NATIONAL EDUCATION POLICY
(NEP – 2020)

FOUR-YEARS UNDERGRADUATE PROGRAMME
WITH HONOUR/RESEARCH
(Eight Semester Course)

Syllabus for B.Sc. (Physics)

(Effective from the Academic Year 2022-2023)

HEMVATI NANDAN BAHUGUNA GARHWAL UNIVERSITY
Srinagar (Garhwal) 246 174, Uttarakhand

COURSE STRUCTURE WITH CREDIT DISTRIBUTION

B.Sc. (Physics)

Semester - I

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Additional-Multidisciplinary/ Interdisciplinary Physics M.D-I/I.D-I (4 Credits)	SEC Skill of Physics (2 Credits)	Extra-curricular Courses/CC (EC) (2 Credits)	Total Credits
Mechanics and Properties of Matter Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Mechanics Theory – 2 credits Practical – 2 Credits	Basic Electronics (2 Credits)	Understanding and connecting with Environment (2 Credits)	20

Semester - II

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Additional-Multidisciplinary/ Interdisciplinary Physics M.D-I/I.D-I (4 Credits)	SEC Skill of Physics (2 Credits)	Extra-curricular Courses/CC (EC) (2 Credits)	Total Credits
Electricity and Magnetism Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Basic Electromagnetism Theory – 2 credits Practical – 2 Credits	Waves and Oscillations (2 Credits)	Life Skill and Personality Development (2 Credits)	20

Note: Students will opt skill course of Physics either in first year (I & II Semesters) or second year (III & IV Semester)

Student on exit after successfully completing first year (i.e., securing minimum required 40 credits) will be awarded "Undergraduate Certificate" of one year, in related field/discipline/subject.

Semester - III

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Additional-Multidisciplinary/ Interdisciplinary Physics (M.D-I/I.D-I (4 Credits)	SEC Skill of Physics (2 Credits)	Extra-curricular Courses/CC (EC) (2 Credits)	Total Credits
Heat and Thermodynamics Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Thermodynamics Theory – 2 credits Practical – 2 Credits	Basic Electronics (2 Credits)	Indian Knowledge System (IKS)/ (AMSC)* (2 Credits)	20

Semester - IV

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Additional-Multidisciplinary/ Interdisciplinary Physics M.D-I/I.D-I (4 Credits)	SEC Skill of Physics (2 Credits)	Extra-curricular Courses/CC (EC) (2 Credits)	Total Credits
Waves and Optics Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Elementary Optics Theory – 2 credits Practical – 2 Credits	Waves and Oscillations (2 Credits)	Indian Knowledge System (IKS)/ (AMSC)* (2 Credits)	20

Note: Students will opt skill course of Physics either in first year (I & II Semesters) or second year (III & IV Semester)

***Student has to opt either** Indian Knowledge System (IKS) or Additional Multidisciplinary Skill Course (AMSC) in III or IV Semester*

Student on exit after successfully completing two years (i.e., securing minimum required 80 credits) will be awarded "Undergraduate Diploma" of two years, in related field/discipline/subject.

Semester - V

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Vocational course*/ Field Visit/Lab Work/ Entrepreneurship Skills (4 Credits)	Extra-curricular Courses/CC (EC) (2 Credits)	Language - I (2 Credits)	Total Credits
Modern Physics Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Lab Testing of Electronics Components (4 credits)	Culture, Traditions and Moral Values (2 Credits)	Indian, Modern, Regional Language-I (2 Credits)	20

**Evaluation Process: 30% Internal Test + 70% Design and Study of an Electronic Device*
Note: Students will opt vocational course of Physics either in fifth of sixth semester
Note: Student will have the option to study any two languages one each in V & VI Semester.

Semester - VI

Core Physics-I (6 Credits)	Core Subject-II (6 Credits)	Vocational course*/ Field Visit/Lab Work/ Entrepreneurship Skills (4 Credits)	Communication Skills/CC (2 Credits)	Language - II (2 Credits)	Total Credits
Quantum Mechanics Theory – 4 Credits Practical – 2 Credits	Other Subject (6 Credits)	Lab Testing of Electronics Components (4 credits)	Based on soft skill Development (2 Credits)	Indian, Modern, Regional Language-II (2 Credits)	20

**Evaluation Process: 30% Internal Test + 70% Design and Study of an Electronic Device*
Note: Students will opt vocational course of Physics either in fifth of sixth semester
Note: Student will have the option to study any two languages one each in V & VI Semester.
Student on exit after successfully completing three years (i.e., securing minimum required 120 credits along with securing additional 2 credits under SSD course work) will be awarded "Bachelor's Degree" of three year, in related field/discipline/subject.

CORE PHYSICS
(Theory: 4 Credits; Practical: 2 Credits)

ADDITIONAL INTERDISCIPLINARY PHYSICS
(Theory: 2 Credits; Practical: 2 Credits)
[For students with Core Subjects other than Physics]

B.Sc. (Physics) Semester I

Core Physics-I: Mechanics and Properties of Matter	**4 Credits [60 hours]**

Laws of Motion and conservation laws: Frames of reference, Newton's Laws of motion, Work and energy, uniform circular motion, Conservation of energy and momentum. Conservative and non-conservative forces, Motion of rocket, Motion of a particle in a central force field, Kepler's laws of planetary motion, Newton's Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell. Satellite, Basic idea of global positioning system (GPS).
Rotational Motion: Dynamics of a system of particles, Centre of mass, Angular velocity and momentum, Torque, Conservation of angular momentum, Equation of motion, Moment of inertia, theorem of parallel and perpendicular axis, moment of inertia of rod, rectangular lamina, disc, solid sphere, spherical shell, kinetic energy of rotation, rolling along a slope.
Fluids: Surface Tension and surface energy, Excess pressure across surface: application to spherical drops and bubbles, variation of surface tension with temperature - Jaeger's method. Viscosity: Flow of liquid, equation of continuity, energy of fluid, Bernoulli's theorem, Poiseuille's equation and method to determine coefficient of viscosity, Variations of viscosity of a liquid with temperature
Elasticity: Hooke's law, Stress –strain, Elastic potential energy, Elastic moduli: Young's, Bulk and shear modulus of rigidity, Poisson's ratio, relation between elastic constants Work done in stretching and in twisting a wire, Twisting couple on a cylinder, Strain energy in twisted cylinder, Determination of Rigidity modulus by statical and dynamical method (Barton's and Maxwell's needle), Torsional pendulum, Young's modulus by bending of beam, Determination of Y, η and σ and moment of inertia by Searle's method.

Additional Interdisciplinary Physics: Mechanics	**2 Credits [30 Hours]**

Laws of Motion: Frames of reference, system of particle, Centre of Mass.
Momentum and Energy: Conservation of momentum, Work and energy, Conservation of energy , and Motion of rockets.
Rotational Motion: Angular velocity and angular momentum. Torque, Conservation of angular momentum.
Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant).Kepler's Laws (statement only).

Reference Books:

1. Mechanics Berkeley Physics course, vol.1: Charles Kittel et al. 2007, Tata McGraw- Hill
2. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley.
3. Mechanics: Mathur and Hemne, S Chand Publications.
4. Fundamentals of Mechanics: J. C. Upadyaya, Himalyan Publication.
5. Mechanics and General Properties of Matter: P. K. Chakraborty, Books and Allied Pvt. Ltd.
6. Elements of mechanics, Prakash & Agrawal, Pragati Prakashan Meerut.
7. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
8. Mechanics Berkeley Physics course, v.1: Charles Kittle, et. Al. 2007, Tata McGraw-Hill.
9. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
10. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Core Physics-I: Mechanics and Properties of Matter (Practical)	**2 Credits**
Additional Interdisciplinary Physics: Mechanics (Practical)	**2 Credits**

List of Experiments:

1. To determine the Modulus of Rigidity by static method
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of Inertia of an irregular body by Inertia Table
4. To determine the Young's Modulus by Bending of Beam Method.
5. of a Wire by Maxwell's needle.
6. To determine g by Bar Pendulum.
7. To determine the Elastic Constants of a Wire by Searle's method.
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine g by Kater's Pendulum.
10. To study the Motion of a spring and to determine (a) Spring Constant (b) Value of g

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

B.Sc. (Physics) Semester I or III

Skill Course Physics: Basic Electronics	**2 Credits [30 Hours]**

Diode, valve, triode Valve, Tetrode Valve, their characteristics, P-N Junction, Transistors, PNP, and NPN, their characteristics, common emitter, common base, and common base configurations.

Rectifier half wave and Full wave, Filter L-section and π-section, principles of CRO, Principle of operational amplifier.

Boolean algebra, logic Gates, Binary hexadecimal, octal decimal systems, LED, Photodiode. Tunnel diode, Point contact diode, Schotkey diode, SCR.

Reference Books

1. Electricity and electronics – Saxena, Arora and Prakash (Pragrati Prakashan Meerut).
2. Principles of electrical engineering and electronics, v K Metha and Rohit Mehta (S Chand Publication Delhi).

B.Sc. (Physics) Semester II

Core Physics-I: Electricity and Magnetism **4 Credits [60 hours]**

Vector Analysis: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (Statements only)
Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric.
Magnetism: Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.
Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.
Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Additional Interdisciplinary Physics: Basic Electromagnetism **2 Credits [30 Hours]**

Electrostatics:

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, Uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculationof electric field from potential, Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarization, Displacement vector, Gauss's theorem in dielectrics Parallel plate capacitor completely filled with dielectric.

Magnetism:

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin.

Core Physics-I: Electricity and Magnetism (Practical)	**2 Credits**
Additional Interdisciplinary Physics: Basic Electromagnetism (Practical)	**2 Credits**

List of Experiments:

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) Dc current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measuring of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality factor
7. To study parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge
9. To verify the Thevenin and Norton Theorem
10. To verify the Superposition and Maximum Power Transfer Theorem

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

B.Sc. (Physics) Semester II or IV

Skill Course Physics: Waves and Oscillation	**2 Credits [30 Hours]**

HAMONIC OSCILLATION

Solution of equation of harmonic motion, simple pendulum, compound pendulum, motion of a vertically loaded spring, LC circuit, energy in simple harmonic motion, addition of simple harmonic motion, damped vibrations, relaxation time, forced harmonic oscillator, sharpness of resonance.

WAVES

Nature, production, and propagation, equation of progressive wave, forms of wave equation, longitudinal waves, superposition of waves, stationary waves, their characteristics, and their analytical treatment, phenomenon of beats, Fourier analysis, Fourier theorem, evaluation of constants, A_0, A_n and B_n, applications of Fourier analysis, square wave, saw tooth wave, vibration of a stretched strings, velocity, vibrations of a rectangular membrane, velocity, Doppler's shift, ultrasonic waves-definition, production and applications.

Reference Books:

1. A textbook of waves and oscillations, Ashok K Ganguli (S Chand).
2. Oscillations and waves, Satya Prakash (Pragrati Prakashan, Meerut).

B.Sc. (Physics) Semester III

Core Physics-I: Heat and Thermodynamics **4 Credits [60 hours]**

Thermodynamic Description of system and laws of thermodynamics: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law, Reversible & irreversible processes.

Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Clausius Clapeyron Equation, Joules Law, Joule Thomson effect.

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications. Clausius- Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases, mono-atomic and diatomic gases.

Theory of radiation: Black body radiation, Spectral distribution, Concept of energy density, Derivation of Planck's law, Deduction of Wein's distribution law, Rayleigh Jeans law, Stefan Boltzmann law and Wein's displacement law from Plank's law.

Maxwell Boltzmann law- distribution of velocity- Quantum statistics, Phase space, Fermi- Dirac distribution law, electron gas, Bose-Einstein distribution law, photon gas, comparison of three statistics.

Additional Interdisciplinary Physics: Thermodynamics **2 Credits [30 Hours]**

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P & C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes.

Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears &G. L. Salinger. 1988, Narosa
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Core Physics-I: Heat and Thermodynamics (Practical)	**2 Credits**
Additional Interdisciplinary Physics: Thermodynamics (Practical)	**2 Credits**

List of Experiments:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint & H. T. Workshop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal,1985, Vani Publication.

B.Sc. (Physics) Semester I or III

Skill Course Physics: Basic Electronics	**2 Credits [30 Hours]**

Diode, valve, triode Valve, Tetrode Valve, their characteristics, P-N Junction, Transistors, PNP, and NPN, their characteristics, common emitter, common base, and common base configurations.

Rectifier half wave and Full wave, Filter L-section and π-section, principles of CRO, Principle of operational amplifier.

Boolean algebra, logic Gates, Binary hexadecimal, octal decimal systems, LED, Photodiode. Tunnel diode, Point contact diode, Schotkey diode, SCR.

Reference Books

1. Electricity and electronics – Saxena, Arora and Prakash (Pragrati Prakashan Meerut).
2. Principles of electrical engineering and electronics, v K Metha and Rohit Mehta (S Chand Publication Delhi).

B.Sc. (Physics) Semester IV

Core Physics-I: Waves and Optics **4 Credits [60 hours]**

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).
Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses.
Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves, Spherical waves, Wave intensity.
Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations.
Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem, Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings:Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditorium.
Wave Optics: Electromagnetic nature of light, Definition and Properties of wave front, Huygens Principle.
Interference: Interference: Division of amplitude and division of wavefront, Young's Double Slit experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes, Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.
Michelson's Interferometer: (1) Idea of form of fringes (no theory needed), (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, (5) Visibility of fringes.
Diffraction: Fraunhofer diffraction: Single slit; double Slit. Multiple slits & Diffraction grating, Fresnel Diffraction: Half-period zones. Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.
Polarization: Transverse nature of light waves. Plane polarized light – production and analysis, Circular and elliptical polarization.

Additional Interdisciplinary Physics: Elementary Optics **2 Credits [30 Hours]**

Electromagnetic nature of light, Definition and Properties of wave front, Huygens Principle. Aberration in lenses, Eyepieces. Resolving power of Telescope and Microscope.
Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment
Diffraction: Fraunhofer diffraction: Single slit . Diffraction grating. Fresnel Diffraction. Fresnel Diffraction pattern of a straight edge,
Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill.
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, S. ChandPublication.
4. University Physics, F W Sears, M. W. Zemanskyand, H. D. Young.

Core Physics-I: Waves and Optica (Practical)	**2 Credits**
Additional Interdisciplinary Physics: Elementary Optics (Practical)	**2 Credits**

List of Experiments:

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda 2$ – T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster`s focusing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a given Prism using MercuryLight.
8. To determine the value of Cauchy Constants of a material of a prism.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium & (2) Mercury light using planediffraction Grating. To determine the Resolving Power of a Plane Diffraction Grating.
14. To measure the intensity using photosensor and laser in diffraction patterns ofsingle and double slits.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint & H. T. Workshop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

B.Sc. (Physics) Semester II or IV

Skill Course Physics: Waves and Oscillation	**2 Credits [30 Hours]**

HAMONIC OSCILLATION

Solution of equation of harmonic motion, simple pendulum, compound pendulum, motion of a vertically loaded spring, LC circuit, energy in simple harmonic motion, addition of simple harmonic motion, damped vibrations, relaxation time, forced harmonic oscillator, sharpness of resonance.

WAVES

Nature, production, and propagation, equation of progressive wave, forms of wave equation, longitudinal waves, superposition of waves, stationary waves, their characteristics, and their analytical treatment, phenomenon of beats, Fourier analysis, Fourier theorem, evaluation of constants, A_0, A_n and B_n, applications of Fourier analysis, square wave, saw tooth wave, vibration of a stretched strings, velocity, vibrations of a rectangular membrane, velocity, Doppler's shift, ultrasonic waves-definition, production and applications.

Reference Books:

1. A textbook of waves and oscillations, Ashok K Ganguli (S. Chand).
2. Oscillations and waves, Satya Prakash (Pragrati Prakashan, Meerut).

B.Sc. (Physics) Semester V

Core Physics-I: Modern Physics **4 Credits [60 hours]**

Wave–Particle Duality: Planck's quantum theory, photo-electric effect, Compton scattering, pair production, De Broglie hypothesis and matter waves, phase and group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle, energy-time uncertainty.

Atomic Structure: Rutherford and Bohr's models, atomic spectra, Bohr's quantization rule and atomic stability, energy level and spectra, atomic excitation, electron spin, Pauli's exclusion principle, fine structure, spin orbit coupling, L-S and J-J couplings, total angular momentum.

Atoms in Electric and Magnetic Fields: Electron Angular Momentum, Space Quantization, electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stem-Gerlach Experiment, Normal and Anomalous Zeeman Effect, Stark effect, Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Nuclear Properties and Transformation: Size and structure of nucleus, non-existence of electron in the nucleus, atomic weight, binding energy, semi-empirical mass formula, nature of nuclear force. Radioactivity: stability of nucleus, law of radioactive decay, half-life and Mean lifetime, α-Decay, β-decay, energy released, γ-ray emission, fission and fusion, mass deficit and generation of energy, elementary idea of nuclear reactors, thermonuclear reactions.

Reference Books

1. Concepts of Modern Physics. Arthur Beiger, 4th Edition. 2019, Tata McGraw Hill
2. Modern Physics for Scientists and Engineers. John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2nd Edition, 2015, University Science Books, U.S.
3. Six Ideas that Shaped Physics: Particles Behave like Waves. Thomas A. Moore, 3rd Edition, 2016. Tata McGraw Hill
4. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill
5. Modern Physics. R.A. Serway. C.J. Moses, and C.A. Moyer. 3rd Edition, 2012. Cengage Learning
6. Modern Physics. R Murugeshan, Kiruthiga Sivaprasath, 18th Edition, 2016, S. Chand & Company Pvt Ltd.
7. Modern Physics. Kenneth S. Krane, 4th Edition, 2019, Wiley

Core Physics-I: Modern Physics (Practical)	2 Credits

List of Experiments:

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source - Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Reference Books

1. Advanced Practical Physics for students. B.L. Worsnop & H.T. Flint,1971, Asia Publishing House.
2. Advanced level Practical Physics. Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985. Heinemann Educational Publishers
3. A Text Book of Practical Physics. Indu Prakash, Ramakrishna, A.K. Jha, 11th Edition, 2012, Kitab Mahal, New Delhi.

B.Sc. (Physics) Semester V or VI

Vocational Course Physics: Lab Testing of Electronic Component	4 Credits

Identification of various electronic components, understanding galvanometer, voltmeter, ammeter and Multimeter for their use in measurements, resistor, capacitor, and inductors testing and measurements and understanding their fundamentals.

AC and DC voltage and current, testing, measurements and understanding their fundamentals, testing of battery, fuse, and circuit continuity, tube light and heaters, switches and relays, testing of diodes, LED, transistors and ICs and their fundamentals.

Introduction to soldering and desoldering practices, fault finding and repair of electronic instruments, design and demonstration of an electronic circuit.

Reference Books

1. Testing of Electronic Components. E. A. Fernandez, P. J. Sarkar, 2021, Shroff Publishers
2. Principles of Testing Electronic Systems. S. Mourad, Y. Zorian, 2000, John Wiley & Sons, Inc.
3. Mastering Electronics Repair: A Practical Handbook for Beginners and Experts. V T Sreekumar (Author & Publisher)
4. Practical Electronics - A Self-Teaching Guide. R. Morrison 2003, Wiley Self-Teaching Guides
5. Basic Electronics. Mitchel E. Schultz, McGraw Hill, Special Indian Edition

B.Sc. (Physics) Semester VI

Core Physics-I: Quantum Mechanics **4 Credits [60 hours]**

Time Dependent Schrodinger Equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; properties of wave function, interpretation of wave function, probability and probability current densities in three dimensions, physical significance of wave functions, normalization, linearity and superposition principles, eigenvalues and eigenfunctions, position, momentum and energy operators, commutator of position and momentum operators, expectation values of position and momentum, wave function of a free particle.

Time Independent Schrodinger Equation: Hamiltonian, stationary states and energy eigenvalues, expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions, time independent Schrodinger equation and stationary states, wave packets, application to the spread of Gaussian wave-packet for a free particle in one dimension, Fourier transforms and momentum space wavefunction, uncertainty principle: example and applications.

General Discussion of Bound States in an Arbitrary Potential: continuity of wave function, quantization of momentum and energy, boundary condition and emergence of discrete energy levels, application to one-dimensional problem, particle in a box, potential barrier, square well potential, one dimensional harmonic oscillator, energy levels and energy eigenfunctions.

Quantum Theory of Hydrogen-Like Atoms: Time independent Schrodinger equation in spherical polar coordinates, separation of variables for the second order partial differential equation, spherical harmonics, angular momentum operator, radial wavefunctions, orbital angular momentum, quantum numbers and their significance.

Reference Books:

1. Quantum Mechanics, M.C. Jain, Tata McGraw Hills
2. Quantum Physics, H C Verma, 2nd Ed, TBS Publication
3. Quantum Mechanics: Concepts and Applications, Zettili N., 2nd Ed, John Wiley
4. Advanced Quantum Mechanics, Satya Prakash, 5th Ed, Kedarnat-Ramnath Publication
5. Quantum Mechanics, E. Merzbacher, John Wiley and Sons
6. Quantum Mechanics, V. K. Thankappan, Wiley Eastern
7. Quantum Mechanics, Satya Prakash, Pragati Prakashan, Meerut
8. A Textbook of Quantum Mechanics, P.M. Mathews, K.Venkatesan, Tata McGraw Hills
9. Modern Quantum Mechanics, J.J. Sakurai, Addison-Wesley
10. Quantum Mechanics, A. K. Ghatak and S. Lokanathan, 3rd Ed, MacMillan
11. Quantum Mechanics, Bransden and Joachain, Pearson Education publications
12. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed 2005, Pearson Education

Core Physics-I: Quantum Mechanics (Practical)	2 Credits

Problem Solving Software

1. C/C++/Scilab for solving the problems based on Quantum Mechanics

Laboratory Based Experiments

2. Use C/C++/Scilab for solving the problems based on Quantum Mechanics
3. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
4. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
5. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Reference Books

1. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Publications.
2. Numerical Recipes in C: The Art of Scientific Computing, W. H. Press et al., 3rd Edn. 2007, Cambridge University Press.
3. Elementary Numerical Analysis, K. E. Atkinson, 3rd Edn, 2 0 0 7, Wiley India Edition.
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896
5. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
6. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S.Chand and Company, New Delhi, ISBN: 978-8121939706
7. Scilab Image Processing: Lambert M. Surhone, 2010, Betascript Publishing, ISBN: 978-6133459274A
8. Quantum Mechanics, Leonard I. Schiff, 3rd Ed. 2010, Tata McGraw Hill.
9. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

B.Sc. (Physics) Semester V or VI

Vocational Course Physics: Lab Testing of Electronic Components	4 Credits

Identification of various electronic components, understanding galvanometer, voltmeter, ammeter and Multimeter for their use in measurements, resistor, capacitor, and inductors testing and measurements and understanding their fundamentals.

AC and DC voltage and current, testing, measurements and understanding their fundamentals, testing of battery, fuse, and circuit continuity, tube light and heaters, switches and relays, testing of diodes, LED, transistors and ICs and their fundamentals.

Introduction to soldering and desoldering practices, fault finding and repair of electronic instruments, design and demonstration of an electronic circuit.

Reference Books

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2. Principles of Testing Electronic Systems. S. Mourad, Y. Zorian, 2000, John Wiley & Sons, Inc.
3. Mastering Electronics Repair: A Practical Handbook for Beginners and Experts. V.T. Sreekumar (Author & Publisher)
4. Practical Electronics - A Self-Teaching Guide. R Morrison 2003, Wiley Self-Teaching Guides
5. Basic Electronics. Mitchel E. Schultz, McGraw Hill, Special Indian Edition