Bangalore University
Syllabus for B. Sc (Semester Scheme)
From 2004 – 05
Course No: Phy – 101
(Mechanics Oscillations and Waves)

UNIT – 1

1. Review of vector algebra – Adding vectors geometrically, subtraction and multiplication of vectors, equality of vectors, unit vector (as treated in Halliday and Resnick and H.C. Verma), Cartesian and polar co-ordinates, Components of velocity and acceleration in plane polar co-ordinates. Application of these to circular motion and a real velocity. A few problems to be worked out.
(4 hrs)

2. Motion along a straight line – Instantaneous velocity and acceleration, motion with uniform and non-uniform acceleration – Derivations of equations like

$V = V_0 \text{Exp} (-kt)$, and $X = V_o/K [1 – \text{Exp} (- kt)]$
Calculation of terminal xlocity and displacement of body falling under gravity in resistive media.
(2 hrs)

3. Relative motion in one dimension concept of reference frame to show that observers on different reference frames that with a constant velocity relative to each other will measure the same acceleration for a moving particle. Relative motion in two dimensions and the rule that observers ondifferent reference frames moving with constant velocity relative to each other measure the same acceleration.
(2 hrs)

4. Force and Motion 1: – Elements of Newtonian Mechanics – What causes an acceleration? Newton's First law of Motion – force – Inertial reference frames – Concept of inertial mass – Newton's Second Law of Motion and its limitations – forces like Gravitational force - weight of a body. Normal force – Newton's Third Law of Motion – Applying Newton's Law to solve problems - free body diagrams (to work and problems illustrating the concept of free body diagram).
(7 hrs)

UNIT – II

5. Force and motion 2: – Friction Static and Kinetic friction, rolling Friction. Properties of friction, the drag force and terminal velocity. Motion in accelerated frames rotating frames, concept of pseudo and inertial forces. Coriolis force and applications of Coriolis force to trade winds, cyclones, erosion of riverbanks and Foucault's pendulum. Motion along an inclined plane with and without friction – Basic forces and interactions (problems on bodies connected by spring or string to be worked out).
(9 hrs)

6. Concept of Lagrangian and Hamiltonian equations for a particle – Example of Simple pendulum.

(2 hrs)

7. Energy – Kinetic Energy, work, work and kinetic energy theorem – work done by gravitation force – work done in lifting and lowering objects – work done by a spring force, the work done by a constant applied force – work done by general variable force. Work and kinetic energy theorem with a variable force. Three dimensional analysis – power (problems to be solved).

(4 hrs)

UNIT – III

8. Potential energy – work and potential energy – conservative and non-conservative forces – path – independence of conservative forces with proof. Determination of potential energy values – Gravitational potential energy, Elastic potential energy. Conservation of mechanical energy – Reading a potential energy curve – turning points – equilibrium points – conservation of energy – isolated systems – problems

(7 hrs)

9. System of particles - the center of mass – solid bodies, Newton's second law for a system of particles. Proof of the equation: F(net) = Mxa (com) – Linear momentum – The linear momentum of a system of particles – conservation of linear momentum – Systems with varying mass – a Rocket – finding the acceleration and velocity of Single stage and Multi –stage rockets – External forces and internal energy changes – problems.

(6hrs)

10. Elastic and inelastic collisions in 2- dimension.

(2 hrs)

11. Dynamics of rotation – Angular velocity and acceleration - Kinetic energy of rotation – MI of a body – Theorem of MI - parallel and perpendicular axes theorems with proofs – Calculation of MI of a disc, ring, solid sphere and solid cylinder – Torques and Newton's Second Law – The Kinetic energy of a body rolling down an inclined plane (translational and rotational) – Newton's second law in angular form – Angular momentum of a rigid body. Conservation of angular momentum – some examples – Explanation of gyroscopic motion (qualitative).

(7 hrs)

12. Oscillations – Simple harmonic motion – KE & PE at any instant – Simple and Compound pendulum as examples of S.H.M. – Damped S.H.M. forced oscillations and resonance. Combination of S.H.M. and Lissajous figures.
(4 hrs)

13. Transverse and longitudinal waves their period, frequency - speed of transverse waves on a string – Energy of motion – Intensity or power (to derive equation) – Principle of Super position its effects like interference, beats and stationery waves. Fourier analysis of a saw tooth wave.
(4 hrs)

COURSE No: PHY 102: Physics Lab 1

List of Experiments:

1. Verification of parallel and perpendicular axes theorems.
2. Verification of principle of conservation of energy.
3. Verification of conservation of linear momentum.
4. Oscillation of spring to determine spring constant. To determine the effective mass of the spring and hence "g".
5. Coupled Oscillations – Measurement of the periods of normal modes.
6. Bar pendulum – "g" by graphical method.
7. Mode constants.
8. Helmholtz Resonator.
9. MI of disc using torsinal pendulum.
10. MI of a flywheel.
11. Study of stationery waves on a stretched string.
12. Damping of a rigid pendulum.
13. Determination of Coefficients of static, kinetic and rolling frictions.

SYLLABUS FOR B.SC (SEMESTER SCHEME)
FROM 2004 – 2005
COURSE NO. PHY 201
(Properties of matter, heat and thermodynamics)

UNIT 1

PROPERTIES OF MATTER

Elasticity : Review of elastic behavior of solids in general, origin of elastic forces, stress, strain diagram, elastic limit and Hook's Law, moduli of elasticity and Poisson's ratio. Derivation of relation connecting elastic constants, limiting values of Poisson's ratio, work done (energy stored) in stretching a wire, resilience, thermal stresses, factors affecting elasticity, factor of safety.

Beams, bending of beams, expression for bending moment, single cantilever with theory, I-section girders, couple per unit twist, torsional oscillations. Rigidity modulus of a material by static method and dynamic method with theory, determination of elastic constants by Searle's double bar method.

(8 hrs)

KINEMATICS OF MOVING FLUIDS: Review of Equation of continuity, Euler's equation of motion, Bernoulli's Theorem, some applications of Bernoulli's equation
(1) the speed of efflux (Toricelli theorem)
(2) the Venturimeter
(3) the curved flight of a spinning ball (Magnus effect)
(4) the lift on air craft wing (all qualitative).

Viscosity: Coefficient of viscosity, stream line and turbulent flow, critical velocity, Reynold's number and its significance, Derivation of Poiseulle's formula for the flow of a viscous fluid through a narrow tube. Motion of a body in a viscous medium, Stokes law with derivation and expression for terminal velocity, factors affecting viscosity.

(6 hrs)

UNIT II

SURFACE TENSION:

Surface tension and surface energy, molecular interpretation of surface tension, angle of contact and wetting, pressure difference across a curved liquid surface, capillary ascent, interfacial surface tension, drop –weight method with necessary theory, force between two plates separated by a thin layer of liquid, ripples and waves, factors affecting surface tension – surfactant temperature and impurity.

(5 hrs)

THERMAL PHYSICS;

Review of gas laws, degree of freedom and principle of equipartition of energy based on kinetic theory of gases, atomicity of gases, derivation of U = 3/2 RT, Introduction to atomic heat of solids, mean free path, transport phenomena like diffusion, viscosity and thermal conductivity of gas. Maxwell's law of distribution of velocity (without derivation) – calculation of most probable velocity, mean velocity and root mean square velocity.

Change of state, real gases, Andrews experiments on carbon dioxide, critical constants, Van der waals equation of state and correction. Comparison of van der Waals isothermals with Andrew's isothermals.

(10 hrs)

UNIT III

THERMODYNAMICS:

The Zeroth Law – definition and explanation.

Thermodynamic variables: Extensive and intensive – equation of states – various processes. P-V Indicator diagram.

The first law of thermodynamics – sign convention of heat and work, work done by Isothermal process of an Ideal gas, Internal energy as a state function, Application of first law –

(i) Cycle process
(ii) Isolated process
(iii) Adiabatic process
(iv) Isochoric process
(v) Isobaric process
(vi) Isothermal process
(vii) Relation between the heat capacities for ideal gases.

Adiabatic process for an ideal gas – relation between temperature and volume, pressure and volume, pressure and temperature. Work done in an adiabetic process for ideal gases.
Reversible and Irreversible process, Enthalpy.

(7 hrs)

The Second law of Thermodynamics, Heat engines – Carnot cycle and its efficiency with derivation, Practical cycles used in internal combustion engines (qualitative), Carnot's engine, Refrigerator, coefficient of performance.
Carnot's theorem, thermodynamics scale of temperature Clausis Clapeyron equation, elevation of boiling point, the triple point. Clausius inequality.
Second law of thermodynamics and entropy, principle of increase of entropy, change in entropy in

(1) Adiabatic process (2) Free expansion (3) Cyclic process
(4) Isobaric process (5) Perfect gases (6) Mixture of two gases.

Microscopic interpretation of entropy, temperature – entropy (T-S) diagram of a carnot's cycle and its use.

Third law of thermodynamics (Nernst Heat Theorem)

(8 hrs)

UNIT IV

Thermodynamic potentials –

(i) Internal energy
(ii) Enthalpy
(iii) Helmholtz free energy
(iv) Gibb's free energy and their significance, conditions of equilibrium of phases in terms of cribb's potential. Maxwell's thermodynamic relations and their

significance, Application of Maxwell's thermodynamic relations, Clausius Clapeyron's equation, Variation of internal energy with volume, difference between the heat capacities for ideal gases and real gases, Tds equations (energy equations), Temperature variation under adiabatic processes.

(5hrs)

Low Temperature Physics

Phase transition liquefactions of gases (i) Joule Kelvie porous plug experiments (Thomason effect): working and discussion of results-expression for Joule-Kelvin coefficient –Joule Kelvin heating and cooling for perfect gases, temperature of inversion, its relation with critical temperature, difference between adiabatic-expansion and Joule-Kelvin effect. (ii) adiabatic demagnetization (thermo magnetic effect) – production of low temperature by adiabatic demagnetization : working and theory – thermodynamics expression for cooling. Methods adopted for liquefying gases: cascade process, regenerative process coupled with Joule-Thomason cooling, adiabatic expansion with Joule Thomason Cooling(qualitative)

(8 hrs)

Course No: PHY 202: Physics Lab-II

List of Experiments:

1. Young's modulus by single cantilever.
2. Young's modulus by stretching.
3. Young's modulus by uniform bending.
4. Rigidity modulus by dynamic method.
5. Rigidity modulus by static method.
6. Elastic constants by Searles double bar.
7. Surface tension and interfacial tension by drop-weight method.
8. Viscosity of water by damping torsional oscillations.
9. Experimental verification of velocity distributions.
10. Viscosity by stoke method.
11. Newtown's law of cooling.
12. K.by Lee's & Charlton's method.
13. Bulk modulus of rubber

(A minimum of ten experiments should be performed)

Syllabus for B.Sc.(Semester Scheme)
From2004-2005
Course No: PHY 301
(Electricity, Magnetism and Radiation)

UNIT I

1. **Network theorems:**

Thevenin's theorem, Superposition theorem(mesh current analysis)-Maxwell's power transfer theorem (Derivation). Some applications.

(5 hrs)

2. **Magnetism:**

Introduction. Definition of magnetic field B-Magnetic force on a moving charge. Lorentz force. Force on a current carrying conductor in a magnetic field. Torque on a current loop in a magnetic field. Ballistic galvanometer (theory)- charge sensitivity – effect of damping – applications of B. G: Determination of capacitance and high resistance by leakage. Magnetic dipole moment - Torque on a magnetic dipole. Equivalence of a current loop to a magnetic dipole.
Biot- savart's law. Applications, Theory of Helmholtz galvanometer-magnetic field due to a current in a straight conductor of a finite lenghth- field along the axis of a solenoid. Ampere's law. Application- magnetic field at a point dae to a straight current carrying conductor of infinite length-magnetic field inside a solenoid(with derivational)

(10 hrs)

UNIT II

3.Electro Magnetic Induction:

Faraday's and Len3's laws- RH rule, energy stored in a conductor-elementary ideas about eddy currents and applications- electromagnetic damping- induction furnace-introduction motor-electric brakes and speedometers.

(3 hrs)

4.Electromagnetism:

Review of vectors analysis-Physical significance of divergence of a vector and Gauss theorem –physical significance of curl of a vector and Stroke's theorem.

Concept of displacement and total current, equation of continuity – setting up of Maxwell's equations-setting up of wave equations for E & B – Velcocity of e.m wave light as e.m wave – Velocity of e.m.wave in a dielectric medium – transverse nature of e.m wave (proof)-Poynting theorem-Poynting vector-energy density of e.m waves.

(12 hrs)

UNIT III

5. Transient Currents:

Theory of CR circuit (charging and discharging) – LR circuit (growth and decay)-LCR circuit (charging discharging).

(6 hrs)

6. Alternating Currents:

Real value expression for the mean value and rms value- response of LC, CR and LCR circuit to sinusoidal voltages-Impedance by using j operators- series and parallel resonance circuits- expression for the 'Q' factor, bandwidth – expression for the power in an a. c circuit – choke-its applications.

(9 hrs)

UNIT IV

7. Thermoelectricity:

Seeback effect – thermoelectric series-neutral temperature-laws of thermoelectricity-Peltier effect – demonstration of Piltier effect (any two experiments)-Peltier Coefficient – applications of thermodynamics to a thermoelectric circuit-Thomason effect-Experiments to demonstrate Thomson effect (any two experiments)-Thomson coefficient-theory of thermoelectricity circuit- total EMF – thermoelectric diagrams and uses-applications of thermoelectricity – Boy's radio micrometer, thermopile and thermoelectric pyrometer.

(9 hrs)

8. Radiation:

Black body radiation and distrubution of energy in its spectrum-Kirchoffs law –Stefan-Boltzmann law and Wien's distribution-Wien's displacement law –Rayleigh-Jeans law-Derivation of Plank's law – Radiation pressure (without derivation). Solar constant and its determination-Estimation of surface temperature of the sun.

(6 hrs)

Course No: PHY 302: PHYSICS Lab III

List of Experiments:

1. Verification of Thevenin's theorem.
2. Verification of superposition theorem.
3. Study of charging and discharging of a capacitor in an RC circuit.
4. Verification of maximum power transfer theorem.
5. Verification of thermo emf of a thermocouple- determination of constants and verification of law of intermediate temperatures and metals.
6. Series resonance.
7. Parallel resonance.
8. Determination of constants of a Ballistic Galvanometer.
9. Determination of self inductance of the given coil by using an A.C bridge.(Anderson's or Maxwells bridge).
10. Verification of Stafan's law of radiation.
11. Reduction factor of Helmholtz galvanometer using potentiometer.
12. Determination of L & C by equal voltage method.
13. Desauty's Bridge.
14. High Resistance by leakage.

Syllabus for B.Sc. (Semester Scheme)
From 2004-2005
Course No: PHY 401
(Acoustics, Optics and Lasers)

UNIT I

Acoustics:

Velocity of sound in solids, rods and strings, expression for the same. Kundt tube experiment. Quinke's Method for the velocity.

(4 hrs)

Reflection, refraction and diffraction of sound. Percentage of reflection and refraction at a boundary- Acoustic impendence of a medium –Impedance matching transducers.

(4 hrs)

Principles of Microphones and loud speakers. Basic ideas of electromagnetic sound recording and reproduction.

(2 hrs)

Geometrical optics:

Velocity of light- Foucaults rotating and the kerr cell method.

(2 hrs)

Fermat's principle of extremum path and its application to reflection refraction and rectilinear propagation of light.

(3 hrs)

UNIT II

Physical Optics:

Huygen's wave theory of light concept of Huygen's Principle and construction of wave front, proof of laws of reflection and refraction of a spherical wave front at a plane surface.

(4 hrs)

Interference:

Review of interference of light waves up to conditions for observable interference.

Coherent sources: Production of coherent sources. Biprism-construction, working and experiment it to find wavelength- white light fringes. Introduction a thin film in the path of interfering beam-calculation of Refractive index/thick ness of thin film.

(5 hrs)

Coherent sources by
Amplitude division, Colour of this films-Theory – reflected and transmitted system – Stokes treatment of reflected and transmitted amplitudes- Theory and experiments of Air – wedge, Newton's Rings with applications.

(5hrs)

Michelson's Interferometer and applications.

(2hrs)

UNIT III

Diffraction of Light

Fresnel diffraction:

Division of wave front into half period/fresnel(HP)zones-Theory of rectilinear propagation, Zones Plate: Preparation and working as a lens, Expression for focal length, comparison with lens, diffraction at a straight edge-theory

(5hrs)

Fraunhofer diffraction – Single slit – Theory- many slits-grating-Theory of Normal & oblique incidence-Dispersive power-Resolution-Rayleigh's criterion – expression for resolving power of grating and Telescope.

(5hrs)

Polarisation:

Review of plane polarized light. And method's of production.

(1 hr)

Polarisation by double refraction-crystals-Huygens' explanation of double refraction Retarding plates-Theory of Quarter wave plate(QWP) and half wave plate(HWP).

(4hrs)

UNIT IV

Production and detection of circularly, elliptically and linearly polarized light with necessary theory.

(2hrs)

Optical activity –Polarimeter-working of Laurentz Half shade Polarimeter-Fresnel's explanation of optical activity.

(2 hrs)

LASERS:

General Principles- Spontaneous and induced emission –optical pumping, resonance cavity-active medium-population inversion-Condition for laser action. Mention of Eistein's constants A & B. Purity of a spectral line – time and spatial coherence-Ruby and He-Ne lasers-Pulsed and tunable-lasers.

(7 hrs)

HOLOGRAPHY

Elementary ideas of holography-Principle, theory, production and analysis of a hologram.
(2hrs)

Course No: PHY 402: Physics Lab IV

List of experiments.

1. Kundt's Tube-
2. Verification of Brewster's law.
3. Modes of vibration of a fixed – free strip(Assuming of f of Ac and young's modulus).
4. Lens combination-f by magnificantion (graphically)
5. R.I of liquid – parallax method.
6. Biprism.
7. Air- wedge.
8. Newton's Rings.
9. Diffraction grating-minimum deviation.
10. Diffraction grating-normal incidence.
11. Resolving power of a Telescope.
12. Diffraction at a straight edge.
13. Specific Roatation-Polarimeter.
14. Diffraction at a wire or aperture- using Laser.

(A minimum of ten experiments should be performed)

Syllabus for B.Sc. (Semester Scheme)
FROM2004-2005
Course No: PHY501
(Gravitation, Space Physics and Electronics)

UNIT I

Gravitation, Space Physics, Atmospheric Physics

Newton's law a of Gravitation, gravitational potential and field intensity due to spherical distribution of matter (solid sphere only). Derivation of Kepler's law of planetary motion from Newton's laws (Vector method), inertial and gravitational mass.
(4 hrs)

Escape velocity, elements of satellite motion, orbital velocity and time period, lunching of artificial satellites, geostationary satellites, weightlessness and artificial gravity- Remote sensing – Solar and terrestrial radiation, atmospheric effects. Spectral response of some natural earth surface features, remote sensing applications. Evolution of remote sensing in India.
(4 hrs)

Composition of atmosphere, uertical structure of the atmosphere – Thermodynamics of dry air, moist air, hydrostatic balance, static stability, Heat balance of the atmosphere, Green House effect.

(3 hrs)

Atmospheric dynamics-Basic equations- equations of motion, continuity equation. Equation of state, First law of Thermodynamics, Atmospheric waves, Sound waves, Gravity waves, Rossby waves. Kelvin waves. Principles of numerical weather prediction.

(4 hrs)

UNIT II

Electronics(I)

Review of p-n junction diodes-zener diode and its use as a voltage regulator. Tunnel diode and its characteristics.
Review of transistors – CE mode –Transistor as an amplifier- h parameters and their uses in Analyzing the amplifer circuit. FET – volt- ampere characteristics-Application of FET CRO and its used.
Integrated circuits- monolithic IC – description of discrete IC- Techniques of manufacturing thin film and thick film IC. Hybrid IC.

(15 hrs)

UNIT III

Electronics (II)

Operational amplifiers – ideal OP amplifier characteristics and its applications.

Oscillators – Feed back concepts- oscillator circuits-Feed back amplifier-oscillator operation-phase and frequency considerations- oscillator operation – phase shift oscillator Wein bridge oscillator-tuned oscillator circuits (Hartley and Colpitt oscillators).

Binary systems-Digital computer systems-Binary numbers-number base conversion – octal and hexa decimal numbers- conjugate elements-binary codes-binary storage registers-binary logic (AND, OR, NOT, NAND, NOR, exclusive OR)-Truth table Binary graphical representation of input and output.

Combination logic – Adders (full and half adder). Subtractor (full and half) Code converters i.e., BCD to excess 3 code. (BCD-Binary Code Decimal)

(15 hrs)

Course no-PHY502: Electronics Lab

List of experiments

1. CRO and its applications (Lissjous figures).
2. FET characteristics.
3. RC coupled amplifier.
4. FET amplifier.
5. Phase shift oscillator.
6. AF and RF oscillators.
7. Study of regulated power supply-CRO waveform.
8. Digital gates-Half and Full adder circuits.
9. Op amp (Differentiators, integrator etc). Inverter. Summing amplifier (AC and DC out put).
10. P Spice – circuits schematic editor (any circuit can be built up and output can be got) using computer
11. Transistor characteristics- calculation of h parameters.
12. Emitter follower.
13. Inverting and non- inverting amplifier.

(A minimum of ten experiments should be performed)

Syllabus for B.Sc. (Semester Scheme)
From2004-2005
Course No: PHY503
(Quantum mechanics, atomic and molecular Physics)

UNIT-I

Development of Quantum Mechanics

Introduction to quantum mechanics. Plank's quantum theory, Failure of classical physics to explain the phenomena such as atomic spectra, black body radiation, photoelectric effect, Compton Effect and Specific heat of solids. Explanation of the above effects on the basis of quantum mechanics. (5hrs)

Wave Particle Duality and Uncertainty Principal

De Broglie's hypothesis of matter waves. Thomson's Experiment, Davissson and Germer's experiment-Normal incidence method. Concepts of wave packets for a quantum particle, group velocity and phase velocity, Relation between particle velocity and group velocity, Bohr's quantum condition and matter waves, Heisenberg's uncertainty principal-different forms, Gamma ray microscope experiment. Application – Why electrons cannot be inside the nucleus? (10 hrs)

UNIT II

Schrodinger's Equation

The concept of the wave function, physical significance of waves function, Development of time dependent Schrodinger equation for a free particle, operators for X, P and E. Time -independent Schrodinger equation. Max Born's interpretation of the wave function, Eigen values and Eigen functions. Applications of Suchrodinger equation –Particle in one dimensional box, derivation of eigen values and eigen functions, mention of solutions for a three dimensional case, Linear Harmonic Oscillator. (10 hrs)

Atomic Spectra

Review of Bohr's theory of hydrogen atom- mention of expressions for total energy, wave number and Rydberg constant. Variation of the Rydberg constant with nuclear mass. Sommerfeld's modification of the Bohr atomic model (qualitative), Excitation and ionization potentials, Franks-Hertz experiment. (5 hrs)

UNIT III

Vector Model of the Atom

Concept of Spatial quantization and spinning electron. Different Quantum numbers associated with the vector atom model, Spectral terms and their notations, selection rule, coupling schemes-l-s and j-j coupling(multi electron systems), Pauli's Exclusion Principal, expression for maximum number of electrons in an orbit. Spectra of alkali elements(sodium D-line), Larmor precession, Bohn magneton, Stern-Gerlach Experiment. Zeeman effect, experimental study of Zeeman effect, theory of normal and anomalous Zeeman effects based on quantum theory. Paschen-Back Effect and Star effect (qualitative only)

(10 hrs)

Molecular Spectra

Pure rotational motion: spectrum and selection rules, Vibrational motion:spectrum and selection rules, Rot-Vib spectrum. Scattering of light-Tyndall, Rayleigh and Raman's scattering. Experimental study of Raman effect, Quantum theory of Raman effect.

(5 hrs)

<u>Course No: PHY 504: Modern Physics Lab-1</u>

List of experiments

1. Characteristics of a photocell.
2. Determination of the Planck's constant using a photo cell.
3. Determination of e/m by Thoson's Method.
4. Ionisation Potential of Xenon.
5. Study of solar spectrum- Fraunhofer lines and the determination of Rydberg constant.
6. Analysis of Band spectra.

7. Analysis of rotational and vibrational spectra .
8. Analysis of rotational and vibrational spectra.
9. Study of spectra of hydrogen.
10. Absorption spectrum of $KMnO_4$.
11. Sommerfeld's fine structure constant α by measuring fine structure separation of Na doublets. (Photograph?).

(A minimum of ten experiments should be performed)

Syllabus for B.Sc. (Semester Scheme)
From 2004-2005
Course No: PHY 601
(Statistical Physics & Solid State Physics)

UNIT I

Statistical Physics

Introduction Basic concepts-phase space, microstate and macro state thermodynamic probability-classical or Maxwell Boltzmann statistics – Basic postulates Distribution function – Maxwell distribution of molecular velocities- Quantum statistics-Introduction – Bosons and Fermions- Bose –Einstein statistics – postulates – Distribution function Fermi Dirac statistics – postulates – Distribution function. (7 hrs)

Free Electron Theory of Metals

Introduction –Drude and Lorentz classical theory-Expression for electrical conductivity-Ohm's law- Wiedmann –Franz law –Density of states for free electrons-Fermi-Dirac disturibution function and Fermi energy- expression for Fermi energy and kinetic energy at absolute zero above absolute zero. (5hrs)

Nano Materials

Nanoscale systems- Properties-examples and applications. (2hrs)

Smart Materials

Their properties, examples and applications. (2hrs)

UNIT II

X-rays

Production – Coolidge x-ray tube-continuous and characteristic X-rays, Mosley's laws scattering of X-rays –Compton effect. Basic ideas of crystal structure –Bravais lattices-symmetry elements-lattice plane, Miller indices- spacing between lattice planes of cubic crystals-Bragg's law of x-ray diffraction –Power method. Elementary ideas of crystal binding – Liquids crystals, classification, properties and applications.

(14 hrs)

UNIT III

Band Theory of Solids

Introduction – Statements of Bloch theorem –The Bloch function kroning penny model Energy Vs wave vector relationship – Distinction between metals, insulators and semiconductors. Intrinsic semiconductors – concept of holes- concept of effective mass – Derivation of expression for carrier concentration and electrical conductivity – extrinsic semiconductors- impurity states energy band diagram and the Fermi level. Hall effect in metals and semiconductors- optical properties of solids Solar cell – photoconductivity- Light dependent resistors- Light emitting diodes- Superconductivity – introduction- Experimental facts-Zero resistivity –The critical field – The critical current density- Meissner effect- Type I and type II superconductors – Cooper pairs BCS Theory – Persistent currents- super conducting magnets – magnetic levitation – isotope effect- temperature dependence of specific heat and thermal conductivity.

(13 hrs)

Paramagnetism

Quantum theory – Derivation of expression for paramagnetics susceptibility – Curie law.

(2hrs)

Course No: PHY 602: Modern Physics Lab II

List of Experiments:

1. Analysis of X-ray photograph.
2. Energy gap of a semiconductor.
3. Determination of dielectric constant.
4. Solar cell characteristics- Open circuit voltage-short circuit current efficiency.
5. LED Characteristics-graph of wavelength vs current –Spectral response.
6. LDR Characteristic –dark resistance-saturation resistance-material constant.
7. Semiconductor temperature sensor- (Pure silicon) output voltage vs temperture (calibrtion).
8. Spectral Response of a selenium photo cell (λ vs 1).
9. Transistor as a switch and an active device.
10. Determination of Fermi energy of copper.
11. Resistivity of a material by four probe technique.
12. Determination of thermal conductivity of a material.

(A minimum of ten experiments should be performed)

Experiments with optical fibers, smart materials and liquid crystals are suggested.

Syllabus for B.Sc. (Semester Scheme)
From 2004-2005
Course No: PHY 603
(Relativity, Astrophysics & Nuclear Physics)

UNIT I

RELATIVITY

Review of frames of reference, inertial and non-inertial frames, principles of Galilean relativity.
Michelson – Morley experiment with a brief historical background, significane of its negative result.
Postulates of special theory of relativity, Derivation of Lorentz transformation equations.
Proper time and proper lengh, Time dilation, illustration with 'twin paradox' and 'life time of a lemeson'.
Lorentz-Frtizgerald length contraction, simultaneity in relativity.
Velocity transformation equations.
Variation of mass with velocity.
Mass-energy and momentum – energy relations.
Qualitative introduction to Minkowski's space.

(15 hrs)

UNIT II

ASTROPHYSICS

Absolute or intrinsic luminosity, apparent brightness, apparent magnitude scale of Hipparchus. Distinction between visual and bolo metric magnitudes, distance modulus relationship.

Stellar parallax and unit of stellar distances: Definition of aresec and parsec (pc). Relation between distance of a star and its parallax. Definitions of astronomical unit (AU) and light year (ly) and equation relating AU, ly and pc.

(Repeatedly mention)
Surface or effective temperature and colour of star: Definitions wien's displacement law. Intrinsic temperature of a star. Expression for average temperature, core temperature and core pressure and core pressure of a star based on the linear density model of a star.

Surface of effective temperature and colour of a star: Definitions Wien's displacement law. Intrinsic temperature of a star. Expression for average temperature, core temperature and core pressure of a star based on their linear density model of a star.

Spectral classification of stars and their chemical composition: Edward Charles Pickering classification (ie OBAFGKM) Harvard sequence and Yerke's luminosity classification. Size (radius) of a star. Expression for radius using Stefan –Boltzmann law. Spectral signature of elements present in the stellar atmosphere. Mass-luminosity relationship and expression for life-time of a star.

Hertzsprung-Russll (HR) diagram: Main sequence stars and their general characteristics. Evolution of a star to white dwarf stage through red giant stage, Supernova explosion . Formation of a pulsar or neutron star and black hole(qualitative) with mention of typically required temperatures and the corresponding densities. Event horizon, singularity and Schwarzchild's radius (qualitative).

Gravitational Potential energy or self energy of a star: Statement and explanation of Virial theorem. Expression for gravitational potential energy or self –energy of a star based on the linear density model.

(5 hrs)

UNIT III

NUCLEAR PHYSICS

Nuclear charge: Rutherford's theory of alpha particle scattering, derivation of Rutherford's scattering formula(assuming the path of the alpha particle to be a hyperbola).
Nuclear mass: Aston's mass spectrograph with theory.
Alpha decay: Range and disintegration energy of alpha particles, Geiger –Nuttal law. Brief description of characteristics of alpha ray spectrum, Gamow's theory of alpha decay.

Beta decay: Types of beta decay (electron, positron decay and electron capture). Characteristics of beta spectrum, Paul is neutrino hypothesis.

Detectors of nuclear radiation : Variation of ionization current with applied voltage in a gas. Ionization chamber and identification of the regions of operation of ionization detector, Proportional counter and GM counter. Working of Proportional and Geiger – Muller counter.

Nuclear accelerators: Cyclotron and electron synchrotron.
Nuclear reactions : Conservation laws in nuclear reactions with examples. Expression for Q value of a nuclear reaction, endoergic and exoergic reactions, threshold energy.

Course No: PHY 604: Modern Physics Lab III

List of Experiments:

1. Calculation of physical properties of stars and plotting of H-R diagram.
2. Determination of the temperature of an artificial star.
3. Determination of the distance of a distant object by the parallax method.
4. Low pass filter.
5. High pass filter
6. Band pass filter.
7. Verification of inverse square law applicable to intensity of gamma ray emitted by a Radioactive substance using a GM counter.
8. Determination of mass absorption of coefficient of aluminum for gamma rays.
9. Characteristic of a Geiger –Muller (GM Counter)
10. Half-life of K_{49}.
11. Analysis of stellar spectra.

12. Analysis of sunspot photographs.
(A minimum of ten experiments should be performed)