the end of the course learners will be able to:

1. To gain knowledge of basic devices such as Diodes, Transistors, Thermister and Operational amplifier.
2. Apply them to various circuits.
3. Understand the effect of temperature on devices such as transistors.
4. Improvise effective methods for performance of these devices under various conditions.
5. Apply them to solve various circuit problems.
6. Understand the use of Operational amplifiers in Inverting and Non-Inverting amplifiers, adder and subtractor circuits.

References:

Electronic Principles – A.P.Malvino TMH 5th edition 1996.
Electronics Devices and Circuits An Introduction- Allen Mottershed 3rd edition PHI 1997
Intergrated electronics-Millman and Halkias TMH 1972
Basic Electronics and Linear Circuits-Bhargava, Kulshrestha and Gupta. TMH
Op-amp and Linear Intergrated Circuits- Ramakant Gayakwad PHI

Experiments (minimum four)

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.

S.Y.B.Sc. Physics Paper I: **HEAT & THERMODYNAMICS**

SEM IV paperI	Heat & Thermodynamics	Theory & Practicals
Course Objectives: This course will provide students with 1. Understanding of basic principles of kinetic theory of gases. 2. Knowledge of zeroth, first and second law of thermodynamics. 3. Discussion of Andrew's and Amagat's experiment which explain behavior of real gases. 3. Understanding of concept of entropy.		
Theory		
Kinetic theory of gases. 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.		**8L**
Behavior of real gases. 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.		**7L**
Thermodynamics. **Zeroth and First law of Thermodynamics.** 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.		**8L**
Second law of Thermodynamics. 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.		**8L**
Entropy. 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.		**14L**
Learning Outcome: At the end of the course learners will be able to: 1. Understand the kinetic theory of gases. 2. Derive an expression for average kinetic energy of a gas molecule. 3. Derive an equation for Brownian motion. 4. Obtain Van der Waal's equation of state. 5. Discuss the zeroth, first and second law of thermodynamics. 6. Understand the concept of entropy. 7. Solve the problems related to above concepts.		

Text Books/References Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press(1965) Thermal Physics – S.C . Garg, R.M. Bansal and C. K. Ghosh, TMH (1993) Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960) Text Book of Heat – G.R. Noakes, Mcmilan & Co(1960) Thermodynamics - William C .Reynolds (1968) Heat and Thermodynamics – M.W. Zemansky and R.H. Ditman, McGraw Hill (1997)	
Experiments (minimum four) 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	

S.Y.B.Sc. Physics Paper II: **MODERN PHYSICS**

SEM IV Paper II	MODERN PHYSICS	Theory & Practicals

Course Objectives: ***At the end of the course, students will be able to:***

1. Determine the e/m for a charged particle.
2. Review the concept of atomic model and apply it to determine the energy levels for a given gas.
3. Understand typical crystal structures and determine their structure using X-ray diffraction.
4. Define lasers, classify the different types of lasers and apply them to optic fibres and holography..

Theory	
Electrons, Nucleus and Atoms: 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.	**4L**
Brief review of Atomic models: 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.	**5L**
Atomic Physics: Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph.	**4L**
Particle Accelerators: Linear accelerator and Cyclotron.	**2L**
Crystal Structure: Crystal lattice, crystal planes and Miller indices, unit cells, typical crystal structures	**3L**
X-rays: 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.	**5L**
Properties of electromagnetic radiation: 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.	**10L**
LASERS: 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	12L

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.	
Learning Outcome: At the end of the course learners will be able to: 7. Understand the concept of Lorentz Force and apply it to the motion of charged particles in electric and magnetic fields. 8. Understand the design and working of particle accelerators and mass spectrometers. 9. Appreciate the concept of quantization of energy levels by studying Frank-Hertz experiment. 10. To define crystalline and amorphous solids. 11. To determine miller indices and calculate the "d" spacing of the crystal 12. Determine charge to mass ratio of electrons by using Thomson's method. 13. Appreciate theory of the concept of Modern physics and also study relevant experiments. 14. Apply the concepts of Modern Physics to solve problems and to perform experiments.	
Text Books/References 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 four) 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	

T.Y.B.Sc. Physics Paper I : ELECTRONICS

SEM V Paper I	**Electronics**
Course Objectives At the end of the course, students will be able to: 1. Understand the concept of transistor. 2. Apply the concept of transistor as a switch in switching applications such as multivibrator circuits. 3. Convert Binary to decimal numbers and vice-versa. 4. Understand the basic function of logic gates and their applications.	
Theory	
Transistors Multivibrators. Transistor as a switch, switching times, Multivibrators – Astable, Monostable, Bistable and Schmitt Trigger.	**6L**
Field Effect Transistors. 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.	**11L**
Applications of OP-AMP. Active diode circuits, Intergrator, Differentiator, Comparator, Window comparator, Schmitt Trigger, Waveform generator –Square wave, Triangular and Ramp Generator and monostable.	**9L**
Timers: The 555 Timer, Basic concept, 555 block diagram, Monostable, Astable, Bistable, Schmitt Trigger and Voltage controlled oscillator (VCO) using 555 timer.	**6L**
Digital Electronics: **Number system Logic**. 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**)**	**16L**
Flip Flops and Counters. 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	12L

counters, Principle of digital counter digital voltmeter, and digital clock. Encoders and decoders .	
Learning Outcome **Learner will be able to :**Describe the function of the transistor as a switch and explain its application in switching circuits. • Describe the application of operational amplifiers in diode circuits and circuits such as Integrator and Differentiator. • Define the Field effect transistor, its types and differences. • Explain the application of FET in circuits such as AGC, VVR. • Explain the use of Op-amp as a comparator and window comparator and hence their applications in wave-shaping circuits. • Describe the working of a basic timing circuit using the IC 555 and its applications in multivibrator circuits. • Understand the number logic system using binary numbers and their use in basic logic gates. • Explain the working of a basic flip-flip and its applications in digital circuits such as counters.	
Reference Books Electronic Principles: A.P. Malvino TMH 5th edition 1996. Digital Principles and Applications: Malvino and Leach TMH 4th edition 1986. Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 1997 Intergrated Electronics: Millman and Halkias TMH 1972 Electronic Devices and Circuits: Millman and Halkais Mc Graw Hill 1967 Modern Digital Electronics: R. P. Jain TMH 3rd edition 2003. Principles of Electronics: V.K.Metha S.Chand & Company 8th edition 2003.	

T.Y.B.Sc. Physics Paper II : WAVE MECHANICS

SEMV Paper II	**WAVE MECHANICS**

Course Objectives

1. To illustrate dual nature of matter and radiation and importance of De-Broglie hypothesis in development of quantum mechanics
2. To explain experimental evidence of De-Broglie hypothesis.
3. To explain wave group HUP and correspondence principle and Schrodinger's equation.
4. To explain applications of STIE
5. To explain quantum mechanical aspects of molecular spectra, alpha decay and tunnel diode.

Theory

Wave and particles: 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.	**10L**
The Wave Function: 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.	**6L**
Heisenberg's Uncertainty Principle: 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.	**6L**
Schroedinger's Wave Equation: 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	**13L**
Application of Schrodinger's Steady State Equation: 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	**25L**

classical and quantum mechanical results for particle energy $E>V_o$ and $E<V_o$. 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.

Learning Outcome

Learner will be able to

- Students learn about complimentary nature of matter and radiation.
- Solve problems using Schrodinger's equation.
- Calculate probabilities of particle location and expectation values using quantum mechanical tools
- Learn about thought experiments and quantum mechanical arguments in their support
- Learn about evolution of modern physics

Reference Books

Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)
Introduction to Modern Physics, F.K. Richtmayer, E.H.Kennard, J.N. Cooper (6th Ed.)
Introduction to Atomic Physics, H.E.White
H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics,V Edition, Chapman and Hall
Introduction to Quantum Mechanics, P.T. Matthews, TATA McGRAWL-HILL Pub. Ltd.

T.Y.B.Sc. Physics Paper III: Nuclear Physics

SEM V Paper III	Nuclear Physics
Course Objectives • Explain properties of nucleus • Explain radioactivity, nuclear reactions • Explain different methods to detect nuclear radiation	
Theory	
Properties of the Nucleus: 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.	**4L**
Nuclear forces: Main characteristics of Nuclear Forces. Meson theory of Nuclear forces, Estimation of the mass of a meson using Heidelberg's Uncertainty Principle, Yukawa potential.	**8L**
Radioactivity: 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.	**7L**
Radioactive decay: 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.	**10L**
Nuclear models: 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	**10L**
Nuclear Shell Model: 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.	**10L**

Nuclear Energy: 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	**7L**
Detection of Nuclear Radiation: Ionization chamber, Proportional counter, Geiger Muller counter, Photographic Emulsions.	**4L**
Learning Outcome **Learner will be able to** • Apply knowledge in distinguishing exothermal and endothermal process • Explain the process in a nuclear reactor • Apply the knowledge in detecting the radiations	
Reference Books 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	

T.Y.B.Sc. Physics Paper IV: Electromagnetic Theory I

SEMV Paper IV	Electromagnetic Theory I	Theory
Course Objectives: This course will provide students with : 1. Adequate knowledge of mathematical physics and mathematical skills which is required to understand and solve problems of Electromagnetic Theory and other branches of Physics 2. Understanding of concept of electric force, electric field and potential due to stationary charges. 3. Definitions of discrete and continuous charge distributions. 4. Understanding of Gauss' Law and its applications. 5. Knowledge of different techniques to solve electrostatic problems. 6. Understanding the concept of polarization and electrostatic phenomena in dielectric medium.		
Theory		
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]	15L	
Electrostatics 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].	10L	
Techniques to solve electrostatic problems 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]	8L	
Electric Fields in matter Polarization, Field 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]	10L	
Microscopic Theory of Dielectrics Molecular field in a dielectric, induced dipoles, A simple model, polar molecules, Langevin-Debye formula, permanent polarization, ferroelectricity.	8L	
Work and Energy in electrostatics 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]	9L	
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.	
Learning Outcome: At the end of the course, learners will be able to: 1 Define scalar field & vector field and 'del' operator. 2. Understand vector differentiation and rules of vector differentiation. 3 Learn the concepts of directional derivatives, gradient of a scalar function, divergence and curl of a vector function and apply them to physical problems. 4. Solve problems related to vector calculus. 5 Express laplacian operator in cartesian, spherical and cylindrical co-ordinate systems. 6 Learn basic laws of electrostatics and define electric field and potential due to discrete and continuous charge distributions. 7 Understand Gauss' Law and its applications. 8. Learn different techniques to solve electrostatic problems. 9. Understand the concept of polarization and electrostatic phenomena in dielectric medium. 10 Find dielectric constant and absolute capacitance experimentally.	

T.Y.B.Sc. Physics Paper V: PRACTICAL COURSE

SEMV Paper V	PRACTICAL COURSE	
Course Objectives: 1. To guide students to perform at least a minimum of 8 experiments from the syllabus		
Practicals		
Practical Paper I Experiments. (Minimum eight). 1) Study of transistorised Multivibrators- Astable, Monostable, and Bistable. 2) Study of Schmitt trigger using transistor. 3) F.E.T Characteristics. 4) F.E.T Common Source Amplifier. 5) OP-amp as a bridge amplifier and its application in temperature measurement. 6) Regulated power supply using IC 723. 7) Study of IC 555 as Astable, Monostable, Bistable Multivibrator and its use as Voltage Controlled Oscillator 8) Analog and Digital Multiplexer. 9) Verification of De Morgan Law's and Boolean Identities. 10) NAND and NOR gates as universal building blocks 11) Binary addition- Half adder and Full adder using any gates. 12) Study of JK flip flop with JK FF IC's (Ripple counter and Decade counter).		3HRS Per expt
Practical Paper II Experiments (Minimum eight) 1. Specific heat of graphite. 2. Resolving power of grating/Prism. 3. Fraunhoffer diffraction at double slit. 4. Lloyd's mirror . 5. Absorption spectrum of a liquid (KI). 6. Polarimeter. 7. Transient response of L-C-R circuit using square wave generator and C.R.O. 8. Core losses and copper losses in a transformer. 9. Measurement of Dielectric constant of a liquid by any method. 10. Susceptibility measurement by immersing a parallel plate capacitor in a dielectric medium. 11. Capacitance of two co-axial metal tubes. 12. E and D field measurement for parallel plate capacitor and calculation of dielectric constant.		3HRS Per expt
Learning Outcome: At the end of the course, learners will be able to: • Students learn skills of measurement using Laboratory instruments. • Students learn to tabulate and document results of measurement in journal • Students learn to draw inferences and conclusions, identify sources of error and interpret results. .		

T.Y.B.Sc. Physics Paper I: SOLID STATE DEVICES AND INSTRUMENTATION

SEMVI Paper I	SOLID STATE DEVICES AND INSTRUMENTATION	Theory
Course Objectives: : ***At the end of the course, students will be able to:*** 1. Classify industrial devices based on their properties and working mechanism. 2. Identify two terminal devices and their working. 3. Apply these devices to basic instrumentation circuits. 4. Construct basic Analog voltmeter and ammeter. .		

Solid State Devices: **Two Terminal Devices.** 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.	**6L**
Industrial Devices. 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 .	**12L**
Image Capture Devices. Vidicon tube, Plumbicon, Silicon Diode Array Vidicon, Solid State Image scanners (CCD's).	**5L**
Instrumentation: **Measuring Instruments.** Analog DC ammeter, Multirange ammeter, Universal shunt, DC voltmeter, Multirange voltmeter, Extending voltmeter range, Transistor voltmeter, Ohmmeter – Series and shunt type, Multimeter, Digital voltmeter, multimeter and frequency meter, Q meter.	**16L**
Oscilloscope: CRT, CRO block diagram (simple CRO), Vertical amplifier, horizontal deflection system, sweep generator, Delay line.	5L
Transducers: 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	12L
Signal Generator: Standard signal generator, AF sine and square wave generator, function generator.	4L
Refrences : - Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky.	

Monochrome and Colour TV, R.R. Gulati). Electronic Instrumentation: Kalsi TMH Electronic Devices and Circuits: J. Millman and C. Halkias Electronic Instrunentation and Measurement Techniques: William David Cooper PHI 3rd edition Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 3rd edition Electronic Principles – Malvino A course in Electrical and Electronic Measurement: A. K. Sawhney Dhanpat Rai and Com. 2001.	
Learning Outcome: At the end of the course, students will be able to: 1. Understand the working of two terminal devices such as Power diodes, tunnel diodes, Varicap diodes, Schottky diode and their applications. 2. Understand the working of Industrial devices such as SCR, TRIAC, DIAC and their applications in various circuits. 3. Explain the working principle of solid state image scanners (CCD's) and the Basic LED TV. 4. Understand the use of PMMC in basic measuring instruments such as analog DC ammeter, voltmeter, Ohmmeter, Multimeter. 5. Describe the simple CRO building block and its various stages. 6. Define transducers, types of transducers(Electrical and Mechanical), Semiconductor strain gauge, LVDT, Capacitive and Peizo electric. 7. Describe the Standard Signal generator, AF Sine and square wave generator and the basic function generator.	

T.Y.B.Sc. Physics Paper II: Atomic Physics

SEMVI Paper II	Atomic Physics

Course Objectives

1. Discuss the application of Schrodinger's equation to hydrogen atom.
2. Describe the structure of alkali metal elements and effect of magnetic field on atom and to discuss X-ray spectra.
3. Discuss spectra of diatomic molecules and Raman spectra

Theory

Hydrogen Atom: 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.	**6L**
Many Electron Atoms: Paul 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.	**9L**
Atomic Spectra: Spectroscopic rotation, Selection rules (derivation from transition probabilities), Alkali metal type spectra, Principal, Sharp, Diffused and Fundamental series, fine structure in alkali spectra.	**8L**
Atoms in a Magnetic Field: 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.	**8L**
X-ray Spectra: 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.	**6L**
Spectra of Diatomic Molecules: Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibration-Rotation spectra, Fortrat Parabolas and explanation of band structure on its basis, Electronic spectra.	**15L**
Raman Effect: 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.	**8L**

Learning Outcome **Learner will be able to** • Apply Schrodinger's equation to hydrogen atom and obtain the three quantum numbers. and discuss effect on atom due to spin orbit interaction. • Explain the fine structure observed in alkali element due to spin orbit interaction and due to applied magnetic field. • Analyse the diatomic spectra of the molecule	
Reference Books 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, Barrow5. Spectrophysics, Anne P. Thorne, Chapman and Hall	

T.Y.B.Sc. Physics Paper III: THERMODYNAMICS AND STATISTICAL MECHANICS

SEMVI Paper III	THERMODYNAMICS AND STATISTICAL MECHANICS	Theory

Course Objectives:

1. To explain how statistics of the microscopic world can be used to explain thermal features of the macroscopic world.
2. To explain the use of thermal and statistical principles in a wide range of applications.
3. To explain a variety of mathematical techniques and probability concepts used in statistical Physics.
4. To explain various statistical distributions such as MB, BE and FD statistics.
5. To explain the theoretical principles and design of internal combustion engines.
6. To explain the techniques of production of low temperature and refrigeration.
7. To explain relation between thermodynamic entropy and probability.

Thermodynamics. **Power cycles.** Internal Combustion Engines – The Otto cycle and its efficiency. Diesel cycle and its efficiency. Mean effective pressure in Carnot, Otto ad Diesel cycles	**5L**
Production of low temperature. 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.	**25L**
Statistical Mechanics. **Probability** 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,	**15L**
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.	15L
Refrences : - Thermodynamics and Statistical physics – D.P Khandelwal and A.K. Pande, Himalaya Publishing House Introduction to Statistical Mechanics – B.B. Laud, New Age International (2003) Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press(1965) Thermal Physics – S.C Garg, R.M. Bansal and C. K. Ghosh, TMH (1993) Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960)	

Text Book of Heat – G.R. Noakes, Mcmilan & Co (1960) Thermodynamics - William C .Reynolds (1968) Heat and Thermodynamics – M.W. Zemansky and R.H. Ditman, McGraw Hill (1997) Perspectives of modern physics – Arthur Beiser, 5th edition, McGraw hill (1995)	
Learning Outcome: At the end of the course, students will be able to: • Students learn various mathematical tools used in statistical mechanics. • Students learn to differentiate between MB , BE and FD statistics and the conditions under which BE and FD distributions behave as MB distributions. • Students learn to construct illustrative examples of MB, BE and FD distributions. • Students learn about comparison between various ICT engines such as Karnaught auto and diesel engines. • Students learn to evaluate performance of ICT engines. • Students learn production of low temperature and the techniques involved. • Students learn about difference between liquid helium 1 and liquid helium 2 and peculiar properties of liquid helium 2.	

T.Y.B.Sc. Physics Paper IV: Electromagnetic Theory II & Theory of Relativity

SEMVI Paper IV	Electromagnetic Theory II & Theory of Relativity	Theory
Course Objectives: This course will provide students with : 1. Basic knowledge of magnetic effects produced by steady currents. 2. Understanding of the basic laws explaining magnetic fields produced by steady currents and magnetic vector potential. 3. Basic knowledge of Maxwell's equations and electromagnetic energy 4. Understanding of postulates of special theory of relativity, Lorentz transformation equations and various phenomena related to special theory of relativity.		
Theory (Electromagnetic Theory II) **Magnetostatics and Relativity**		
Magnetic Field of Steady Currents Biot-savart's law and its applications, Ampere's circuital law, magnetic vector potential, magnetic field of a distant circuit, magnetic scalar potential.[Reitz]		**10L**
Magnetic Field in material media 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.		**14L**
Microscopic Theory of Magnetism Molecular field inside matter, Origin of Diamagnetism, Origin of Paramagnetism, theory of Ferromagnetism , Ferromagnetic domains.[Reitz,Griffiths]		**6L**
Magnetic Energy Magnetic energy of coupled circuits, Energy density in the magnetic field, Hysteris Loss.[Reitz]		**3L**
Maxwell's Equations Faraday's Law of electromagnetic induction, Generalization of Ampere's Law, Displacement current, Maxwell's equations and their empirical basis, Electromagnetic energy.[Reitz,Griffiths]		8L
Relativity Michelson-Morley experiment, postulates of the theory of special Relativity.		**3L**
Relativistic Kinematics 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 .		**8L**
Relativistic Mechanics Mechanics and Relativity, Redefining momentum, Relativistic momentum, Relativistic mass, Equivalence of mass and energy.		**8L**
Refrences : - 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.	
Learning Outcome: At the end of the course, students will be able to: 1 Understand the Biot-Savart's law, Ampere's law and apply them to various cases. 2 Understand the concept of magnetic vector and scalar potential. 3 Define magnetic susceptibility, permeability and obtain relation between them. 4 Derive boundary conditions on field vectors. 5 Understand paramagnetism, dimagnetism and ferromagnetism 6 Understand magnetic circuits and study various cases of magnetic circuits. 7 Derive expressions for magnetic energy of coupled circuits and energy density. 9 Understand Maxwell's equations and Poynting theorem 10 Study Michelson Morley experiment and understand postulates of special theory of relativity. 11 Derive the equations of Lorentz transformation and their consequences. 12 Derive the equations of relativistic addition of velocities. 13 Understand Doppler effect and solve the problems. 14 Understand various aspects of Relativistic dynamics and equivalence of mass and energy	

T.Y.B.Sc. Physics Paper VI: PRACTICAL course

<table>
<tr><td>SEMVI Paper V</td><td>PRACTICAL COURSE</td><td></td></tr>
<tr><td colspan="3">Course Objectives: This course will provide students with :
1.To guide students to perform at least a minimum of 8 experiments from the syllabus</td></tr>
<tr><td colspan="3">Practicals</td></tr>
<tr><td colspan="2">Practical Paper I
Experiments. (Minimum eight).
1) Energy band gap of a semiconductor (point contact diode eg. OA 79).
2) Light emitting diode. VI characteristics, Band gap energy (wavelength of emission), Variation of output power with applied voltage.
3) Photoconductive cell: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 rectifier.
6) DIAC and TRIAC Characteristics, Gate triggering application.
7) Design of simple square / sine wave oscillator. Using discrete components or IC LM 8030
8) Construction and design of analog multirange voltmeter, ammeter and ohmmeter
9) Crystal Oscillator: Determination of velocity of ultrasonic waves in a liquid medium and calculation of the compressibility of the liquid using crystal oscillator.
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) VI characteristics of tunnel diode and its use in an oscillator (type 1N 2940 or equivalent)
12) Study of LVDT (including calibration) and its use in any one application.</td><td>3HRS Per expt</td></tr>
<tr><td colspan="2">Practical Paper II
Experiments (minimum eight)
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.
7. e/m using cathode ray tube.
8. Measurement of Hysteresis loss using CRO
9. Michelson Morley Experiment.
10. Absolute capacity by ballistic galvanometer.
11. Mutual inductance by ballistic galvanometer.
12. Variation of mass with velocity. (Computer Simulation)
13. C1/C2 by ballistic galvanometer</td><td>3HRS Per expt</td></tr>
<tr><td colspan="2">Learning Outcome: At the end of the course, learners will be able to:
• Students learn skills of measurement using Laboratory instruments.
• Students learn to tabulate and document results of measurement in journal
• Students learn to draw inferences and conclusions, identify sources of error and interpret results.</td><td></td></tr>
</table>