Kumaun University Nainital

Semester System (2019 onwards)

B.Sc. (PHYSICS)

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

Science Faculty
(Department of Physics)

COURSE CONTENTS

Kumaun University Nainital

Kumaun University Nainital

B. Sc. Syllabi for Physics

(Session July 2019 Onwards)

Semester System Course Structure

Total Six Semesters, 75 marks (60 marks external + 15 marks internal) in each Paper followed by one practical carrying 50 marks in each Semester.

Semester–wise Distribution of Papers

I. First Semester

Paper 1: Mechanics and General Properties of Matter
Paper 2: Electricity and Magnetism
Practical: 50 Marks
Total: 200 Marks

II. Second Semester

Paper 1:` Theory of Oscillations
Paper 2: Waves, Acoustics and Electromagnetic Waves
Practical: 50 Marks
Total: 200 Marks

III. Third Semester

Paper 1: Heat and Thermodynamics
Paper 2: Geometrical Optics
Practical: 50 Marks
Total: 200 Marks

IV. Fourth Semester

Paper 1: Physical Optics
Paper 2: Elementary Solid State Physics and Statistical Physics
Practical: 50 Marks
Total: 200 Marks

V. Fifth Semester

Paper 1:	**Quantum Mechanics and Special Relativity**
Paper 2:	**Network Analysis, Solid State Devices and Basic Electronics**
Practical:	**50 Marks**
Total:	**200 Marks**

VI. Sixth Semester

Paper 1:	**Modern Physics**
Paper 2:	**Analog and Digital Electronics**
Practical:	**50 Marks**
Total:	**200 Marks**

Each Question paper will have two sections. Section "A" consists of Eight (08) Short Answer Type Questions each carrying Nine (09) marks. Attempt any Five (05) questions from this section. Section "B" will consist of Two (02) Long Answer Type Questions (Both Compulsory) each carrying Fifteen (15) marks and will have internal choice.

Detailed Syllabus

Semester-I

Paper-I:	**Mechanics and General Properties of Matter**	**MM-60**
Unit-I:	Vectors	
Unit-II:	Gravitational field and potential	
Unit-III:	Conservation Laws	
Unit-IV:	Dynamics of rigid body and Moment of Inertia	
Unit-V:	Properties of Matter	
Paper-II:	**Electricity and Magnetism**	**MM-60**
Unit-I:	Electric field and potential	
Unit-II:	Electric and Magnetic fields in Matter	
Unit-III:	Electric Currents (AC and DC)	
Unit-IV:	Magnetostatics	
Unit-V:	Electromagnetic Induction	
Practical:		**MM-50**

Semester-I

Paper-I: Mechanics and General Properties of Matter 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, Gauss's, Stokes's and Green's theorem (Physical Examples).

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.

Unit-III: Conservation Laws

Concept of inertial and Non-inertial frames of references, Work energy theorem, Conservative and non-Conservative forces, Linear restoring force, Gradient of potential, Conservation of energy for the particle; Energy function, Concept of Centre of mass, Angular momentum and torque, Laws of conservation of total energy, total linear momentum and total angular momentum alongwith their examples.

Unit-IV: Dynamics of rigid body and Moment of Inertia

Translatory and Rotatory motion, Equation of motion for Rotating rigid body, angular momentum vector and moment of inertia, Theorem of parallel and perpendicular axes, Moment of inertia of a cylinder, rod, lamina, ring, disc, spherical shell, solid sphere, kinetic energy of rotation, rolling along a slope, Application to compound pendulum.

Unit-IV: Properties of Matter

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

Viscosity, Stokes's law, Posieuille's formula, Equation of continuity, Bernoulli's theorem, Surface tension and its molecular interpretation.

Books Recommended:

1. R. Resnick and D. Hilliday: Physics Vol-I
2. Berkeley physics course Vol-I (McGraw Hill)
3. R.P. Feynman, R.B.Lightan and M.Sand: The Feynman Lectures in Physics.
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).
7. J.C. Upadhayay: General Properties of matter Vol-I.

Semester-I

Paper II: Electricity and Magnetism MM-60

Unit-I: Electric field and potential

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. Electric field and potential due to long charged wire, Spherical shell, sphere, disc, dipole.

Unit-II: Electric and Magnetic fields in Matter

Moments of charge distributions, Polar and non-polar molecule, polarization vector, electric displacement vector, three electric vectors, dielectric susceptibility and permittivity, polarizability, Clausius-Mossotti relation.

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: Electric Currents (AC and DC)

Electric Current, Equation of continuity, electrical conductivity, Lorentz-Drude theory, Wiedmann-Frenz law, Transient currents, R-C circuit, Time constant.

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: 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-V: Electromagnetic Induction

Faraday's laws of induction, Lenz's law, Electromotive force, Measurement of magnetic field, Eddy current, Skin effect, Mutual inductance, Self inductance.

Books Recommended:

1. Berkeley Physics Course Vol.II (McGraw Hill)
2. R. Resnick and D. Hilliday: Physics Vol-II
3. D.C. Tayal "Electricity and Magnetism**"** Himalaya Publishing.
4. Mahajan and Rangwala "Electricity and Magnetism**"** (Tata McGraw Hill).
5. B.B.Laud, "Electricity and Magnetism**"**
6. K.K Tewari, "Electricity and Magnetism**",** S. Chand and Co

Practicals: MM-50

List of Experiments for B.Sc. Semester-I (at least eight experiments which cover the 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. Viscosity of water by Posieuille's method.
8. Calibration of ammeter by potentiometer.
9. Calibration of voltmeter by potentiometer.
10. Specific resistance determination.
11. Conversion of Galvanometer in to a voltmeter.
12. Conversion of Galvanometer in to a ammeter.
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. Determination of Ballistic Constant.
18. Comparison of capacities by Ballistic Galvanometer.
19. Variation of magnetic field along the axis of a current carrying circular coil.
20. Hysteresis.
21. Determination of self inductance/ Mutual inductance.
22. Study of R-C, LCR circuits.

Semester-II

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

Unit-I: Simple Harmonic Oscillations
Unit-II: Damped Harmonic Oscillations
Unit-III: Forced Harmonic Oscillations
Unit-IV: Applications

Paper-II: Waves, Acoustics and Electromagnetic Waves **MM-60**

Unit-I: Analysis of wave motion
Unit-II: Ultrasonics
Unit-III: Acoustics
Unit-IV: Applications
Unit-V: Electromagnetic Waves

Practical: MM-50

Semester-II

Paper I: 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 absorption, phenomenon of resonance, amplitude resonance, 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. R. Resnick and D. Hilliday: Physics Vol-I
2. D.S. Mathur "Mechanics" S.Chand and Co.
3. Brijlal and Subrahmanyam, "Waves and Oscillations", S.Chand and Co
4. B.S.Semwal and M.S.Panwar, "Wave Phenomena and material Science"
5. Berkeley physics course Vol-I (McGraw Hill)
6. R.K.Ghose, " The mathematics of waves and Vibrations" McMillan
7. D.P.Khandelwal, "Oscillations and Waves" Himalaya Publishing
8. I.I.Pain "Physics of Vibration"
9. A. P. French, "Vibrations and Waves" (CBS Pub. & Dist., 1987)
10. B.S. Rajput " Physics for Engineers" Vol II Pragati Prakashan.
11. Satya Prakash; Waves and Oscillations, Pragati Prakashan.

Semester-II

Paper-II: Waves, Acoustics and Electromagnetic Waves 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.

Unit-V: 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.

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.
9. B.B.Laud Electromagnetics (Wiley Eastern limited)
10. Berkely Physics course, Vol II "Electricity and Magnetism" (McGraw Hill).

Practicals: **MM-50**

List of Expts. for B.Sc. Semester-II (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. Melde's Experiment.
8. Lissajous figures.
9. Determination of Ultrasonic velocity.
10. To prove the laws of vibrating strings and determine the frequency of A.C mains.

Semester-III

Paper- I:	**Heat and 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	
Practicals:		**MM-50**

Semester-III

Paper-I: Heat and Thermodynamics MM-60

Unit-I: Basic concepts and 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 and Entropy

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.

Entropy, Mathematical formulation of Second law of thermodynamics, Entropy of an ideal gas, T-S diagram and its applications, Evaluation of Entropy changes in simple cases, Third law of thermodynamics.

Unit-III: Thermodynamic Relations

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.

Unit-IV: Transport of Heat

Modes of heat transfer via Conduction, Convection and Radiation, Fourier's law, One dimensional steady state conduction, Heat conduction through plane. Thermal conductivity and its experimental detection, Newton's law of cooling, Dimensional analysis applied to forced and free convection.

Black body radiation, 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-V: Kinetic Theory of Gases

Kinetic theory of gases, Microscopic description 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.

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)
6. Zemansky and Dittman: Heat and Thermodynamics (The McGraw-Hill)

Semester-III

Paper-II: Geometrical Optics MM-60

Unit-I: Fermat's Principle and refraction

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: Theory of Image formation 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, Monochromatic and Chromatic aberration, Condition of achromatism, Achromatic combination of lenses in contact and separated lenses, Spherical mirrors and Schmidt corrector plates, Theory of dispersion.

Unit-IV: Optical Instruments-I

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)

Practicals: MM-50

List of Expts. for B.Sc. Semester-III (at least eight experiments which cover understanding of theory course)

1. Thermal conductivity of bad conductor.
2. Mechanical equivalent of heat by Searle's method.
3. Thermal conductivity of a good conductor by searle's method.
4. To study the variation of Thermo-emf of a Thermocouple with Different Temperature.
5. Stefan's Law and to determine the Stefan's constant.
6. Platinum resistance thermometer.
7. J-Callendar and Barne's method.
8. Newton's law of cooling - Specific heat of kerocene oil.
9. To determine the Critical temperature and critical pressure of a gas.
10. To measure temperature with the help of Joule's constant volume air thermometer.
11. Nodal slide assembly, Location of cardinal points of lens system.
12. Newton's formula.
13. Dispersive power of prism.

Semester-IV

Paper-I:	**Physical Optics**	**MM-60**
Unit-I:	Interference	
Unit-II:	Diffraction	
Unit-III:	Polarization	
Unit-IV:	Optical Instruments-II	
Paper-II:	**Elementary Solid State Physics and Statistical Physics**	**MM-60**
Unit-I:	Crystal Structure	
Unit II:	Lattice Vibration and thermal Properties of Solids	
Unit-III:	Band theory of Solids	
Unit-IV:	Basic Concepts in Statistical Physics	
Unit-V:	Classical Statistics	

Semester-IV

Paper-I: 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: Optical Instruments-II

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-II: Elementary Solid State Physics and Statistical 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).

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 II: 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-III: 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.

Unit-IV: Basic Concepts in Statistical Physics

Basic postulates of Statistical Physics, Macro and Micro States, 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, Boltzmann entropy relation.

Ensembles, Micro -canonical, Canonical and Grand Canonical ensembles, 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-V: Classical Statistics

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

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)
5. B.B.Laud "Introductions to Statistical Mech."(McMillan)
6. Bhattarjee J.K. "Statistical Physics", (Allied Publishers)
7. F.Reif, "Statistical Physics", (Mc.Graw Hill)
8. Kamal Singh "Elements of Statistical Mechanics", (S.Chand).
9. K.Hung "Statistical Physics"(Chapman and Hall/CRC)
10. J.P. Srivastava: Elements of Solid State Physics (PHI Learning)

Practicals: MM-50

List of Experiments for B.Sc. Semester-IV (at least eight experiments which cover understanding of theory course)

1. Resolving power of a telescope.
2. To determine the Resolving Power of a Prism.
3. Biprism- determination of λ.
4. Newton's ring experiment- Determination of λ.
5. Determination of λ by a transmission grating.
6. Cauchy's formula.
7. Zone-plate experiment study of different orders.
8. Absorption of light.
9. Malus' Law.
10. Specific rotation in cane sugar solution.
11. To determine the thickness of mica-sheet by using Biprism.
12. Random events- Statistical board method.

Semester-V

Paper-I	**Quantum Mechanics and Theory of Special Relativity**	**MM-60**
Unit-I	Origin of Quantum theory and Old Quantum Mechanics	
Unit-II	Operator Formulation of Quantum mechanics	
Unit III	The first law of Quantum Mechanics - Schrödinger equation	
Unit IV	Theory of Special Relativity	
Paper-II	**Network Analysis, Solid State Devices and Basic Electronics**	**MM-60**
Unit-I	Network Theorems	
Unit-II	Power Supplies	
Unit-III	Solid State Devices	
Unit-IV	Amplifiers	

Semester-V

Paper-I: Quantum Mechanics and Theory of Special Relativity MM-60

Unit-I: Origin of Quantum theory and Old Quantum Mechanics

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.

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-II: Operator Formulation 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-III: The first law of Quantum Mechanics – The Schrödinger Equation

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.

Unit-IV: Theory of Special Relativity

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

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)
6. A. Beiser , Perspective of Modern Physics, (Tata McGraw Hill)
7. H.S. Mani and Mehta, Introduction to Modern Physics , (Allied East West Press)
8. David Mc mohan: Quantum Mechanics (McGraw Hill)

Semester-V

Paper –II: Network Analysis, Solid State Devices and Basic Electronics MM-60

Unit–I: Network Theorems

Kirchhoff's Laws, Superposition Theorem, Constant voltage source and constant current source, Conversion of voltage source into current source, Thevenin's Theorem and procedure for finding thevenin equivalent circuit, Norton's Theorem and procedure for finding Norton equivalent circuit, Maximum power transfer theorem, Applications of Network Theorems, Four terminal Network and h-parameters.

Unit-II: Power Supplies

Semiconductor diode: P-N Junction diode, Diode Parameters, Equation of diode current, Diode circuits with DC and AC Voltage sources, Diode as a rectifier: Half and Full wave rectifiers, Bridge rectifiers, Peak inverse voltage, Efficiency, Ripple factor, Filters: Low pass and High pass filters, Band pass and Band stop filters, L and π – filters (Series inductor, Shunt capacitor, LC, CLC filters), Zener diode, its characteristics, Voltage regulation.

Unit-III: Solid State Devices

Special Diodes: Tunneling effect, Tunnel diode, Varactor diode, Point contact diode, V-I characteristic of these diodes, Optoelectronic devices: Light emitting diode, Photodiode, Photo multiplier tube, Bipolar junction transistor, Transistor operation and its Biasing rule, Transistor currents, Transistor circuit configuration (CB, CE, and CC configuration), Transistor characteristics in different configuration, cut-off and saturation points, Active region, Leakage current in transistor and thermal runaway, Relation between transistor current in various configuration, General idea of FETs.

Unit-IV: Amplifiers

Single-stage transistor amplifiers, Common base (CB) amplifier, various gains of a CB amplifier, Common emitter (CE) amplifier, various gains of a CE amplifier, characteristics of a CE amplifier, Common collector (CC) amplifier, various gains of a CC amplifier, characteristic of a CC amplifier, Comparison of a amplifier configurations, Amplifier classification based on biasing condition, Power amplifiers (Class A, Push-Pull amplifier, Class B and Class C), Noise and Distortion in amplifiers, Multistage amplifier, Amplifier coupling, RC- coupled two stage amplifier and its frequency response, Advantage of RC coupling, Transformer coupled two stage amplifiers and its frequency response, Advantage of transformer coupling.

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 Electronice (S.Chand and Co.)
4. J.D. Ryder: Networks, Lines and Fields (Pritice Hall Edition)

Practicals: MM-50

List of Experiments for B.Sc. Semester-V (at least eight experiments which cover the understanding of theory course)

1. To study characteristics of R-C coupled Amplifier.
2. To study the characteristics of integrating and differentiating circuit.
3. To draw the characteristics of P-N junction diode.
4. To draw the characteristics of PNP and NPN junction transistor.
5. Measurements of h-parameters of a transistor.
6. Study of different types of Rectifiers and Filters.
7. Verification of Network theorems.
8. Child Langmuir law.
9. Triode/ Tetrode/ Pentode characteristics and constants.
10. Study of power supply (Ripple factor).
11. Study of Zener diode and regulation (taking different source voltage and loads).
12. Phase measurement using a C.R.O.
13. Study characteristics of T.C. Amplifier and B.W.
14. To study the Characteristics of a Photo-diode.
15. Inverse square law using Photo-Voltaic Cell.

Semester-VI

Paper-I	**Modern Physics**	**MM-60**
Unit-I	Atomic Models	
Unit-II	Optical Spectra and X-rays	
Unit-III	Theory of Lasers	
Unit-IV	Molecular Spectroscopy	
Unit-V	Subatomic Physics	
Paper-II	**Analog and Digital Electronics**	**MM-60**
Unit-I:	Feedback Amplifier	
Unit-II:	Oscillators	
Unit-III:	Number System and Boolean Algebra	
Unit-IV:	Logic Gates	

Semester-VI

Paper-I **Modern 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.

Unit-V Subatomic Physics

Structure of atomic nucleus, nuclear properties (charge, mass, spin, shape), nuclear binding energy, liquid drop model and semi-empirical mass formula.

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.)
6. S.N. Ghosal, Nuclear Physics (S. Chand and Co.)
7. Paul A. Tipler: Modern Physics (W H Freeman and Co.)

Semester-VI

Paper-II: Analog and Digital Electronics **MM-60**

Unit–I: Feedback Amplifiers

Principle of feedback amplifiers, Classification of positive and negative feedback, Advantage of negative feedback, gain stability, Decreased distortion, Increased bandwidth, Forms of negative feedback, Shunt-derived series fed voltage feedback amplifier, Current-series feedback amplifier, Voltage-shunt negative feedback amplifier, Current-shunt negative feedback amplifier, Positive feedback and its advantage.

Unit–II: Oscillators

Classification of oscillators, Frequency of oscillating current, Frequency stability of an oscillator, Essential of a feedback LC oscillator, Tuned base oscillator, Tuned collector oscillator, Hartley oscillator, Colpitt oscillator, Clapp oscillator, Tunel diode oscillator, Crystal oscillator, Phase shift oscillator, Wien Bridge oscillator, Relaxation oscillator, Multivibrators (Astable, monostable and bistable), Schmitt trigger, Saw-tooth generator, Blocking oscillators.

Unit–III: Number System and Boolean Algebra

Number systems, Decimal, Binary, Octal and Hexadecimal number systems, Binary to decimal conversion, Double-Dadd method, Binary operations, Binary addition, Binary subtravtion, Complement of a number (1's complement and 2's complement), Binary divison, Representation of a Binary number as electrical signals, Conversion of Binary to octal, Binary to hexadecimal and vice-versa (Inter-conversion), BCD, GREY, EXCESS-3 codes, Boolean algebra, Features of Boolean algebra, Laws of Boolean algebra, Equivalent switching circuit, Demorgan's theorems and Duals.

Unit–IV: Logic Gates

Positive and Negative logic, Two input OR gate, Diode OR gate and transistor OR gate, Three input OR gate and its truth table, Exclusive OR gates, The AND gate, Diode AND gate and transistor AND gate, The NOT gate, Bubbled gates, The NOR gate, The NAND gate, NAND and NOR as universal gates, The XNOR gate, Adders and subtractors, Half Adders, Full adders, Paralled binary adder, Half subtractor and Full 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. Brophy, Communication Electronics (McGraw-Hill Education)
5. R Boylested , Electronic Devices & Circuit theory (PHI)

Practical: **MM-50**

List of Experiments for B.Sc. Semester-VI (at least six experiments which cover 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 Thomson method.
6. 'e/m' Magnetron method.
7. 'e/m' Helical method
8. Wave shapes and frequency of Multivibrators.
9. Ionization potential of mercury.
10. Band gap energy of semiconductor using a junction diode.
11. Study of logic gates.
12. To study characteristics of R-C coupled Amplifier with and without feedback.