Semester System (2016-17 onwards)

B.Sc. (PHYSICS)

THREE-YEAR FULL-TIME PROGRAMME (Six-Semester Course)

Science Faculty

(Physics Department)

COURSE CONTENTS

Kumaun University Nainital

Kumaun University Nainital
B. Sc. Syllabi in Physics
(Session 2016-17 Onwards)

Semester System Course Structure

(Total Six Semesters, 80 marks in each Paper followed by practical carrying 60 marks each in each Semester):(80Marks= 60 marks external+ 20 marks internal for each paper)

Semester–wise Distribution of Papers with Marks

I. First Semester :

Paper 1: Mechanics	**80 Marks**
Paper 2: Electricity	**80 Marks**
Paper 3: Theory of Oscillations	**80 Marks**
Practical	**60 Marks**
	Total = 300 Marks

II. Second Semester :

Paper 1: General Properties of matter	**80 Marks**
Paper 2: Magnetism	**80 Marks**
Paper 3: Waves and Acoustics	**80 Marks**
Practical	**60 Marks**
	Total = 300 Marks

III. Third Semester :

Paper 1: Thermodynamics	**80 Marks**
Paper 2: Geometrical Optics	**80 Marks**
Paper 3: Elementary Solid State Physics	**80 Marks**
Practical	**60 Marks**
	Total = 300 Marks

IV. Fourth Semester :

Paper 1: Heat Transfer Mechanism	**80 Marks**
Paper 2: Physical Optics	**80 Marks**
Paper 3: Statistical Physics	**80 Marks**
Practical	**60 Marks**
	Total = 300 Marks

V. Fifth Semester

Paper 1: Quantum Mechanics	**80 Marks**
Paper 2: Atomic and molecular Physics	**80 Marks**
Paper 3: Basic Electronics	**80 Marks**
Practical	**60 Marks**
	Total = 300 Marks

VI. Sixth Semester

Paper 1: Special Relativity and Electromagnetic waves	**80 Marks**
Paper 2: Subatomic Physics	**80 Marks**
Paper 3: Analog and Digital Electronics	**80 Marks**

Practical **60 Marks**

Total = 300 Marks

For 3 year degree course which shall be of six semesters

For each semester there will be three theory papers of 80 marks each out of which 20 marks shall be decided by internal assessment & 60 marks by semester end theory examinations followed by practical of 60 marks per semester. The pattern of theory papers will be same in each paper and in each semester as follows.

The Question paper shall have three sections. **Section "A"** consists of **Twelve (12) objectives /fills in the gap Type Questions** carrying **one (01)** mark each. All questions of this section are compulsory. **Section "B"** shall consist of Six (06) **Short Answer Type Questions** carrying **Six (06) marks** each. Attempt any **Four (04)** questions from this section. **Section "C"** shall consist of Four (04) **Long Answer Type Questions** carrying **twelve (12) marks** each. Attempt any **Two (02)** questions from this section.

Syllabus

Semester I

(Academic Year- 2016-17)

Paper I: - Mechanics **MM-60**

Unit-I- Vectors

Unit-II- Gravitational field and potential

Unit-III- Conservation of Energy

Unit-IV- Conservation of Linear momentum and Angular momentum

Paper II:- Electricity **MM-60**

Unit-I- Electric field and potential I

Unit-II- Electric field and potential II

Unit-III- Electric fields in Matter

Unit-IV- Electric currents (steady and varying)

Paper III:- Theory of Oscillations **MM-60**

Unit-I- Simple Harmonic Motion

Unit-II-Damped Harmonic Oscillations

Unit-III- Forced Harmonic Oscillations

Unit-IV-Applications

Practical: **MM-60**

Semester I

Paper I: Mechanics **MM-60**

Unit-I- Vectors

Triple product of vectors, scalar and vector field, Calculus of vectors, Application of vectors to linear and rotational quantities, Del operator, Gradient, Divergence and curl of vectors, circular motion, Gauss's, Stokes's and Green's theorem (Examples to be given from physical situations)

Unit-II- Gravitation-field and potential

Gravitational field and potential, Gravitational potential energy, Gravitational field Intensity and potential due to a ring, a spherical shell, solid sphere and circular disc, gravitational self energy, Inverse square law of forces, Kepler's laws of planetary motion, artificial satellite.

Unit-III- Conservation of Energy

Concept of inertial and Non-inertial frames of references, Work energy theorem, Conservative & non-Conservative forces, Linear restoring force, Gradient of potential, Conservation of energy for the particle; Energy function, motion of a body near the surface of the earth, Law of conservation of total energy.

Unit-IV- Conservation of Linear and Angular momentum

Conservation of Linear momentum, Centre of mass, System of variable mass, the rocket, Angular momentum and torque, Areal velocity, Examples of Conservation of Angular momentum.

Books Recommended:

Mechanics and General Properties of matter.

1. Berkeley physics course Vol.I Mechanics(McGraw Hill)
2. R.P. Feynman, R.B.Lightan and MSand "The Feynman Lectures in Physics"
3. J.C. Upadhayay "General Properties of matter" Vol-I
4. D.S. Mathur "Mechanics" S.Chand and Co.
5. D.S. Mathur "Elements of Properties of Matter" S.Chand and Co.
6. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan.

Semester I

Paper II: Electricity MM-60

Unit-I- Electric field and potential-I

Coulomb law, Gauss' theory, its integral and differential forms, line integral of Electric field, Electric field and potential due to an arbitrary charge distribution. Electrostatic energy, energy stored in an Electric field.

Unit-II- Electric field and potential -II

Electric field and potential due to long charged wire, Spherical shell, sphere, disc, dipole. Method of electrical images and application to system of point charges near a grounded conducting plane surface.

Unit-III- Electric fields in Matter

Polar and non-polar molecule, polarization vector, electric displacement vector, three electric vectors, dielectric susceptibility and permittivity, polarizability, Clausius-Mossotti relation, Langevin's theory of polar dielectrics, moments of charge distributions.

Unit-IV- Electric currents (steady and varying)

Meaning of electric Current, its speed, density, Equation of continuity, electrical conductivity, Lorentz-Drude theory, Wiedmann-Frenz law, Kirchoff's laws and their applications, Transient currents, R-C circuit.

Books Recommended:

1. Berkeley physics course Vol.II "Electricity and Magnetism**"** (McGraw Hill)
2. Hilliday and Resnick-Vol-II
3. Mahajan and Rangwala "Electricity and Magnetism**"** (Tata McGraw Hill)
4. K.K Tewari, "Electricity and Magnetism**",** S. Chand and Co.
5. B.B.Laud, "Electricity and Magnetism**"**
6. D.C. Tayal "Electricity and Magnetism**"** Himalaya Publishing.
7. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan

Semester I

Paper III: Theory of Oscillations MM-60

Unit-I- Simple Harmonic Oscillations

Periodic motion, SHM in mechanical systems, Energy of Simple harmonic oscillator, Superposition of SHM(s), Oscillations of two masses connected by a spring, Non-linear (An-harmonic) oscillator and its applications to simple pendulum.

Unit-II-Damped Harmonic Oscillations

Damping force, Different cases for over, critical and under damping, Mechanical damped harmonic oscillators, Logarithmic decrement, Power Dissipation, Relaxation time & Quality Factor.

Unit-III- Forced Harmonic Oscillations

Forced oscillations, Mechanical driven harmonic oscillators, Transient and steady state behavior, Power dissipation phenomenon of resonance, amplitude/velocity resonance, sharpness of resonance/ Fidelity, Bandwidth and quality factor,

Unit-IV-Applications

Applications of Simple harmonic motion in compound pendulum, Torsional pendulum and LC circuit, Composition of two SHM(s) of different frequency ratio, Lissajous' figures for equal frequencies ratio and 2:1 frequencies ratio, Applications of Damped Harmonic and Forced oscillations for moving coil galvanometer and LCR circuits..

Books Recommended:

1. Brijlal and Subrahmanyam, "Waves and Oscillations", S.Chand and Co
2. B.S.Semwal and M.S.Panwar, "Wave Phenomena and material Science"
3. Waves: Berkeley Physics Course(SIE) by Franks Crawford (Tata McGrawHill).
4. R.K.Ghose, " The mathematics of waves and Vibrations" McMillan
5. D.P.Khandelwal, "Oscillations and Waves" Himalaya Publishing
6. I.I.Pain "Physics of Vibration"
7. A. P. French, "Vibrations and Waves" (CBS Pub. & Dist., 1987).
8. D.S. Mathur "Mechanics" S.Chand and Co.
9. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan.
10. Satya Prakash; Waves and Oscillations, Pragati Prakashan.

Practical- MM-60

List of Expt. for B.Sc.I year semester-I (at least eight experiments which cover understanding of theory course)

1. Oscillations of mass spring system.
2. Study of compound (Kater's) pendulum.
3. Study of compound (Bar) pendulum.
4. Study of relaxation in a simple pendulum.
5. Study of under damped harmonic oscillator.
6. Torsional oscillations (Maxwell's needle experiment)
7. Calibration of ammeter by potentiometer.
8. Calibration of voltmeter by potentiometer.
9. Specific resistance determination.
10. Conversion of Galvanometer in to a voltmeter.
11. Conversion of Galvanometer in to a ammeter.
12. To investigate the Motion of Coupled Oscillators.
13. Charging and discharging through a capacitor.
14. De Sauty's bridge- C1/C2.
15. R1/R2 by potentiometer.
16. To determine High Resistance by Leakage of a Capacitor.
17. Melde's Experiment.

Semester II

(Academic Year- 2016-17)

Paper I:- General Properties of matter **MM-60**

Unit-I- Dynamics of rigid body and idea of Moment of Inertia

Unit-II- Moment of Inertia of various bodies

Unit-III- Elasticity

Unit-IV-Viscosity & Surface Tension

Paper II:- Magnetism MM-60

Unit-I- Magnetostatics

Unit-II- Magnetic field in matter

Unit-III- Alternating Currents

Unit-IV-Electromagnetic Induction

Paper III:- Waves and Acoustics **MM-60**

Unit-I- Analysis of wave motion

Unit-II- Ultrasonics

Unit-III- Acoustics

Unit-IV-Applications

Practical: **MM-60**

Semester II

Paper-I: General Properties of matter MM-60

Unit-I- Dynamics of rigid body and idea of Moment of Inertia

Equation of motion for Rotating rigid body, angular momentum vector and moment of inertia, Translatory and Rotatory motion, theorem of parallel and perpendicular axes.

Unit-II- Moment of Inertia of various bodies

Moment of inertia of a rod, lamina, ring, disc, spherical shell, solid sphere, kinetic energy of rotation, rolling along a slope, precession, Application to compound pendulum.

Unit-III- Elasticity

Basic concept, Elastic constants and their Interrelations, torsion of cylinder, bending of beam, bending moment, Cantilever, shape of Girders/ rail tracks.

Unit-IV-Viscosity & Surface Tension

Viscosity, Stokes's law Posieuille's formula, capillaries in series and parallel, Equation of continuity, Bernoulli's theorem, Surface tension, molecular interpretation

Books Recommended:

1. Berkeley physics course Vol.I Mechanics(McGraw Hill)
2. R.P. Feynman, R.B.Lightan and MSand "The Feynman Lectures in Physics"
3. J.C. Upadhayay "General Properties of matter" Vol-I
4. D.S. Mathur "Mechanics" S.Chand and Co.
5. D.S. Mathur "Elements of Properties of Matter" S.Chand and Co.
6. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan

Semester II

Paper-II: Magnetism MM-60

Unit-I- Magnetostatics

Lorentz force, Bio-Savert's law, Ampere's law, Application of Biot-Savert law, magnetic field due steady current in a long straight wire, Interaction between two wires, field due a Helmholtz coil, solenoid and current loop, magnetic vector potential, permeability, Energy stored in Magnetic field.

Unit-II- Magnetic field in matter

Magnetization, magnetic susceptibility, diamagnetic, paramagnetic and ferromagnetic substances, Hysteresis and B-H curve, Langevin's theories of Diamagnetism and paramagnetism, Weiss theory of ferromagnetism.

Unit-III- Alternating Currents:

Impedance, admittance and reactance, R-C, R-L and L-C circuits with alternative e.m.f. source, series and parallel L-C-R circuits, resonance and sharpness, Power in A-C circuits, choke coil.

Unit-IV-Electromagnetic Induction

Faraday's laws of induction, Lenz's law, Electromotive force, Measurement of magnetic field (Search coil, Earth inductor, Flux meter), Eddy current, Skin effect,
Mutual inductance and reciprocity theorem, Self inductance.

Books Recommended:

1. Berkeley physics course Vol.II "Electricity and Magnetism**"** (McGraw Hill)
2. Hilliday and Resnick-Vol-II
3. Mahajan and Rangwala "Electricity and Magnetism**"** (Tata McGraw Hill)
4. K.K Tewari, "Electricity and Magnetism**",** S. Chand and Co.
5. B.B.Laud, "Electricity and Magnetism**"**
6. D.C. Tayal "Electricity and Magnetism**"** Himalaya Publishing.
7. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan

Semester II

Paper III: Waves and Acoustics **MM-60**

Unit-I- Analysis of wave motion

Characteristics, Differential equation of a wave motion, principle of superposition, Interference, Beats, stationary waves, Energy of stationary waves, Wave velocity and group velocity, Fourier theorem, Fourier analysis of square, triangular and saw-tooth waves.

Unit-II- Ultrasonics

Classification of Sound waves, Ultrasonics, Quartz crystal and Piezo electric effect,
Magnetostriction effect, Properties of Ultrasonic, Detection of ultrasonic waves, Determination of velocity of ultrasonic waves in liquid (Acoustic grating method)

Unit-III-Acoustics

Energy density of plane acoustic waves, Acoustic intensity, Measurement of acoustic intensity – the dB scale, Characteristics and loudness of Musical sound,
Acoustic impedance, Reflection and transmission of acoustic waves.

Unit-IV-Applications

Application of wave propagation in various physical cases, Applications of Ultrasonics, Acoustics of buildings, reverberation time, Sabine's formula, Principle of sonar system.

Books Recommended:

1. Brijlal and Subrahmanyam, "Waves and Oscillations", S.Chand and Co
2. B.S.Semwal and M.S.Pasewar, "Wave Phenomena and material Science"
3. Waves: Berkeley Physics Course(SIE) by Franks Crawford (Tata McGrawHill).
4. R.K.Ghose, " The mathematics of waves and Vibrations" McMillan
5. D.P.Khandelwal, "Oscillations and Waves" Himalaya Publishing
6. I.I.Pain "Physics of Vibration"
7. A. P. French, "Vibrations and Waves" (CBS Pub. & Dist., 1987)
8. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan.

Practical- **MM-60**

List of Expt. for B.Sc. I year- Semester II (at least eight experiments which cover understanding of theory course)

1. Determination of modulus of rigidity (dynamical, statical method).
2. Young's modules by bending of beam of known material.
3. Elastic constants by Searle's method (η, γ and σ).
4. Moment of inertia of a fly wheel.
5. Inertia table Experiment.
6. Surface Tension determination.
7. Frequency of A.C mains.
8. Lissajous figures.
9. Viscosity of water by Posieuille's method.
10. Determination of velocity of sound in a medium.
11. Determination of Ballistic Constant.
12. Comparison of capacities by Ballistic Galvanometer.
13. Variation of magnetic field along the axis of a current carrying circular coil.
14. Determination of Ultrasonic velocity.

15. Hysteresis.

16. Determination of self inductance/ Mutual inductance.

17. Study of R-C, LCR circuits.

Semester III

(Academic Year- 2017-18)

Paper- I – Thermodynamics **MM-60**

Unit-I-Basic Concepts and First law of thermodynamics

Unit-II- Second law of Thermodynamics

Unit-III- Entropy

Unit-IV- Applications of Thermodynamics

Paper-II- Geometrical Optics **MM-60**

Unit-I- Fermat's Principle and refraction (Spherical Surfaces)

Unit-II- Image Theory for Lens systems

Unit-III- Optical Aberrations and dispersion

Unit-IV- Associated Optical Instruments

Paper- III –Elementary Solid State Physics **MM-60**

Unit-I- Crystal Structure

Unit-II- Crystal Diffraction

Unit IV- Lattice Vibration & thermal Properties of Solids

Unit-IV- Band theory of Solids

Practical: **MM-60**

Semester III

Paper- I :- Thermodynamics **MM-60**

Unit I:- Basic concepts & First law of thermodynamics

Thermodynamic Systems, Thermal equilibrium and Zeroth law of thermodynamics, Equation of state and First law of thermodynamics, Discussion of Heat and Work, Quasi-static Work; Reversible and Irreversible; Path Dependence; Heat Capacities Adiabatic Processes, Vander Wall equation, Distinction between Joule, Joule-Thompson and Adiabatic expansion of a gas.

Unit-II- Second law of Thermodynamics

Insufficiency of first law of thermodynamics, Condition of Reversibility, Carnot's Engine and Carnot's Cycle, Second law of thermodynamics, Carnot's Theorem, Thermodynamic scale of temperature and its identity to perfect gas, scale of temperature, Heat engines in Practice: Steam engine and Diesel engine, Clausius Theorem.

Unit-III:- Entropy

Entropy, Mathematical formulation of Second law of thermodynamics, Entropy of an ideal gas, T-S diagram and its applications, Entropy of the Universe in reversible and Irreversible processes, Evaluation of Entropy changes in simple cases, Third law of thermodynamics, The Entropy Constant at Absolute Zero, Nernst Heat Theorem.

Unit-IV:- Applications of Thermodynamics

Thermodynamic potentials, Maxwell's equation from thermodynamic potentials, Some useful manipulations with partial derivatives (cooling in adiabatic processes and Adiabatic stretching of a wire), The Clausius–Clapeyron's equations, Triple point, Applications of Maxwell's thermo dynamical relations.

Books Recommended

1. S. Loknathan, "Thermodynamics, Heat and Statistical Physics" (Prentice Hall India
2. Sharma and K.K. Sarkar "Thermodynamics, and Statistical Physics" (Himalaya Pub)
3. Brijlal and Subrahmanyam, "Heat and Thermodynamics" (S Chand)
4. Saha and Srivastav "Treatise on heats", (The Indian Press Publications)
5. S.C. Garg, R.M. Bansal and Ghose, "Thermal Physics" (Tata McGraw-Hill)

Semester III

Paper-II- Geometrical Optics **MM-60**

Unit-I- Fermat's Principle and refraction (Spherical Surfaces)

Fermat's principle of extremum path and its application to deduce laws of reflection and refraction, Refraction at concave surface, Principal foci, Lateral and longitudinal magnifications, Aplanatic points of spherical surface.

Unit-II- Image Theory for Lens systems

Gauss's general theory of image formation, Coaxial symmetrical system, Cardinal points of an optical system, General relationships, Thick and Thin lens, lens combinations, Newton's formula, Coaxial lens system, Lagrange's equation of magnification, Refraction through a thick lens.

Unit-III- Optical Aberrations and dispersion

Aberrations in images, Spherical aberration, Chromatic aberration, Condition of achromatism, Achromatic combination of lenses in contact and separated lenses, Monochromatic aberrations and their reduction, Spherical mirrors and Schmidt corrector plates, Theory of dispersion.

Unit-IV- Associated Optical Instruments

Nodal Slide, Eyepiece, Ramsden's, Huygen's and Gaussian eyepieces, Their comparison, Astronomical refracting telescope, Microscopes, Spectrometer and its uses, Oil immersion objectives meniscus lens.

Books Recommended

1. D.P. Khandelwaland "Optics and Atomic Physics" (Himalaya, Publishing House)
2. Jenkins and White "Fundamentals of Optics" (Tata McGraw-Hill)
3. A.K. Ghatak "Physical Optics",(Tata McGraw-Hill)
4. Brijlal and Subrahmanyam, "Optics" (S Chand)
5. K.D. Moltev "Optics" (McGraw-Hill)
6. B. K. Mathur, "Optics" (Gopal Printing Press)

Semester III

Paper- III –Elementary Solid State Physics **MM-60**

Unit-I- Crystal Structure

Single crystals and polycrystalline forms, Lattice, Basis and crystal structure, Translational symmetry and basis vectors, Unit cell (primitive and non-primitive), Two dimensional point groups and Bravais lattices, Miller indices, SC, BCC and Sodium Chloride structures, closed packed structures(FCC and HCP),

Unit-II- Crystal Diffraction

Reciprocal lattice, X-rays diffraction, Bragg's law, Laue and powder methods of X-rays diffraction, Introductory electron and neutron diffraction, Ewald construction and Brillouin zones.

Unit III- Lattice Vibration and thermal Properties of Solids

Lattice vibrations, Monoatomic lattice, Phonons, Free electron theory of metals, limitations of Lorentz Drude theory, Somerfield theory, Specific heat and paramagnetism of free electrons, Dulong and Petit's law, Departure of the law at low temperatures, Einstein's theory of specific heat and its limitations, Debye's theory of specific heat of solids,

Unit-IV- Band theory of Solids

Motion of an electron in periodic potential (one dimensional), Results of Kronig-Penny model, Distinction between conductors, Semiconductors and Insulators, Intrinsic and Extrinsic semiconductors, Effective mass of electron, Concept of holes.

Books Recommended

1. Dekker "Solid State Physics"(Laxmi Publications)
2. C.kittel "Introduction to Solid State Physics"(Wiley)
3. S.O.Pillai "Solid State Physics"(New Age International)
4. Saxena,Gupta and Saxena, "Fundamental of solid State Physics"(Pragati Prakashan- Meerut)

Practical: **MM-60**

List of Expt. for B.Sc-II year, semester-III (at least eight experiments which cover understanding of theory course)

1. Biprism- determination of λ.
2. Newton's ring experiment- Determination of λ.
3. Determination of a μ of liquid.
4. Determination of λ by a transmission grating.
5. Cauchy's formula.
6. Zone-plate experiment study of different orders.
7. Absorption of light.
8. Malus' Law.
9. Thermal conductivity of bad conductor.
10. Mechanical equivalent of heat by Searle's method.
11. Thermal conductivity of a good conductor by searle's method.
12. To study the variation of Thermo-emf of a Thermocouple with Different Temperature.
14. Specific rotation in cane sugar solution.
15. To determine the value of Stefan's constant.

Semester IV

(Academic Year- 2017-18)

Paper-I: - Heat Transfer Mechanism **MM-60**

Unit-I: Conduction and Convection

Unit-II- Kinetic Theory of Gases

Unit-III- Thermal Radiation

Unit-IV- Low Temperature Physics

Paper-II-Physical Optics **MM-60**

Unit-I- Interference

Unit-II-Diffraction

Unit-III-Polarization

Unit-IV- Associated Optical Instruments

Paper-III- Statistical Physics **MM-60**

Unit-I- Basic Concepts

Unit-II- Ensembles and Thermodynamic Connections

Unit-III- Classical Statistics

Unit-IV- Quantum Statistics (BES & FDS)

Practical: **MM-60**

Semester IV

Paper-I: - Heat Transfer Mechanism **MM-60**

Unit-I- : Conduction and Convection

Modes of heat transfer via Conduction, Convection and Radiation,
Conduction: Fourier's law, One dimensional steady state conduction, Heat conduction through plane and composite walls, Cylinders and spheres, Electrical analogy, Thermal conductivity and its experimental detection,
Convection: Newton's law of cooling, Dimensional analysis applied to forced and free convection, Dimensionless numbers and their physical significance.

Unit-II- Kinetic Theory of Gases

Kinetic theory of gases, Microscopic View of an Ideal gas, Degrees of freedom, Law of Equipartition of Energy, Distribution law of velocities, Most probable speed, Average speed and root mean square velocity of molecules, Pressure exerted by a perfect gas, Kinetic Interpretation of Temperature.

Unit-III- Thermal Radiation

Physical quantities associated with Radiation, Black body, Radiation from non-black-bodies, Thermodynamics of radiations inside a hollow enclosure, Kirchoff's Laws, Derivation of Stefan

Boltzmann Law, Wein's displacement law, Black body spectrum formula- early attempts, Raleigh Jean's Law, Quantum theory of Radiation, Planck's formula for black body spectrum, Wien's law, Radiation as a photon gas.

Unit-IV:- Low Temperature Physics

Methods of producing low temperatures via Joule- Kelvin Expansion and Adiabatic demagnetization, Joule Thomson Coefficient, Inversion temperature, Introduction to cryogenics and refrigeration, Air conditioning Mechanism, Air compression Machine, Hampson's and Linde's regenerative cooling machine, Liquification of air, Hydrogen and Helium, Solidification of Helium.

Books Recommended

1. S. Loknathan, "Thermodynamics, Heat and Statistical Physics" (Prentice Hall India)
2. Sharma and K.K. Sarkar "Thermodynamics, and Statistical Physics" (Himalaya Pub.)
3. Brijlal and Subrahmanyam, "Heat and Thermodynamics"(S Chand)
4. Saha and Srivastav "Treatise on heats", (The Indian Press Publications)
5. S.C. Garg, R.M. Bansal and Ghose, "Thermal Physics" (Tata McGraw-Hill)

Semester IV

Paper-II- Physical Optics **MM-60**

Unit-I- Interference

The principle of superposition, Two slit interference, coherence, Division of wave front and amplitude, Optical path retardations lateral shift of fringes, Fresnel biprism, Interference with multiple reflection, Thin films, Application for precision measurements, Haidinger fringes, Fringes of equal thickness and equal inclination.

Unit-II-Diffraction

Fresnel's and Fraunhofer diffraction: Diffraction of single slit, Zone plates, intensity distribution, Resolution of image, Rayleigh criterion, Resolving power of telescopes and microscopes, Diffraction due to 2-slits and N-slits, Diffraction grating, Resolving power of grating and comparison with resolving powers of prisms.

Unit-III- Polarization

Plane polarized, Circular polarized and elliptically polarized light, Malus law, Brewster's law, Double reflection and uniaxial crystals, Application of bi-refringence, Dichroism, Optical rotation, Rotation of plane of polarization, Optical rotation in liquids and crystals, Polarimeter.

Unit-IV- Associated Optical Instruments

Michelson intereferometer and its application for precise measurement of wavelength, Wavelength difference and width of spectral lines, Twyman-Green interferometer, Tolansky fringes, Fabry-Perot interferometer and Etalon.

Books Recommended

1. D.P. Khandelwal "Optics and Atomic Physics" (Himalaya Publishing)

2. Jenkins and White “Fundamentals of Optics” (Tata McGraw-Hill)

3. A.K. Ghatak “Physical Optics”,(Tata McGraw-Hill)

4. Brijlal and Subrahmanyam, “Optics”(S. Chand)

5. K.D. Moltev “Optics” (McGraw-Hill)

6. B. K. Mathur, “Optics” (Gopal Printing Press)

Semester IV

Paper-III- Statistical Physics **MM-60**

Unit-I- Basic Concepts

Basic postulates of Statistical Physics, Specification of states, Macro state, Micro State, Phase Space, Density distribution in phase space, μ space representation and its division, Statistical average values, Condition of equilibrium, Stirling’s Approximation, Entropy and Thermodynamic probability ($S = K \ln \Omega$), Boltzmann entropy relation.

Unit-II- Ensembles and Thermodynamic connections

Definition, Micro -canonical, Canonical and Grand Canonical ensembles, Their thermodynamic connections, Statistical definition of temperature and interpretation of second law of thermodynamic, Pressure, Entropy and Chemical potential. Entropy of mixing and Gibb’s paradox, Partition function and Physical significances of various statistical quantities.

Unit-III- Classical Statistics:

Maxwell-Boltzmann statistics and Distribution law, Energy distribution function, Maxwell-Boltzmann law of velocity distribution (most probable velocity, average velocity, RMS velocity), Limitations of M-B statistics.

Unit-IV- Quantum Statistics (BES & FDS)

Bridging Microscopic and Macroscopic behaviour, indistinguishability of particles and its consequences, Transition to quantum statistics and its implications, , Bose–Einstein and Fermi-Dirac gases, Gas Degeneracy, Applications to liquid helium, Free electrons in a metal and Photon gas, Fermi level and Fermi energy.

Books Recommended

1. B.B.Laud “Introductions to Statistical Mech.”(McMillan)

2. Bhattarjee J.K. “Statistical Physics”, (Allied Publishers)

3. F.Reif, “Statistical Physics”, (Mc.Graw Hill)

4. Kamal Singh “Elements of Statistical Mechanics”, (S.Chand).

5. K.Hung “Statistical Physics”(Chapman and Hall/CRC)

Practical: **MM-60**

List of Expt for B.Sc-II year, semester IV (at least eight experiments which cover understanding of theory course)

1. Nodal slide assembly, Location of cardinal points of lens system
2. Newton's formula
3. Dispersive power of prism.
4. Limit of resolution of a telescope.
5. To determine the Resolving Power of a Prism
6. Stefan's law.
7. Platinum resistance thermometer.
8. J-Callendar and Barne's method.
9. Random events- Statistical board method.
10. Newton's law of cooling - Sp. heat of kerocene oil.
11. To verify the Cauchy's dispersion formula.
12. To find the thickness of the wire using optical bench.
13. To determine the thickness of mica-sheet by using Biprism.
14. To determine the Critical temperature and critical pressure of a gas.
15. To measure temperature with the help of Jolly's constant volume air thermometer.

Semester V

(Academic Year- 2018-19)

Paper-I-Quantum Mechanics **MM-60**

Unit-I- Origin of Quantum theory

Unit-II- Wave-Particle Duality

Unit-III- Formalism of Quantum mechanics

Unit IV- Schrödinger equation -The first law of Quantum Mechanics

Paper-II- Atomic and molecular Physics **MM-60**

Unit-I- Atomic Models

Unit-II- Optical Spectra and X-rays

Unit-III- Theory of Lasers

Unit-IV- Molecular Spectroscopy

Paper-III- Basic Electronics **MM-60**

Unit-I- Network Theorems

Unit-II- Power Supplies

Unit-III- Solid State Devices

Unit-IV- Amplifiers

Practical: **MM-60**

Semester V

Paper-I-Quantum Mechanics **MM-60**

Unit-I- Origin of Quantum theory

Origin of quantum theory, limitation of Classical Physics, Black body Radiation, Planck's radiation law and Einstein's explanation, The photo electric effect and Einstein correction, Compton effect.

Unit-II- Wave-Particle Duality

De Broglie's Hypothesis, Wave-Particle Duality, Davisson-Germer Experiment, G.P Thomson experiment, Taylor's experiment, Wave description of Particles by Wave Packets, Group and Phase Velocities, Principle of Complimentarity, Heisenberg Uncertainty principle, Gamma ray microscope, Single slit experiment.

Unit-III- Formalism of Quantum mechanics

Linear vector space, Linear Operator, Definition of position, momentum , Energy and Angular momentum operator, Eigen value and Eigen functions, Hermitian operators, Postulates and basic theorems of Quantum mechanics, Operator method for solving Eigen values problem, Energy of Harmonic oscillator.

Unit IV- Schrödinger equation – The first law of Quantum Mechanics

Origin of non relativistic Quantum Mechanics, Overview of wave mechanics, Simple one dimensional quantum system Oscillator, Time independent and time dependent one dimensional Schrödinger equation, Steady state solutions, Physical interpretation of wave functions, probability current density, Ehrenfest's theorem, Particle in a box, Idea of Tunneling.

Books Recommended

1. L.I. Schiff, "Quantum Mechanics" (McGraw Hill Book Co.)
2. Chris J. Isham, "Lectures on Quantum Theory" (Allied Publisher)
3. B.S. Rajput , "Advanced Quantum Mechanics" (Pragati Prakashan)
4. Ghatak and Lokanathan , "Quantum Mechanics" (Macmillan Pub.)
5. Mathew and Venkatesan , "Quantum Mechanics"(Tata McGraw-Hill)

Semester V

Paper-II- Atomic and Molecular Physics **MM-60**

Unit-I- Atomic Models

Thomson model, Rutherford model, Bohr model and spectra of hydrogen atom, Fine structure, Bohr Magnetron, Larmor's precession, Somerfield model, Stern-Gerlach experiment, Vector atomic model, Space Quantization and Spinning of an electron.

Unit-II- Optical Spectra and X-rays

Optical spectra, Spectral notations, L-S, J-J coupling, Selection rules and intensity rules, Explanation of fine structure of Sodium D line, Zeeman effect, X-ray spectra(characteristics and continuous), Moseley's law.

Unit-III- Theory of Lasers

Einstein A and B coefficients, Spatial and Temporal coherence, Optical pumping, Population inversion, Laser action, Basic idea of LASER and MASER, Ruby Laser and He-Ne laser, Some applications.

Unit-IV- Molecular Spectroscopy

Franck-Condon Principle, Molecular spectra, Rotational, Vibration and Electronic spectra of diatomic molecules, General features of electronic spectra, Luminescence, Basics of Raman effect.

Books Recommended

1. H.S. Mani and Mehta, Introduction to Modern Physics , (Allied East West Press)

2. A. Beiser , Perspective of Modern Physics, , (Tata McGraw Hill)

3. Ahmad and Lal, Modern Physics (S. Chand and Co.)

4. B.V.N. Rao, Modern Physics (New Age International)

5. R. Murugeshan Modern Physics (S. Chand and Co.)

Semester V

Paper-III- Basic Electronics **MM-60**

Unit-I- Network Theorems

Kirchhoff's laws, Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer Theorem, Applications of Network theorem, Four terminal network and h-parameters.

Unit-II- Power Supplies

Half and Full wave rectifiers, Bridge rectifiers, Ripple factor, Low pass and High Pass Filters, L and π – Filters, Zener Diode and Voltage Regulation, V.R. tubes.

Unit-III- Solid State Devices

Semiconductor diodes, Point contact diode, Varactor diode, Tunnel diode, Photo diode, Light emitting diode, Junction Transistors, Transistor operation, Characteristics curves, Common emitter, Common base, Common collector configurations, General idea of FET, MOSFETS, UJT, SCR, CSES.

Unit-IV- Amplifiers

Classification, Basic amplifier, Load line Transistor biasing, Single stage Transistor amplifier, (Common base, Common emitter) RC and TC amplifiers, FET characteristics and amplifier, Power amplifier (Class A, Push-pull class B and class C), Decibels, Frequency response curve and Bandwidth.

Books Recommended

1. M.K. Baagde, S.P.Singh and Kamal Singh , Elements of Electronics ,(S. Chand and Co.)

2. B.L.Theraja,Basic Electronics ,(S. Chand and Co.)

3. V.K.Mehta, Elements of Electronics ,(S. Chand and Co.)

4. Gupta –Kumar Hand Book of Electronics (Pragati prakashan)

Practical: **MM-60**

List of Expt. for B.Sc. III year Semester-V (at least six experiments which cover the understanding of theory course)

1. Frank-Hertz Experiment.
2. Determination of 'h' Planck's constant by Photoelectric effect.
3. Spectrum of Hydrogen and Rydberg constant.
4. Speed of light by Leacher's wires.
5. 'e/m' by Busch method.
6. 'e/m' Magnetron method.
7. 'e/m' Helical method
8. Measurement of Magnetic field strength.
9. Spectrum of Sodium atom (D1-D2 lines).
10. Mercury Spectrum.
11. To study response characteristics of R-C coupled Amplifier with feedback.
12. To study the characteristics of integrating and differentiating circuit.
13. To draw the characteristics of P-N junction diode.
14. To draw the characteristics of PNP and NPN junction transistor.

15. Measurements of h-parameters of a transistor.

Semester VI

(Academic Year- 2018-19)

Paper-I- Relativistic Mechanics **MM-60**

Unit-I- Foundation of Special theory of Relativity

Unit-II- Consequences of Lorentz Transformations

Unit-III- Electromagnetic waves

Unit-IV-Relativity of Electromagnetism

Paper-II- Subatomic Physics **MM-60**

Unit-I- Elements of Nucleus

Unit-II- Radioactivity

Unit-III- Elementary Particles

Unit-IV- Nuclear Devices

Paper-III- Analog and Digital Electronics **MM-60**

Unit-I- Feedback Amplifier

Unit-II- Oscillators

Unit-III- Boolean algebra

Unit-IV- Logic Gates

Practical: **MM-60**

Semester VI

Paper-I- Special Relativity and Electromagnetic waves **MM-60**

Unit-I- Foundation of Special theory of Relativity

Frames of reference, Galilean transformations, Ether hypothesis, Failure of Michelson-Morley experiment, Postulates of Special theory of relativity, Lorentz transformations.

Unit-II- Consequences of Lorentz Transformations

Length contraction, Time dilation, Velocity transformations and Law of velocity addition, Variation of mass with velocity, Relativistic energy and mass energy equivalence, Concept of four vector, Examples of position and momentum four vectors.

Unit-III- Electromagnetic waves

Maxwell's equations in differential and integral forms, Electromagnetic energy and Poynting theorem , Wave equations, Plane electromagnetic waves in free space, Maxwell's equations for isotropic, nonisotropic and dielectric medium, Plane Electromagnetic wave in Conducting and non-conducting (dielectric) medium

Unit-IV- Relativity of Electromagnetism

Notations for Four- vectors, space and light like separations, Energy-Momentum Four Vector, Four vector potential, electromagnetic field tensor, Lorentz invariance, Lorentz force, covariant form of Maxwell's equations, four vector formulation of current and continuity equation

Books Recommended

1. H.S. Mani and Mehta, Introduction to Modern Physics , (Allied East West Press)

2. A. Beiser , Perspective of Modern Physics, , (Tata McGraw Hill)

3. Ahmad and Lal, Modern Physics (S. Chand and Co.)

4. B.V.N. Rao, Modern Physics (New Age International)

5. B.B.Laud Electromagnetics (Wiley Eastern limited)

6. Berkely Physics course, Vol II "Electricity and Magnetism" (McGraw Hill.)

7. A. S. Mahajan and A. Rangwala "Electricity and Magnetism" (Tata McGraw Hill.)

Semester VI

Paper-II- Subatomic Physics **MM-60**

Unit-I- Elements of Nucleus

Basic Properties of Nuclei, Mass, Radii, Charge, Nuclear structure, Stability and Binding Energy, Liquid drop model and Semi empirical mass formula.

Unit-II- Radioactivity

Discovery of Radioactivity, Properties of α, β and γ rays, Artificial nuclear transmutation, Soddy Fajan's displacement law, Law of radioactive disintegration, half-life and mean life, Radioactive dating (carbon dating).

Unit-III- Elementary Particles

History and Classification of Elementary particles on the basis of mass, Fundamental interactions, Lepton and Baryon number, Conservation laws, Concept of Iso-spin, hypercharge and Strangeness, basic idea of quarks.

Unit-IV- Nuclear Devices

Particle accelerators; Van de Graff generators, Cyclotron, linear accelerator, Particle detectors, Ionization chamber, Proportional counter and Geiger Muller counter.

Books Recommended

1. H.S. Mani and Mehta, Introduction to Modern Physics , (Allied East West Press)

2. A. Beiser , Perspective of Modern Physics, , (Tata McGraw Hill)

3. Ahmad and Lal, Modern Physics (S. Chand and Co.)

4. D.C. Tayal, Nuclear Physics (Himayla Publication)

5. Pandya and Yaday, Nuclear Physics (Kedarnath- Ramnath pub.)

6. B.N. Srivastav , Basic Nuclear Physics (Pragati Prakashan)

Semester VI

Paper-III- Analog and Digital Electronics **MM-60**

Unit-I- Feedback Amplifier

Classifications, Negative feedback and its advantages, Feedback amplifiers (voltage and current), Positive feedback and its advantages.

Unit-II- Oscillators

RC phase shift Oscillator, Wien bridge Oscillator, Hartley Oscillator, Colpit Oscillator, Tuned base oscillator, Tuned diode oscillator, Crystal oscillator, Stability of Oscillator, Relaxation Oscillators- Multivibtors (astable, monostable and bistable), Schmitt Trigger, Saw tooth generator, Blocking Oscillators.

Unit-III- Boolean algebra

Decimal, Binary, Hexadecimal, Octal, BCD, conversion of one code to another, Complements (one's and two's), Inter-conversions, BCD, GREY, EXCESS-3codes, Boolean Theorems, De-Morgan's Theorems.

Unit-IV- Logic Gates

Truth Tables, OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Adder and Subtractor.

Books Recommended

1. M.K. Baagde, S.P.Singh and Kamal Singh ,Elements of Electronics ,(S. Chand and Co.)

2. B.L.Thereza,Basic Electronics, (S. Chand and Co.)

3. V.K.Mehta, Elements of Electronics, (S. Chand and Co.)
4. Gupta –Kumar Hand Book of Electronics (Pragati prakashan)
5. Brophy, Communication Electronics (McGraw-Hill Education)
6. R Boylested , Electronic Devices & Circuit theory (PHI)

Practical: **MM-60**

List of Expt. for B.Sc. III year, semester-VI (at least six experiments which cover understanding of theory course)

1. Child Langmuir law.
2. Triode/ Tetrode/ Pentode characteristics and constants.
3. Hybrid parameters of transistor.
4. Study of power supply (Ripple factor).
5. Study of single stage R.C. coupled Amplifier and Band -Width.
6. Verification of Network theorems.
7. Band gap energy of semiconductor using a junction diode.
8. Study of Zener diode and regulation (taking different source voltage and loads).
9. Phase measurement using a C.R.O.
10. Study of T.C. Amplifier and B.W.
11. Study of logic gates.
12. Characteristics of FET/SCR and constants.
13. RC Circuits: Time constant, differentiator, integrator.
14. To study the Characteristics of a Photo-diode.
15. Wave shapes and frequency of Multivibrators.