B.Sc. Semester Course Physics Syallbus

Course No.		Periods/Week	Credits
PHB101	Mechanics	3 HPVS	3
PHB102	Electronics	3 HPVS	3
PHB 111	Laboratory	6 H	3
PHB 112	Laboratory	4 PVS	2
PHB201	Oscillation and Waves	3 HPVS	3
PHB202	Thermal Physics	3 HPVS	3
PHB 211	Laboratory	6 H	3
PHB 212	Laboratory	4 PVS	2
PHB 301	Electricity and Magnetism I	3 HPVS	3
PHB 302	Elementary Quantum Mechanics	3 HPVS	3
PHB 303	Digital Electronics	3 H	3
PHB 311	Laboratory	6 H	3
PHB 312	Laboratory	4 PVS	2
PHB 401	Electricity and Magnetism II	3 HPVS	3
PHB 402	Optics	3 HPVS	3
PHB 403	Mathematical Physics I	3 H	3
PHB 411	Laboratory	6 H	3
PHB 412	Laboratory	4 PVS	2
PHB 501	Electromagnetic Theory	4 H	4
PHB 502	Solid State Physics I	4 H	4
PHB 503	Advanced Quantum Mechanics	4 H	4
PHB 504	Statistical Mechanics	4 H	4
PHB 505	Mathematical Physics II	4 H	4
PHB 511	Laboratory	12 H	6
PHB 506	Electromagnetic Theory	3 P	3
PHB 507	Solid State Physics	3 P	3
PHB 512	Laboratory	6 P	3
PHB 601	Solid State Physics II	4 H	4
PHB 602	Atomic & Mol. Phys.	4 H	4
PHB 603	Nuclear and Particle Physics	4 H	4
PHB 604	Semiconductor Physics	4 H	4
PHB 605	Advanced Optics	4 H	4
PHB 611	Laboratory	12 H	6
PHB 606	Atomic & Mol. Phys.	3 P	3
PHB 607	Nuclear and Particle Physics	3 P	3
PHB 612	Laboratory	6 P	3

PHB101 Mechanics 3 Period/week HPVCS

Unit I: Fundamentals of Dynamics

- Newton's Laws of motion, dynamics of a system of particles, centre of mass, conservation of momentum impulse, momentum of variable mass system: motion of rocket
- work-energy theorem, potential energy and energy diagrams, stable and unstable equilibrium
- conservative and non-conservative forces, force as gradient of potential energy
-particle collisions in centre of mass frame and laboratory frame
-inertial frames and Galilean transformations, non-inertial frames and fictitious forces, uniformly accelerated system

Unit II: Rotational Dynamics

- angular momentum of a particle and a system of particles, torque and conservation of angular momentum, rigid body rotation about a fixed axis, moment of inertia: its calculation for regular bodies
-moment of inertia tensor, kinetic energy of rotation, motion involving both translation and rotation
-physics in rotating coordinate systems, centrifugal and coriolis forces

Unit III: Gravitation and Central Force Motion

- law of gravitation, inertial and gravitational mass, potential energy due to spherical shell and solid sphere, angular momentum conservation
- one body problem, two body problem and its reduction to one body problem and its solution
- the energy equation and energy diagram, Kepler's laws, Satellites

Unit IV: Special Theory of Relativity

- Michelson-Morley experiment and its outcome
- postulates of special theory of relativity, Lorentz transformations
- simultaneity and order of events, Lorentz contraction and time dilation
- velocity dependence of mass, equivalence of mass and energy

REFERENCES :

1. Kleppner & Kolenkow.
2. Additional texts:
3. Feynman Lectures-Volume I,
4. Irodov-Problems in Physics,
5. Resnick-Special Theory of Relativity,
6. A.P. French-Newtonian Mechanics,
7. Berkeley Physics Course-Mechanics

PHB102 Electronics 3 Period/week HPVCS

Circuit Analysis: - Kirchhoff's Laws, Mesh and Node Analysis of dc and ac Circuits, Duality in Networks, Equivalent Star (T) and delta (π) Networks. Star to Delta and Delta to Star Conversion. Network, Superposition theorem, Thevenins Theorem, Norton's theorem. Wheatstone Bridge and its Applications to Wein Bridge and Anderson Bridge.

Introduction to Semiconductor Diodes: – P and N Type Semiconductors. Energy Level Diagram. PN junction Diodes and its characteristics. Static and Dynamic Resistance. PN junction Rectifier Diode. Half-wave Rectifiers. Full-wave Rectifiers, Ripple Factor and Efficiency. Qualitative idea of C, L and π - Filters. Zener Diode and Voltage Regulation, Power supply. Basic concepts of Photo Diode, LED, and Varactor Diode.

Bipolar Junction transistors: - N-P-N and P-N-P Transistors, Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions, Transistor as a switch, Current gains α, β and γ and Relations. Load Line Analysis of Transistors. DC Load line and Q-point. Transistor in Active Region and it's Equivalent Circuit.

Amplifiers:- Transistor Biasing and Stabilization. Transistor as 2-port Network. Amplifier and their classification, Class A, B, and C Amplifiers. Ideal amplifier- Voltage gain, current gain, Power gain, Input resistance, output resistance, load line.

Oscillators:- Principle, Classification of Oscillators. Barkhauson's Criterion for Self-sustained Oscillations. Essentials of Oscillators, RC Phase Shift Oscillator, Determination of Frequency. Wein-Bridge oscillator, Hartley Oscillator.

REFERENCES :

1. A. P. Malvino, Electronic Principals, Glencoe, 1993.
2. Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 8Th Edition, Pearson Education, India, 2004.
3. John D. Ryder, Fundamentals of electronics
4. D C Tayal, Basic Electronics
5. Millman & Halkias, Electronic Device and circuits
6. John Morris, Analog Electronics.
7. Solid state electronic devices By Ben G. Streetman & Sanjay Banerjee, Pearson Prentice Hall, 2006.
8. Basic Electronics & Linear Circuits By N. N. Bhargava, D. C. Kulshreshtha & SC Gupta, Tata McGrawHill, 2006
9. Allen Mottershead, Electronic Circuits and Devices, PHI, 1997.

PHB111 Lab I (I Semester) 6 Periods/week H

List of Experiments

General :

1. Least Count of Measuring Instruments (Vernier Callipers, Screw guage, Spherometer, Travelling Microscope, Stop watch, Ammeter, Voltmeter etc.
2. Measurement of Length, Diameter and Radius of Curvature.
3. Error analysis and Graph Drawing.

Mechanics :

4. Moment of Inertia of a Fly Wheel.
5. Determination of "g" and radius of gyration by Bar Pendulum.
6. Elastic constants by Searl's method.
7. "Y" by bending of beam using optical lever method.
8. Moment of Inertia of regular and irregular bodies by Torsion Table.
9. Viscosity of water by Capillary flow method.

PHB112 Lab I (I Semester) 4 Periods/week PVS

List of Experiments

General :

1. Least Count of Measuring Instruments (Vernier Callipers, Screw guage, Spherometer, Travelling Microscope, Stop watch, Ammeter, Voltmeter etc.
2. Measurement of Length, Diameter and Radius of Curvature.
3. Error analysis and Graph Drawing.

Mechanics :

4. Moment of Inertia of a Fly Wheel.
5. Determination of "g" and radius of gyration by Bar Pendulum.
6. Elastic constants by Searl's method.
7. "Y" by bending of beam using optical lever method.
8. Moment of Inertia of regular and irregular bodies by Torsion Table.
9. Viscosity of water by Capillary flow method.

PHB201 Oscillation and Waves 3 Period/week HPVCS

Unit 1: SHM :- Simple Harmonic Oscillations. Differential Equation of SHM and its Solution. Amplitude, Frequency, Time Period and Phase. Velocity and Acceleration. Kinetic, Potential and Total Energy and their Time Average Values. Reference Circle. Rotating Vector. Representation of SHM- Free Oscillations of Systems with One Degree of Freedom :- (1) Mass-Spring system, (2) Simple Pendulum, (3) Torsional Pendulum, (4) Oscillations in a U-Tube, (5) Compound pendulum: Centres of Percussion and Oscillation, and (6) Bar Pendulum.

Unit 2: Superposition of Two Collinear Harmonic Oscillations :- Linearity and Superposition Principle. (1) Oscillations having Equal Frequencies and (2) Oscillations having Different Frequencies (Beats). Superposition of N Collinear Harmonic Oscillations with (1) Equal Phase Differences and (2) Equal Frequency Differences. Superposition of Two Mutually Perpendicular Simple Harmonic Motions with Frequency Ratios 1:1 and 1:2 using Graphical and Analytical Methods. Lissajous Figures and their Uses. System with Two Degrees of Freedom : Coupled Oscillators.

Unit 3: Free Oscillations, Damped Oscillations, Forced Oscillations : Transient and Steady States, Amplitude, Phase, Resonance, Sharpness of Resonance, Power Dissipation and Quality Factor.

Uinit 4: Wave Motion :- Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

Unit 5: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's correction. Superposition of Two Harmonic Waves :- Standing (Stationary) Waves in a String : Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes wrt Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

Suggested Books:

1. Vibrations and Waves by A. P. French.(CBS Pub. & Dist., 1987)

2. The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988)

3. Fundamentals of Waves & Oscillations By K. Uno Ingard (Cambridge University Press, 1988)

4. An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)

5. Waves: BERKELEY PHYSICS COURSE (SIE) by Franks Crawford (Tata McGrawHill, 2007).

PHB202 Thermal Physics 3 Period/week HPVCS

Unit 1: Kinetic theory of gases
Derivation of Maxwell's law of distribution of velocities and its experimental verification. Mean free path. Transport phenomena, viscosity.

Unit 2: Ideal gases
Equation of states, internal energy, specifics heat, entropy. Isothermal and adiabatic processes.

Unit 3: Real gases
Deviation from the ideal gases equation. Andrew's experiments on carbon dioxide gas, continuity of liquid and gaseous states. Vaanderwaal's equation . Critical constants and law of corresponding states. Joule –Thompson effect.

Unit 4: Thermodynamics
Zeroth and first law of thermodynamics. Reversible and irreversible processes. Conversion of heat into work. Carnot's theorem. Second law of thermodynamics. Thermodynamics scale of temperature. Clausius inequality. Entropy changes in reversible and irreversible proceses. Temperature–Entropy diagram. The principle of increase of entropy.

Unit 5: Thermodynamic Functions
Maxwell's relations and their applications. Change of phase. Equilibrium between a liquid and its vapour. Clausius–Claperyron equation. Triple point with examples from physics. Second order phase transitions.

Unit 6: Radiation
Kirchoff's law. Black body radiation. Wein's displacement law. Stefan–Boltzmann law. Plank's law of radiation and qualitative introduction to quanta of radiation.

References :

1. A Text book of heat: M. N Saha and B.N Srivastava (Science book Agency Publications)
2. Heat and Thermodynamics: An Intermediate Textbook By
   Mark Waldo Zemansky, Richard Dittman (McGraw-Hill, 1981).
3. Thermal Physics : Garg, Bansal and Ghosh (Tata McGraw-Hill, 1993).
4. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics:
   Francis W. Sears & Gerhard L. Salinger.(Narosa, 1986).

PHB 211 Lab II (Semester II) 6 periods/week H

Basic Electronics:

1. Growth and Decay of charge on a condenser in RC circuit.
2. I-V characteristic of P-N junction and Zener diode.
3. Input and output characteristics of transistors (CE).
4. Half wave and Full wave rectifier and ripple factor.
5. Variation of frequency of an Oscillator.

Thermal Physics:

6. Thermal Conductivity of a good conductor by Searl's method.
7. Determination of Thermal conductivity of rubber tubing.
8. Ratio of two specific heats of a gas by Clement and Desorme's method.
9. Relation between energy radiated by a bulb and absolute temperature of the filament of the bulb.

PHB 212 Lab II (Semester II) 4 periods/week PVS

Basic Electronics:

1.Growth and Decay of charge on a condenser in RC circuit.
2. I-V characteristic of P-N junction and Zener diode.
3. Input and output characteristics of transistors (CE).
4. Half wave and Full wave rectifier and ripple factor.
5.Variation of frequency of an Oscillator.

Thermal Physics:

6. Thermal Conductivity of a good conductor by Searl's method.
7. Determination of Thermal conductivity of rubber tubing.
8. Ratio of two specific heats of a gas by Clement and Desorme's method.
9. Relation between energy radiated by a bulb and absolute temperature of the filament of the bulb.

PHB301 Electricity and Magnetism I 3 Period/week HPVCS

Unit 1

The topics in this unit are to be revised by the students with minimal help from the teacher. These results will frequently be used in subsequent units.
Mathematical Background: Functions of two and three variables, partial derivatives, geometrical interpretation of partial derivatives of functions of two variables. Total differential of a function of two and three variables, higher order derivatives, repeated integrals of a function of more than one variables, definition of double and triple integrals, change of variables of integrals, Jacobian.
Scalars and vectors, dot and cross products, triple vector product, gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field, line, surface and volume integrals, flux of a vector field, Gauss's divergence theorem, Green's theorem and Stokes theorem; curvilinear co-ordinates: spherical, polar, cylindrical.

Unit 2

Electrostatics: Coulomb's law in vacuum expressed in vector forms, unit of charge(SI system), conservation and quantization of charge; calculation of **E(r)** for simple distributions of charges at rest: monopole, dipole, quadrupole fields. Work done on a charge in an electrostatic field expressed as a line integral, conservative nature of the electrostatic field, electric field as a gradient of scalar field $Er=-\nabla V$, flux of the electric field, Gauss's law and its applications for finding electric field for symmetric charge distributions, Gaussian pillbox, fields at the surface of a conductor, screening of electric field by a conductor, capacitors, electrostatic field energy, force per unit area on the surface of a conductor in an electric field, induced charges; point charge in front of a grounded infinite conductor, method of images. Field equations for electric field in vacuum, energy associated with electric field. Differential form of Gauss's law, Poisson's equation, Laplace's equation, solution's of Laplace's equation in rectangular, spherical and cylindrical co-ordinates; boundary conditions, uniqueness theorem.

Unit 3

Magnetostatics: magnetic field **B(r)** seen through Lorentz force on a moving charge, unit for **B** defined through force on a straight current, magnetic field due to current: Biot-Savart's law; Field equations in magnetostatics: $\nabla.Br=0$, Ampere's law, fields due to a straight wire and a circular current loop; magnetic dipole, circular current and solenoid.

Unit 4

Faraday's law of electromagnetic induction: Integral and differential forms, motional emf, the induced electric field, Inductance : mutual and self, transformers, magnetic energy of coupled circuit's energy in a static magnetic field.

REFERENCES :

1. "Introduction to Electrodynamics" by D.J. Griffiths (Prentice Hall of India Private Limited)
2. "Electricity and Magnetism" by A.S. Mahajan and A.A. Rangwala (Tata McGraw Hill)
3. "Electricity and Magnetism" Berkeley Physics Course ed. E.M. Purcell
4. "Physics", Vol. 2 Halliday and Resnick

PHB302 Elementary Quantum Mechanics 3 Period/week HPVCS

Unit 1:
Review of History of Origin of Quantum Mechanics-Plank's Quantum Hypothesis, Photon
Nature of Light, de Broglie Waves and Wave- Particle Duality, Heisenberg's Uncertainty
Principle.

Unit 2:
Linear Operators. Eigen value problem. Eigen value of a Hermition and Unitary Operators.
Expectation Values. Commutator bracket and Uncertainty relations.

Unit 3:
Postulates of quantum mechanics. Schrodinger wave equation. Born's interpretation of wave
function.

Unit 4:
One dimensional potential well; Infinite square well potential and qualitative discussion of
finite square well potential. Barrier penetration. Simple harmonic oscillator.

Unit 5:
Spherically symmetric potentials. Angular momentum operator. Eigen values of L and L.
Communication Relations. Solution of Hydrogen atom Problem. Degeneracy of Energy levels.

Suggested books :

1. Beiser : Concepts in Modern Physics
2. Mani Mehta : Modern Physics
3. Bernstein, Fishbane & Gasiorowicz: Modern Physics
4. Schwabl : Quantum Mechanics
5. Ghatak : Quantum Mechanics
6. Gasiarowicz : Quantum Physics
7. Bransden and Joachain: Quantum Mechanics
8. Thankappan: Quantum Mechanics

PHB303 Digital Electronics 3 Period/week H

UNIT 1 :
Binary, octal, hexadecimal and decimal Number systems. Interconversion among different number systems. Binary arithmatic. BCD and other types of codes. 1's and 2's compliment of a binary number. Positive and negative logic. AND, OR, NOT, NAND, XOR, NOR and XNOR Gates. Symbols and truth tables. NAND and NOR gates as universal gates.

UNIT 2 :
Noise in electrical circuits. Transmission of binary data as voltage pulses. Corruption of data because of noise. Error detection : Parity. Error correcting codes : Hamming distance, Hamming (7,4) codes. Hadamard code. Elementary introduction to coding theory.

UNIT 3 :
Introduction to different logic families, like RTL, DTL, HTL, IIL, TTL, ECL, CMOS, their merits and demerits. Basic concepts of fan in and fan out, sinking and sourcing of current. Case study of TTL family, voltage levels, TTL NAND gate, totem-pole and open collector output.

UNIT 4 :
Boolean algebra :- De Morgan’s Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products (SOP) method and (2) Product of sums (POS) method. Simplification of switching functions using Karough maps upto 4 variable.

UNIT 5 : Different types of circuits
Arithmetic Circuits :- Binary Addition. Binary Subtraction using 2’s Complement Method).
Half Adders and Full Adders and Subtractors (only up to Eight Bits).
Data processing circuits :- Basic Idea of Multiplexers, De-multiplexers, Decoders, Encoders, Parity Checkers.
Sequential Circuits :- RS, D, and JK Flip-Flops. Level Clocked and Edge Triggered Flip-Flops. Preset and Clear Operations. Race-around Conditions in JK Flip-Flops. Master-Slave JK Flip-Flop (As Building Block of Sequential Circuits).1. Beiser : Concepts in Modern Physics
2. Mani Mehta : Modern Physics
3. Bernstein, Fishbane & Gasiorowicz: Modern Physics
4. Schwabl : Quantum Mechanics
5. Ghatak : Quantum Mechanics
6. Gasiarowicz : Quantum Physics
7. Bransden and Joachain: Quantum Mechanics

Shift registers : - Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out, and Parallel-in-Parallel-out Shift Registers (only upto 4 bits).
Counters : - Asynchronous and Synchronous Counters. Ring Counters. Decade Counter.
D/A and A/D conversion : - D/A converter – Resistive network. Accuracy and Resolution.

Suggested Books:

1. Digital principles and applications By Donald P. Leach & Albert Paul Malvino,
2. Digital Fundamentals, 3rd Edition by Thomas L. Floyd (Universal Book Stall, India, 1998).
3. Digital Electronics by R.P. Jain,
4. Digital Electronics by V K Puri, TMH.

PHB311 Lab III (Semester III) 6 Periods/week H

List of Experiments:

Optics:

1.Focal length of two lenses by Nodal Slide method and verification of Newton's formula.
2.Determination of Magnifying and Resolving power of a telescope.
3. Refractive Index and Dispersive Power of a Prism using spectrometer.
4. Wavelength of light using plane transmission diffraction grating.
5. Resolving power of a grating.
6. Wavelength of light by Newton's Rings method.
7. Diffraction at straight edge.
8. Specific Rotation of Sugar solution by Laurent's Half-Shade Polarimeter.
9. Study of elliptically, polarized light rising Babinet's Compensator.
10. Determination of particle size using Laser.

PHB312 Lab III (Semester III) 4 Periods/week PVS

List of Experiments:

Optics:

1.Focal length of two lenses by Nodal Slide method and verification of Newton's formula.
2.Determination of Magnifying and Resolving power of a telescope.
3.Refractive Index and Dispersive Power of a Prism using spectrometer.
4. Wavelength of light using plane transmission diffraction grating.
5.Resolving power of a grating.
6. Wavelength of light by Newton's Rings method.
7. Diffraction at straight edge.
8. Specific Rotation of Sugar solution by Laurent's Half-Shade Polarimeter.
9. Study of elliptically, polarized light rising Babinet's Compensator.
10. Determination of particle size using Laser.

PHB401 Electricity and Magnetism II 3 Period/week HPVS

Unit 1 : **ELECTRICAL CURRENTS AND CIRCUITS**

Steady current, Current density **J**, non-steady currents and continuity equation, Varying currents: rise and decay of currents in **LR** and **CR** circuits, decay constants, **AC** circuit problems: complex impedance and reactance, phasor algebra, frequency response - series and parallel circuits, resonance, Q factor, Power dissipation and power factor

Unit 2 : ELECTROSTATIC FIELDS IN MATTER

Dielectrics - Polarization and Induced Dipoles, Bound charges. The field of a polarized object, Bound charges and their physical interpretations, Field inside a dielectric. The Gauss's law in the presence of dielectrics. The Electric Displacement Vector D. Susceptibility, permittivity, dielectric constant. Energy in Dielectric systems, Forces on Dielectrics, Clausius-Mossotti equation, Polar molecules. The Langevin formula.

Unit 3 : MAGNETIC FIELDS IN MATTER

Magnetization - Diamagnetism, Paramagnetism, Ferromagnetism, The field of a magnetized object - Bound currents and their physical interpretation, The magnetic field inside matter. Ampere's law in magnetized medium, the magnetic field intensity vector H, Magnetic Susceptibility and Permeability. Ferromagnetism - energy loss in Hysteresis and B-H curve.

REFERENCES :

1. "Introduction to Electrodynamics" by D.J. Griffiths (Prentice Hall of India Private Limited)
2. "Electricity and Magnetism" by A.S. Mahajan and A.A. Rangwala (Tata McGraw Hill)
3. "Electricity and Magnetism" Berkeley Physics Course ed. E.M. Purcell
4. "Physics", Vol. 2 Halliday and Resnick

PHB402 Optics 3 Period/week HPVCS

1. Interference :

Coherent sources, Yopung's Double slit expreiment, Division of wave front. Fresnel's biprism. Division of amplitude. Interference in thin films. Newton's rings. Michelson's interferometer.

2. Diffraction :

Fraunhofer diffraction at single, double and N slits. Fresnel diffraction at a straight edge and circular aperture. Cornu-spiral. Half-period zones. Zone plate. Diffraction grating.

3. Polarization :

Plane, circular and elliptical polarization of light. Double refraction. Nicol prisms. Wave plates. Optical activity.

4. Micellaneous Topics :

Huygens principle. Fermat's principle. Resolving power of optical instrunents and diffraction grating. Principle of lasers and holography.

Suggested Books :

1. A. K.Ghatak : Optics
2. Jenkins and White : Fundamentals of Optics
3. Max Born andf Emil Wolf : Principles of Optics

PHB403 Mathematical Physics I 3 Period/week H

1. Review of Basics :

Review of differential and integral calculus. Gaussian integral. Infinite series. Ordinary differential equations.

2. Linear Algebra :

Vector spaces. Linear independence. Basis. Dimension. Linear transformations. Matrices. Vector subspaces. Quotient space. Inner product.

3. Vector Calculus :

Dot and cross product of vectors. Definition of gradient, curl and divergence. Gauss and Stokes theorems. Introduction to partial differntial equations of physics.

4. Curvilinear coordinates and Multiple integrals :

Calculation of divergence, gradient etc. in spherical polar and cylindrical coordinates. Multiple integrals in two and three dimensions. Change of variable and Jacobian. Area of surfaces and volume of solids.

Suggested Books :

1. Vector Analysis : Schaum Series
2. Advanced Engineering Mathematics bt Kreyzig
3. Linear Algebra : Schaum Series

PHB411 Lab IV (Semester IV) 6 Periods/week H

Electricity and Magnetism:

1. Determination o E.C.E. of copper using a Copper Voltameter and checking the accuracy of ammeter.
2. Determination of Self Inductance of a coil using Anderson's Bridge.
3. Determination of Plank's constant by cut off method.
4. Study of LCR circuit-impedence determination.
5. e/m by Tomson's method.
6. Determination of Galvanometer resistance by Kelvin method and determine the sensitivity of the Galvanometer.
7. Conversion of a moving coil galvanometer into an ammeter and voltmeter.
8. Determination of mechanical equivalent of heat by electrical (static) method.
9. Determination of self inductance of a coil by Rayleigh method.

PHB412 Lab IV (Semester IV) 4 Periods/week PVS

Electricity and Magnetism:

1.Determination o E.C.E. of copper using a Copper Voltameter and checking the accuracy of ammeter.
2.Determination of Self Inductance of a coil using Anderson's Bridge.
3.Determination of Plank's constant by cut off method.
4. Study of LCR circuit-impedence determination.
5. e/m by Tomson's method.
6. Determination of Galvanometer resistance by Kelvin method and determine the sensitivity of the Galvanometer.
7. Conversion of a moving coil galvanometer into an ammeter and voltmeter.
8. Determination of mechanical equivalent of heat by electrical (static) method.
9. Determination of self inductance of a coil by Rayleigh method.

PHB501 Electromagnetic Theory 4 Periods/week H

Unit -1:Introduction
Maxwell's Equations,Gaussian Unites, Macroscopic media, Boundary conditions at media interfaces, Gauge potentials,Coulom's law, Gauss's law, Electrostatic potential, Uniqueness theorem, Green's theorem, Green functions and the boundary value problems, Electrostatic energy.Some problems.

Unit-2:Boundary value problems in electrostatics: 1
Method of images, Point Charge in the presence of a grounded conducting sphere; point charge in the presence of a charged , insulated, conducting sphere; point charge near a conduting sphere at a fixed potentia; conducting sphere in a uniform electric field by image-method; Green function for the sphere:General solution for the potential; Conducting sphere with hemispheres at different potentials; Orthogonal Functions and expantions ; Separation of variables in Cartesian coordinates, Generalized Fouriar expantions. Some problems.

Unit-3:Boundary value problems in electrostatics: 2
Laplace equation in spherical coordinates, Series sulution of the Legendre Equation, Rodrigues formula, the generating function, Expantion in Legendre polynomials, boundary value problems with asymuthal symmetry, Associated Legendre function , spherical harmonics, general solution of Laplece's equation without azimuthal symmetry,addition theorem for spherical harmonics, Laplace equation in cylindrical coordinates, Bessel function ,boundary value problems in cylindrical coordines, Green function in cylindrical polar coordinates

Unit-4: Multipole expantion and Dieletric media
Multipole expantion , multipole expantion of a charge distribution in an external field, microscopic description of dielectric media, examples of dielectri media, boundary value problems with dielectrics, molecular polarizability and electric susceptibility, models for electric polarizability, electrostatic energ in dielectric media. Some problems .

Unit-5:Magnetostatics
Biot and Savart law, Differential equations of Magnetostatics and Amperes law, Vector potential , vector potencial and magnetic induction for a circular current loop. magnetic fields of a localized current distribution. Magnetic moment, force and torque on and energy of a localized current distribution in an external magnetic induction.macroscopic equations, boundary conditions at medium interfaces, techniques for solving boundary value problems in magnetostatics.

Unit-6:Electomagnetic plane waves and wave propagation
Plane waves in a nonconducting medium, linear and circular polarization, stokes parameters, reflection and refraction at a plane interface, Brewster’s angle, total internal reflection,
Action principle for Maxwell’s equations.
Oscillator model for frequency dependence of a dielectric, conductivity, group velocity, causality and dispersion relations, causal propagation.

Unit-7:wave-guides and cavities
The approximation of perfect conductions, Waveguides, rectangular waveguide, energy flow and attenuation, resonant cavities, perturbation of boundary conditions, excitation of waveguide modes.

REFERENCES :

1. IIntroduction to Electrodynamics” by D.J. Griffiths (Prentice Hall of India Private Limited)
2. “Foundations of Electromagnetic Theory” by J.R. Reitz, F.J. Millford and R.W. Christry (Narosa Publishing House)
3. “Introduction to Electromagnetic Field and Waves” by Corson and Lorrain

PHB502 Solid State Physics I 4 Period/week H

Unit 1: Crystal Structure
Crystalline state of solids, Lattice Translation Vector, Unit cell, Wigner- Seitz cell, Number of lattice point per unit cell, packing fraction, Bravais lattice, Miller indices, Interplaner spacing, Symmetry elements.

Unit 2: X-rays and Atomic Bonding
Continuous and characteristic X-rays spectra, Absorption of X-rays, Diffraction of X-rays, Bragg's law, Laue's equations, Powder method, Interatomic forces and classification of solids, Bond dissociation Energy, Cohesive Energy of ionic crystal, Types of Bonds; Ionic bond, Covalent bond, Metallic Bonding, Van der Waals Bonding.

Unit 3: Elementary Lattice Dynamics
Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic molecules chains, Acoustical and Optical Phonons, Qualitative Description of the Phonon spectrum in solids, Einstein and Debye theories of specific heat of solids, Debye T3 law.

Unit 4: Electrical Conductivity
Free electron theory, Sommerfeld model, Fermi level, Density of states, Electrical conductivity of metals and its temperature dependence, Weidemann-Franz law, Hall Effect.

Unit 5: Defects in Solids
Point defects-Frenkel and Schottky vacancies, Line defects-Edge and screw dislocations, Planer defects, Stacking faults.

REFERENCES:

1. Charles Kittle : Introduction to Solid State Physics.
2. Henry Lipson : Interpretation of X-ray Wooter Photographs
3. Charles S Barrett : Structure of Metals
4. Azaroff L. V : Introduction to Solids
5. Cochran W : The Dynamics of Atoms in Crystals
6. Wahab.M.A. : Solid State Physics (Structure and Properties of Materials)

PHB503 Advanced Quantum Mechanics 4 Period/week H

Unit 1 :

Wave functions and wave packets in position and momentum space and their relation using Fourier transform. Time evolution of Gaussian wave packets. Localized states and theUncertainty Principle. Inner product and Schwarz inequality. Position-momemtum uncertainty relation.
Energy level width and decay time relation.

Schrodinger equation for a single particle. Hermiticity of operator. Ehrenfest theorem. Commutator relations. Probability current and continuity equation. Eigenfunctions and eigenvalues of a Hermitian operator. Orthogonality and completeness. Stationary states.

Unit 2:

Harmonic oscillator. Ladder operators and number operator. Hermite Polynomials. Coherent states. Tunneling through step and continuous barriers and application to alpha-decay. Potential well: symmetries of ground state, Parity, resonances.

Unit 3:

Angular momentum. L Operator as a generator of rotations, commutation relations, eigenfunctions, eigenvalues, L in polar co-ordinates, Legendre equation, Spherical harmonics. Central Potentials and bound state problems in 3 dimensions. Laguerre polynomials. Degeneracies of eigenvalues. Motion in E-M field and Zeeman effect.

Unit 4:

Operators and matrices, state vectors, unitary transformations, Schrodinger and Heisenberg representations.

Unit 5:

Spin angular momentum. Stern-Gerlach Experiment. Addition of angular momenta.

Suggested books :

1. Beiser : Concepts in Modern Physics
2. Mani Mehta : Modern Physics
3. Bernstein, Fishbane & Gasiorowicz: Modern Physics
4. Schwabl : Quantum Mechanics
5. Ghatak : Quantum Mechanics
6. Gasiarowicz : Quantum Physics
7. Bransden and Joachain: Quantum Mechanics
8. Thankappan: Quantum Mechanics

PHB504 Statistical Mechanics 4 Period/week H

UNIT 1:

Review of thermodynamic laws; Thermodynamic potentials: Legendre transformation; the Entropy Maximum Postulates; the Energy Minimum Principle;
Macrostates and Microstates; Phase-Space representation; Liouville's theorem; Boltzman Entropy relation; Statitical interpretation of second law of thermodynamics; classical ideal gas; Gibb's paradox;

UNIT 2:

Statistical Mechanics in the Entropy representation: The Microcanonical Ensemble; principle of equal a priori probabilities; Harmonic oscillator; the Einstein model ofi crystalline solid; The two-level system: Negative temperature;

UNIT 3:

Statistical Mechanics in Helmholtz representation: The Canonical Ensemble; probability distribution; additive energies and factorizability of the partition function; Equipartition theorem; internal modes in a gas; The Debye model of nonmetallic crystals; Electromagnetic Radiation;

UNIT 4:

Grand Canonical Ensemble and Quantum Statistics: The ideal Fermi gas; the classical limit and quantum criteria; the strong quantum regime: electrons in a metal; the ideal Bose gas; non-conserved ideal Bose gas: Photons; Bose-Einstein Condensation.

REFERENCES :

1. F. Reif : Fundamentals of Statistical and Thermal Physics.
2. H. B. Callen: Thermodynamics and an Introduction to Thermostatistics, John Wiley and Sons.
3. Greiner, Neiser and Stocker: Thermodynamics and Statistical Mechanics; Springer.

PHB505 Mathematical Physics II 4 Period/week H

Complex Analysis (8 lectures)

Review of complex arithmetic; Complex differentiation: Analyticity of complex functions, Cauchy Reimann conditions; Complex integration: Cauchy integral theorem, Cauchy integral formula, derivative as integral; Complex series: Taylor and Laurent series;
Calculus of Residues: Residues and its application to some useful integrals (of physics).

Dirac Delta Function, Fourier Series and Transform

Dirac delta function: linear density of points; properties and useful representations in one, two and three dimensions; integral representation of the delta function;
Fourier series and transform: Expansions of functions of arbitrary periods; even and odd functions, half range expansions; complex form; Fourier Transform.

Differential Equations and Special Functions

PDE's to ODE's: Separation of variables in Cartesian, Cylinderical and Spherical Coordinates;
First order differential equations: Normal form of FODE, Integrating factors, first order linear differential equations;
Second order linear differential equations : Linearity, Superposition, Uniqueness, Wronskian; the general solutions of
the homogeneaous and inhomogeneaous cases;
Second order linear differential equation with constant coefficient, central force problem;
Laplace's equation in Cartesian coordinates;
Laplace's equation in spherical coordinates: Legendre's differential equation; series solution, orthogonality, recurrence and orthogonality relations; expansions in Legendre polynomials;
Laplace's equation in cylinderical coordinates: solutions of Bessel's differential equation; generating functions, recurrence relations etc; expansions in Bessel's functions and examples;
Some other PDE's of physics: Heat, wave and Schrodinger equations.

Tensors

Vectors: Transformation properties of vectors, covariant and contravariant vectors;
Tensors: Definition, algebraic properties; Numerical tensors (Kronecker delta and Levi-Civita symbols), metric tensor, index raising, lowering, contraction; Electromagnetic field tensor;
Covariant differential, affine connection; Covariant derivative, metric connection; Reimann curvature tensor, Bianchi identity, Ricci tensor, Einstein equation and curvature tensor.

Probability

Basic concepts: Sample space and probability, Permutation, combination, average and standard deviation; Binomial and Poisson distribution, Continuous random variable, Normal distribution.

PHB511 Lab V (Semester V) 12 Periods/week H

List of Experiments:

1.Determination of Thermal Conductivity of a bad conductor by Lee's Disc Method.
2.Determination of Stefan's Constant.
3.Determination of temperature coefficient of resistance for Platinum, using a platinum resistance thermometer and a Cary Fosters Bridge.
4.Determination of charge sensitivity and Ballistic constant of a moving coil Ballistic galvanometer (BG).
5.Determination of High Resistance by Leakage method using BG.
6.Determination of the mutual inductance of two coils by direct deflection method using BG.
7.Determination of Magnetic field by Search-Coil.
8.Determination of magnetic susceptibility .
9.Determination of retentivity and coercivity of a ferromagnetic substance by plotting B-H curve.

PHB506 Electromagnetic Theory 3 Period/week P

Unit 1 : THE ELECTROMAGNETIC FIELD EQUATIONS

Maxwell's modification of Ampere's law, Maxwell's equations, Energy and momentum in electromagnetic fields, Maxwell stress tensor, conservation laws, Electromagnetic potentials, Gauge transformations, Lorentz gauge and Coulomb gauge. Lorentz force in terms of electromagnetic potentials, Propagation of plane electromagnetic waves in free space, Isotropic dielectrics and conducting media, Energy flux in a plane electromagnetic wave. Skin depth, Joule heating in a good conductor, Dispersion: Dispersion in dilute gasses, in liquids and solids.

Unit 2 : REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES

Boundary conditions for the field vectors E, D, B and H at the interface between two media.

Reflection and refraction at the plane interface between two dielectrics, Snell's and Fresnel's formulae, The coefficients of reflection and transmission at the interface between two dielectrics, Brewster's angle and polarization. Reflection at the surface of a good conductor,

Unit 3 : WAVE GUIDES

Propagation of electromagnetic waves between perfectly conducting planes, Wave Guides of simple geometries, resonant cavities, Antennas.

Unit 4 :
Boundary value problems with linear dielectrics : examples of spherical and plane slab homogeneous linear dielectric materials, boundary value problems with linear magnetic materials with simple geometries.

REFERENCES :

1. Electrodynamics by Jackson
2. Int. To Electrodynamics by Griffith
3. Feynman Lectures in Physics Vol II

PHB507 Solid State Physics 3 Period/week P

Unit 1: Crystal Structure

Crystalline state of solids, Lattice Translation Vector, Unit cell, Wigner- Seitz cell, Number of lattice point per unit cell, packing fraction, Bravais lattice, Miller indices, Interplanar spacing, Symmetry elements, Crystal Imperfections.

Unit 2: X-rays and Atomic Bonding

Continuous and characteristic X-rays spectra, Absorption of X-rays, Diffraction of X-rays, Bragg's law, Laue's equations, Powder method, Interatomic forces and classification of solids, Bond dissociation Energy, Types of Bonds; Ionic bond, Covalent bond, Metallic Bonding, Van der Waals Bonding.

Unit 3: Elementary Lattice Dynamics

Lattice Vibrations and Phonons: Linear Monoatomic chains of atom, Qualitative Description of the Phonon spectrum in solids, Einstein and Debye theories of specific heat of solids, Debye T3 law.

Unit 4: Band theory of Solids

Free electron theory, Sommerfeld model, Fermi level, Density of states, Electrical conductivity of metals and its temperature dependence, Weidemann-Franz law, Hall Effect, Electron in periodic potential, Kroning-Penny model, Brilloun zone, Effective mass, Origin of band gap, Classification of materials in terms of band gap.

Unit 5: Semiconductor Properties of Matter

Intrinsic Semiconductors, Extrinsic Semiconductors, Carrier concentration and Fermi level for Intrinsic Semiconductors, Carrier concentration, Fermi level and conductivity for Extrinsic Semiconductors.

REFERENCES:

1. Charles Kittle : Introduction to Solid State Physics.
2. Henry Lipson : Interpretation of X-ray Wooter Photographs
3. Charles S Barrett : Structure of Metals
4. Azaroff L. V : Introduction to Solids
5. Cochran W : The Dynamics of Atoms in Crystals
6. Wahab.M.A. : Solid State Physics (Structure and Properties of Materials

PHB512 Lab VI (V Semester) 6 Periods/week PV

LIST OF EXPERIMENTS:

1. Determination of Stefan' s constant.
2. Determination of temperature coefficient of resistance of Platinum, using a platinum resistance thermometer and a Cary Foster's Bridge.
3. Determination of charge sensitivity and Ballistic constant of a moving coil Ballistic galvanometer.
4. Determination of high resistance by Leakage method.
5. Determination of Magnetic field by Search coil.
6. Determination of Magnetic susceptibility.
7. Determination of retentivity and coercivity ferro-magnetic substance by plotting B-H curve .

PHB601 Solid State Physics II 4 Period/week H

Unit 1: Elementary Band Theory of Solids

Bloch Theorem, Electron in periodic field: Kronig Penney model, Brillouin zones, Effective mass of electron, Origin of Band Gap, Insulator, semiconductor and metals.

Unit 2: Magnetic Properties of Matter

Response of substance to magnetic fields, Dia-, Para- and Ferromagnetic materials, Absence of magnetic charge, Electric current in atoms, Electron spin and magnetic moment Measurement of the susceptibility of paramagnetic substances, Langevin's theory of dia and paramagnetic substances, Curie- Weiss Law, Theory of ferro- magnetism.

Unit 3: Dielectric Properties of Solids

Polarization and Susceptibility, The local field, Dielectric Constant and Polarizability, Clausius-Mossitti Equation, Sources of Polarizability (Electronic, Ionic, Dipolar Polari ability), Classical Theory of Electronic Polari ability, Frequency Dependence of Total Polarizability.

Unit 4: Superconductivity

Introduction and Historical Developments, Electrical Resistivity, Perfect Diamagnetism or Meissner Effect, Supercurrents and Penetration Depth, London Equations, Critical Field and Critical Temperature, Type I and Type II Superconductors,Thermodynamical properties, Flux Quantization, The Josephson Effects and Tunneling, Idea of the BCS Theory, High Temperature Ceramic Superconductors.

Unit 5: Semiconductor Properties of Matter

Intrinsic Semiconductors, Extrinsic Semiconductors, Carrier concentration and Fermi level for Intrinsic Semiconductors, Carrier concentration, Fermi level and conductivity for Extrinsic Semiconductors.

REFERENCES:

1. Charles Kittle : Introduction to Solid State Physics.
2. Henry Lipson : Interpretation of X-ray Wooter Photographs
3. Charles S Barrett : Structure of Metals
4. Azaroff L. V : Introduction to Solids
5. Cochran W : The Dynamics of Atoms in Crystals
6. Wahab.M.A. : Solid State Physics (Structure and Properties of Materials)

PHB602 Atomic and Molecular Physics 4 Period/week H

Unit 1:

Brief review of early models of atomic structure. Frank & Hertz experiment. Reduced Mass. Limits of Bohr-Sommerfeld theory. Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Unit 2:

Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Degeneracy, Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Unit 3:

Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Vibrational Energy Levels, Selection Rules and Vibration Spectra. Rotation- Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra. Determination of Internuclear Distance. Raman Effect, Stoke's and Anti-Stoke's Lines.

Suggested Books:

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book, 1987).
2. Introduction to Atomic Spectroscopy by H.E. White (McGraw Hill).
3. Modern Physics by Mani and Mehta
4. Atomic Physics by J.B.Rajam (S. Chand & Co., 2007).
5. Physics of Atoms and Molecules, Bransden and Joachein 2nd Edition (Pearson 2011).
6. Molecular Spectroscopy, C.N. Banwell. (Tata-McGraw-Hill).

PHB603 Nuclear and Particle Physics 4 Period/week H

UNIT 1: Basic Concepts :

Nuclear size, mass, charge, spin, magnetic moment, stability and binding energy. BE per nucleon and its observed variation with mass number of the nucleus. Estimation of energy released in nuclear fission and fusion. Nuclear forces. Their salient features. Meson theory of nuclear forces.

UNIT 2: Radioactivity:

Radioactive disintegration law. Decay constant, half life and mean life. Successive radioactive transformations. Radioactive equilibrium. Natural radioactive series. Units of radioactivity. Elementary theory of alpha decay. Gamow's explanation. Beta decay. Difficulties encountered to understand the continuous β-ray spectrum. Pauli's neutrino hypothesis. Electron capture process.

UNIT 3: Nuclear models:

The liquid drop model of a nucleus. Weizsacker's semi-empirical mass formula. The shell model of a nucleus.

UNIT 4: Nuclear reactions:

Types of nuclear reactions. The balance of mass and energy in nuclear reactions. Q-value. Threshold energy. Energy production in stars by proton-proton and carbon cycle.

UNIT 5: Elementary Particles:

Fundamental interactions in nature. Classification of elementary particles. Photons, leptons, mesons and baryons. Basic conservation laws. Conservation of lepton number, baryon number, strangeness, isospin. Quark hypothesis. Cosmic rays.

UNIT 6: Accelerators:

Need of accelerators. The cyclotron. Synchrocyclotron. The betatron and the electron synchrotron. The proton synchrotron. Detectors of charged particles. Working principle of Cloud chamber and Bubble chamber. Ionisation chamber. Proportional counter. G.M. Counter. Scintillation Counter.

REFERENCES:

1. A. Beiser : Concepts of Modem Physics.
2. I. Kaplan : Nuclear Physics.
3. Bernard L. Cohen : Concepts of Nuclear Physics (Tata MCGraw Hill, 1998, New Delhi)
4. R.A. Dunlap : Introduction to the Physics of Nuclei and Particles (Singapore : Thomson Asia 2004)
5. Kenneth S. Krane : Introductory Nuclear Physics (John Wiley & Sons, 1988)

PHB604 Semiconductor Physics 4 Period/week H

Unit 1 : Modulation and Demodulation :

Modulation and demodulation techniques of AM, FM and PM, Pulse analog modulation, sampling theorem, Pulse Digital modulation

Unit 2 : Waveshaping Circuits :

Comparators, Schmitt trigger, square wave, triangular wave, pulse, voltage time-base and staircase generators. Sinusoidal oscillators – Phase shift, Wien Bridge and crystal oscillator.

Unit 3 : Semiconductor Devices :

Intrinsic and extrinsic semiconductors : doping, carrier concentration, charge transport; p-n junctions: abrupt, linearly graded and diffused junction, depletion region, I-V characteristics, junction capacitance; zener diode, tunnel diode, Transistors – Construction and working of BJT, JFET, MOSFET, UJT, relaxation oscillator.

Unit 4 : Transistor hybrid model :

Low frequency small signal transistot model – two port device and hybrid model, the h parameters, analysis of a transistor amplifier circuit using h parameters, Miller's theorem and it's dual, high frequency hybrid pi model – conductances and capacitances

References :

1. Communication Systems, Simon Haykin, Wiley
2. Microelectronics, Millman, McGraw Hill
3. Integrated Electronics, Millman & Halkias
4. Physics of Semiconductor Devices, S M Sze & Kwok K Ng, Wiley

PHB605 Advanced Optics 4 Period/week H

Unit – I: Advance Wave Optics

Fermat's Principle and the Laws of Refraction. Elements of transfer matrix method. Harmonic Waves: Superposition of Harmonic Waves, Multiple Beam Interferometry- Plane Parallel Plate and Fabry–Perot Etalon; Kirchhoff–Fresnel Integral, Fresnel Diffraction, Far Field Approximation, and Fraunhofer Observation. Coherence theory: Spatial Coherence, Temporal Coherence, Wave trains and Quasi-Monochromatic Light, Superposition of Wave trains. Principle of Laser: Process and applications

Unit – II: Wave-guides and Fiber Optics

Wave Guides, Guided Waves, Planar Wave guide, Propagating and Evanescent Waves, Restrictive Conditions for Mode Propagation, Phase Condition for Mode Formation, TE - Modes or *s*-Polarization. TM - Modes or *p*-Polarization, Fiber Optics Waveguides: Step index fiber and Graded index fiber, pulse dispersion and distortion in optical fibers. Modes in a Dielectric Waveguide.

Unit-III: Fourier Transformation and Holography

Fourier Transformation, The Fourier Integrals, Fourier Transform Spectroscopy. Holography: Recording of the Interferogram, Recovery of Image with Same Plane Wave.

Unit- IV: Optical Constants & Non-linear optics

Optical Constants of Dielectrics, The Wave Equation, Electrical Polarizability and Refractive Index, Determination of Optical Constants, Fresnel's Formula and Reflection Coefficients, Sellmeier Formula, Nonlinear optical media: second and third order harmonic generation, Kerr and Pockel effects, anisotropic and dispersive optical media.

Unit- V: Introduction to Modern Optics

Concepts of Nanophotonics and applications, Photonic Crystals- One, Two and Three dimensional photonic crystals,

References:

1. Optical Electronics – Ghatak and Thyagarajan
2. Optics – Born and Wolf
3. Optics – K. K. Sharma
4. Nanophotonics – Paras N. Prasad

PHB611 Lav VI (Semester VI) 12 Periods/week H

List of Experiments :

1. Determination of wavelength of Sodium light using Michelson's Interferometer.
2. Verification of Hartman's dispersion formula.
3. Wavelength of Sodium light by Fresnel's Biprism.
4. Determination of dissociation energy of Iodine molecule.
5. Determination of Rydberg's constant with a diffraction grating and a hydrogen tube.
6. Study of R-C coupled amplifier.
7. Study of logic gates.
8. Study of the Flip-Flop circuits.
9. Study of Optical Fibre kit
10. Study of temperature transducer kit

PHB606 Atomic and Molecular Physics 3 Period/week P

Unit 1:
Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

Unit 2:
Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Unit 3:
Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Vibrational Energy Levels, Selection Rules and Vibration Spectra. Rotation- Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra. Determination of Internuclear Distance. Raman Effect, Stoke's and Anti-Stoke's Lines.

Suggested Books:

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book, 1987).
2. Introduction to Atomic Spectroscopy by H.E. White (McGraw Hill).
3. Atomic Physics by J.H.Fewkes & John Yarwood. Vol. II (Oxford Univ., 1991).
4. Atomic Physics by J.B.Rajam (S. Chand & Co., 2007).
5. Physics of Atoms and Molecules, Bransden and Joachein 2nd Edition (Pearson 2011).
6. Molecular Spectroscopy, C.N. Banwell. (Tata-McGraw-Hill).

PHB607 Nuclear and Particle Physics 3 Period/week P

UNIT 1: **Basic Concepts**:

Nuclear size, mass, charge, spin & binding energy. BE per nucleon and its observed variation with mass number of the nucleus. Estimation of energy released in nuclear fission and fusion. Nuclear forces. Their salient features. Meson theory of nuclear forces.

UNIT 2: **Radioactivity**

Radioactivity, Radioactive disintegration law. Decay constant, half life and mean life Successive radioactive transformations. Radioactive equilibrium. Natural radioactive series. Units of radioactivity. Elementary theory of alpha decay. Gamow's explanation. Beta decay. Difficulties encountered to understand the continuous β- ray spectrum. Pauli's neutrino hypothesis. Electron capture process.

UNIT 3: **Nuclear reactions:**

Types of nuclear reactions. The balance of mass and energy in nuclear reactions. Q-value. Threshold energy. Compound nucleus model. Energy production in stars by proton-proton and carbon cycle.

UNIT 4: **Elementary Particles:**

Fundamental interactions in nature. Classification of elementary particles. Photons, leptons, mesons and baryons. Basic conservation laws. Conservation of lepton number, baryon number, strangeness, isospin. Cosmic rays.

UNIT 5: Accelerators and Detectors:

Need of accelerators. The linear accelerator. The cyclotron. Synchrocyclotron. The betatron and the electron synchrotron. The proton synchrotron. Detectors of charged particles. Working principles of cloud chamber and bubble chamber. Ionization chamber. Proportional counter, G. M. Counter. Scintillation Counter.

REFERENCES:

1. A. Beiser : Concepts of Modern Physics.
2. I. Kaplan : Nuclear Physics.
3. Bernard L. Cohen : Concepts of Nuclear Physics (Tata MCGraw Hill, 1998, New Delhi)
4. R.A. Dunlap : Introduction to the Physics of Nuclei and Particles (Singapore : Thomson Asia 2004)
5. Kenneth S. Krane : Introductory Nuclear Physics (John Wiley & Sons, 1988)

PHB612 **Lav VI (Semester VI)** **6 Periods/week H**

List of Experiments :

1. Verification of Hartman's dispersion formula.
2. Wavelength of Sodium light by Fresnel's Biprism.
3. Determination of Rydberg's constant with a diffraction grating and a hydrogen tube.
4. Study of R-C coupled amplifier.
5. Study of logic gates.
6. Study of the Flip-Flop circuits.
7. Study of Optical Fibre kit
8. Study of temperature transducer kit