NATIONAL EDUCATION POLICY
(NEP – 2020)

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

Revised Syllabus for B.Sc. (Physics)

(Effective from the Academic Year 2026-2027)

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

COURSE STRUCTURE WITH CREDIT DISTRIBUTION

B.Sc. (Physics)

First Year – NHEQF Level- 4.5

Course Category	Semester-I				Semester-II			
	Subject/Title	No. of papers	Credits T	Credits P	Subject /Title	No. of papers	Credits T	Credits P
Discipline Specific Core (2 Subjects)	DSC Major – I ***Mechanics and Properties of Matter***	1	3	1	DSC Major – II ***Electricity and Magnetism***	1	3	1
	DSC Minor – II	1	3	1	DSC Minor – II	1	3	1
M.D/I.D Minor - 1 Subject	#M.D/I.D (M) – I ***Physics of the Earth and Atmosphere*** *(Earth Structure and Dynamics)*	1	4	-	#M.D/I.D (M) – II ***Physics of the Earth And atmosphere*** *(Foundations of Atmospheric Science)*	1	4	-
MD/ID General	M.D/I.D (G) – I	1	3	-	M.D/I.D (G) – II	1	3	-
SEC/AEC	AEC - Communication Skills Or AMSC	1	3	-	AMSC Or AEC - Communication Skills	1	3	-
VAC	Understanding and connecting with environment Or Life Skills & personality development	1	2	-	Life Skills & personalit development Or Understanding and connecting with environment	1	2	-
Total		6	18	2		6	18	2

NHEQF Level 4.5	***Student on exit after successfully completing the first year (i.e., securing minimum required 40 credits + 4 Credits in*** **one vocational course/skills-enhancement course of 4 credits*) will be awarded "Undergraduate Certificate" of one year, in the related field/discipline/subject***
# Students are not allowed to choose or repeat courses already undergone at the higher secondary level (12th class) in the proposed I.D/M.D (Minor) category.	
The student may opt for Communication Skills in one semester, and any one course from the Additional Multidisciplinary Skill Course (SEC--AMSC) in the other semester.	
AMSC: *Additional Multidisciplinary Skill Course (is offered as SEC)* *The following courses are offered under AMSC, University may add new courses under AMSC in future:* *1. Plant Nursery Development and Management* *2. Basic Yoga Practices* *3. Physical Education and Sports Management* *4. Regional Folklores and their Cultural Context* *5. Indian Traditional Music* *6. Tour and Travel Operations*	
Communication Skills (AEC): *'Communication Skills' course will be offered in Hindi, English, and Sanskrit languages. Students may opt any one language for studying the course*	
Life Skill & Personality Development (VAC) ***Understanding and Connecting with Environment (VAC)***	

Second Year – NHEQF Level- 4.5

Course Category	Semester-III				Semester-IV			
	Subject/Title	No. of papers	Credits T	Credits P	Subject /Title	No. of papers	Credits T	Credits P
Major-I (One Subject)	DSC Major – III *Thermal Physics*	1	4	1	DSC Major – V *Waves and Acoustic*	1	4	1
Minor -I (One Subject)	DSC Minor – III Thermodynamics	1	3	1	DSC Minor – IV *Waves and Oscillatory Motions*	1	3	1
SEC	SEC Major – IV Foundations of Digital Systems	1	3	-	SEC Major – VI Fundamentals of Computers	1	3	-
MD/ID (Minor)	#M.D/I.D (M) - III *Physics of the Earth and Atmosphere* (Remote Sensing Basics)	1	4	-	#M.D/I.D (M) – IV *Physics of the Earth And atmosphere* (Renewal Energy and Sustainability)	1	4	-
AEC (Language based courses)	Indian, Modern, Regional Language-I	1	2	-	Indian, Modern, Regional Language-II	1	2	-
VAC/AEC	AEC-Indian Knowledge System Or VAC-Culture, traditions and moral values	1	2	-	AEC-Indian Knowledge System Or VAC-Culture, traditions and moral values	1	2	-
Total		6	18	2		6	18	2

NHEQF Level 5	***Student on exit after successfully completing the Second year (i.e., securing a minimum required 80 credits + 4 Credits in*** **one vocational course/skills-enhancement course of 4 credits*) will be awarded a "Undergraduate Diploma" of two years, in a related field/discipline/subject.***

 # Students are not allowed to choose or repeat courses already undergone at the higher secondary level (12th class) in the proposed I.D/M.D (Minor) category.

IKS- Indian Knowledge System- AEC

Culture, Traditions and Moral Values- VAC

Students are required to study both courses — *Indian Knowledge System (IKS)* and *Culture, traditions and moral values* — during the 3rd and 4th semesters. However, they will have the flexibility to study one course in each semester.

IMR Language- 'Indian, Modern, Regional Language'- Hindi, Sanskrit and English (Students have to study 2 different languages in the second year, with one language in one semester and the other language in another semester). One additional course titled "Heritage of Indian Languages" shall be offered, which students may opt for in lieu of any one prescribed language course, subject to the applicable regulations of the programme.

The department may offer a 3-credit SEC Major course as either a fully theory-based or a fully practical-based module.

Note: Student will continue with the same discipline-specific major & Minor in the second year (III & IV Semester) as studied in the first year (I & II semester) of the FYUP.

B.Sc. (Physics) Semester I

DSC Major/Minor – I: Mechanics and Properties of Matter

Credits – 03

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, Centre of mass, system of variable mass, escape velocity, motion of the rocket, Newton's Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell, solid sphere and circular disc, Kaplar's laws for planetary motion.

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 axes, moment of inertia of rod, rectangular lamina, disc, solid sphere, spherical shell, kinetic energy of rotation, rolling along a slope.

Elasticity: Hooke's law, Elastic potential energy, Young's modulus, Bulk modulus, modulus of rigidity, Poisson's ratio, relation between elastic constants, Torsion of cylinder, bending of beam, cantilever, shape of Girders.

Fluid Mechanics: Surface Tension and surface energy, Excess pressure inside a curved surface, Rise of liquid in a capillary tube, Flow of liquid, equation of continuity, Bernoulli's theorem, viscosity, Flow of liquid through a capillary, Poiseuille's formula, Capillaries in series and parallel, Stokes' law.

Reference Books:

1. Fundamentals of Physics: R. Resnick, D. Halliday & J. Walker, Wiley.
2. Mechanics: D.S. Mathur and P.S. Hemne, S. Chand Publications.
3. Fundamentals of Mechanics: J. C. Upadhyaya, Himalayan Publication.
4. Mechanics and General Properties of Matter: P. K. Chakraborty, Books and Allied Pvt. Ltd.
5. Elements of mechanics: Prakash & Agrawal, Pragati Prakashan. Meerut.
6. University Physics: F.W. Sears, M.W. Zemanski, H.D. Young, Addison-Wesley
7. Mechanics: Berkeley Physics course, V.1 – C. Kittle et al., Tata McGraw-Hill.
8. University Physics: Ronald Lane Reese, Thomson Brooks/Cole.

B.Sc. (Physics) Semester I

DSC Major/Minor – I: Mechanics and Properties of Matter (Practical)

Credits – 01

List of Experiments:

1. To determine the Moment of Inertia of a Flywheel.
2. To determine the Moment of Inertia of an irregular body by the Inertia Table
3. To determine the Young's Modulus by the Bending of a beam method.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the Modulus of Rigidity by the static method
6. To determine g by the 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 the Optical Lever Method.
9. To determine g by Kater's Pendulum.
10. To study the Motion of a Spring and to determine (a) the Spring Constant, (b) the 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 Practical Physics, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

B.Sc. (Physics) Semester I

MD/ID (M) – I: Physics of the Earth and Atmosphere

(*Earth Structure and Dynamics*)

Credits – 04

Earth's Structure & Internal Processes: Earth's size, mass, density distribution, Seismic waves (P & S waves, surface waves), interior layering (crust, mantle, core), Heat flow, geothermal gradient, sources of internal heat (radioactivity, residual heat), Mantle convection and plate tectonics (mechanisms and surface expressions).

Solid Mechanics & Surface Dynamics: Elastic and inelastic rock properties, stress, strain, rheology, Faulting, earthquakes, deformation processes (creep, fracture), Hydrological flow, groundwater movement, Darcy's law, stream and sediment dynamics, glacier motion, erosion, waves, tides.

Gravity & Geodesy: Earth's gravity field, geoid, gravity anomalies, isostasy, Gravimetric methods for structural mapping and resource detection, Geodetic measurements, Earth shape, plate motions, precise surveying techniques.

Geomagnetism, Electromagnetics & Geophysical Methods: Earth's magnetic field, geodynamo, secular variation, palaeomagnetism, Electromagnetic surveying, resistivity, magnetotellurics for subsurface imaging, Seismoelectrics, telluric currents, and EM field theory in geophysics.

Reference Books:

1. Frank D. Stacey & Subir K. Banerjee, *Physics of the Earth*
2. C.M.R. Fowler, *The Solid Earth: An Introduction to Global Geophysics*
3. Donald L. Turcotte & Gerald Schubert, *Geodynamics*
4. Harsh Gupta (ed.), *Encyclopaedia of Solid Earth Geophysics*
5. Seth Stein & Michael Wysession, *An Introduction to Seismology, Earthquakes and Earth Structure*

B.Sc. (Physics) Semester II

DSC Major/Minor – II: Electricity and Magnetism

Credits – 03

Vector Calculus and Electrostatics: Vector differential operators: Gradient, Divergence, and Curl, Gauss's theorem (statement and applications), Electric field due to point charge, infinite line charge, uniformly charged spherical shell and solid sphere, Electric potential, line integral of electric field, potential due to point charge, dipole, and spherical charge distributions, Calculation of electric field from Potential, Parallel plate capacitor and spherical capacitor, energy stored in the electrostatic field, Dielectrics, Concept of polarization, displacement vector, Gauss's law in dielectrics, and capacitor with dielectric.

Magnetostatics and Magnetic Properties: Biot–Savart law and its applications, Magnetic field due to straight wire, circular loop, and solenoid, Ampère's circuital law (integral form) and applications, Magnetic vector potential; divergence and curl of magnetic field (B), Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, introduction to diamagnetic, paramagnetic, and ferromagnetic materials.

Electromagnetic Induction and Maxwell's Equations: Faraday's laws of electromagnetic induction, Lenz's law, Self and mutual inductance, energy stored in magnetic field, Equation of continuity, displacement current, and modified Ampère's law, Maxwell's equations (differential form) in vacuum and isotropic dielectrics, Electromagnetic wave equation; plane wave solutions, Poynting vector, energy density in EM field, and transverse nature of electromagnetic waves.

Reference Books:

1. Electricity and Magnetism: Edward M. Purcell, McGraw-Hill Education
2. Electricity and Magnetism: J.H. Fewkes & J. Yarwood. Vol. I, Oxford Univ. Press
3. Electricity and Magnetism: D C Tayal, Himalaya Publishing House
4. University Physics: Ronald Lane Reese, Thomson Brooks/Cole
5. Fundamentals of Physics: D. Halliday, R. Resnick, & J. Walker, Wiley.
6. Introduction to Electrodynamics: D.J. Griffiths, Benjamin

B.Sc. (Physics) Semester II

DSC Major/Minor – II: Electricity and Magnetism (Practical)

Credits – 01

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 charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine high resistance by the Leakage Method
   (iv) To determine the 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 a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a low resistance using Carey Foster's Bridge
9. To verify the Thevenin and Norton Theorems
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 Practical Physics, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

B.Sc. (Physics) Semester II

MD/ID (M) – II: Physics of the Earth and Atmosphere

(*Foundations of Atmospheric Science*)

Credits – 04

Composition, Structure & Energy Balance: Troposphere, stratosphere, mesosphere, thermosphere, exosphere gas composition, trace gases, aerosols**,** Solar insolation, Earth's radiation budget, albedo, Greenhouse effect and lapse rates (~6.5 °C/km), Diurnal/seasonal cycles, humidity, dew point, measurement methods.

Atmospheric Dynamics & Weather Systems: Pressure gradients, geostrophic/gradient/inertial winds, Coriolis force, Air mass classification, frontal boundaries, mid-latitude cyclones, Interpreting surface and upper-air charts, Doppler radar insights, Cloud formation, stability, microphysics (collision/coalescence).

Severe & Tropical Weather: Atmospheric instability, convective storms, radar signals, severe weather dynamics, Formation, structure, tracking, and naming of systems, Primary pollutants, chemical reactions, smog, and acid rain.

Climate Systems & Atmospheric Chemistry: Köppen classes, global wind patterns, ENSO, CO_2, CH_4, N_2O, CFCs; radiative forcing, historical climate change, Ozone, photochemical reactions, aerosol chemistry, Rayleigh/Mie scattering, rainbows, halos (brief overview).

Reference Books:

1. Wallace & Hobbs, *Atmospheric Science: An Introductory Survey*
2. Seinfeld & Pandis, *Atmospheric Chemistry and Physics*
3. K. Mohanakumar, *Stratosphere–Troposphere Interactions* (Springer)
4. Roger G. Barry & Richard J. Chorley, *Atmosphere, Weather and Climate*
5. John A. Curry & Peter J. Webster, *Thermodynamics of Atmospheres and Oceans*

B.Sc. (Physics) Semester III

DSC Major – III: Thermal Physics

Credits – 04

Laws of Radiation and Fundamentals of Thermodynamics: Black body radiation, Spectral distribution, Concept of energy density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan-Boltzmann law and Wien's displacement law from Planck's law, Einstein's contribution to the understanding of Black Body radiation, Thermodynamic systems and variables, Zeroth Law of thermodynamics and temperature, First Law and internal energy, Conversion of heat into work, Various Thermodynamic Processes, Applications of First Law, Reversible and irreversible processes, quasi-static processes.

Second Law and the Concept of Entropy: Limitations of the first law, Heat engine and refrigerator, Carnot's cycle and Carnot theorem, Kelvin-Planck and Clausius statements, Concept of entropy, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Clausius inequality and principle of increase of entropy, Third law of thermodynamics, Entropy at absolute zero and unattainability of zero Kelvin

Thermodynamic Potentials and Applications: Thermodynamic Potentials, Enthalpy, Helmholtz and Gibbs free Energies, Maxwell's relations and their applications, Joule-Thomson effect and inversion temperature, Inversion temperature, Linde and Claude systems for air liquefaction, Liquefaction of helium, hydrogen, nitrogen gases, Cryocoolers and refrigeration cycles, Phase transitions and Clausius-Clapeyron equation, Triple point, Real gas: Van der Waals equation and critical constants, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.

Kinetic Theory of Gases: Basic assumptions of kinetic theory of gases, Derivation of pressure of an ideal gas, Maxwell's law of distribution of velocities and its experimental verification, Concepts of mean, r.m.s and most probable velocity, Mean free path (Zeroth Order), Transport Phenomena (Viscosity, thermal conduction and diffusion), Law of equipartition of energy (Qualitative discussion only, no derivation) and its applications to specific heat of gases for mono-atomic and diatomic gases.

Suggested Readings:

1. Statistical and Thermal Physics, S. Lokanathan & R.S. Gambhir, Prentice-Hall.
2. A Treatise on Heat, M.N. Saha & B.N. Srivastava, The Indian Press.
3. Heat and Thermodynamics, M. Zemansky and R. Dittman, McGraw-Hill
4. Thermodynamics, S.C. Gupta, V. Kumar & H.V. Sharma, Pragati Prakashan.
5. Thermal Physics, S.C. Garg, R.M. Bansal, and C.K. Ghosh, McGraw-Hill.
6. Heat and Thermodynamics, S.L. Kakani & C. Hemrajani, Himalaya Publishing House
7. Thermodynamics, S.K. Gupta, S. Chand Publ.
8. Heat Thermodynamics and Statistical Physics, Brij Lal, N. Subrahmanyam, and P.S. Hemne, S Chand

B.Sc. (Physics) Semester III

DSC Minor – III: Thermodynamics

Credits – 03

Fundamentals of Thermodynamics: Thermodynamic systems, variables, and equations of state, Zeroth law of thermodynamics and temperature scales, First law: internal energy, work, and heat, Thermodynamic processes (isothermal, adiabatic, cyclic).

Second Law and Entropy: Heat engines and refrigerators, Carnot cycle and efficiency limits, Statements of the second law (Kelvin–Planck, Clausius), Entropy: concept, changes in reversible and irreversible processes.

Third Law & Thermodynamic Potentials: Statement and implications of the third law, Absolute zero and entropy behaviour at low temperatures, Thermodynamic potentials: internal energy, enthalpy, Helmholtz, Gibbs free energy, Maxwell's relations and applications in phase transitions, Triple point.

Suggested Readings:

1. Heat and Thermodynamics, M. Zemansky and R. Dittman, McGraw-Hill
2. Thermal Physics, S.C. Garg, R.M. Bansal, and C.K. Ghosh, McGraw-Hill.
3. Heat and Thermodynamics, S.L. Kakani & C. Hemrajani, Himalaya Publishing House
4. Thermodynamics, S.K. Gupta, S. Chand Publ.
5. Heat Thermodynamics and Statistical Physics, Brij Lal, N. Subrahmanyam, and P.S. Hemne, S Chand

B.Sc. (Physics) Semester III

DSC Major – III: Thermal Physics (Practical)

DSC Minor – III: Thermodynamics (Practical)

Credits – 01

List of Experiments:

1. To determine the 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 coefficient of resistance using a platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyse the cooling temperature of a hot object as a function of time using a thermocouple and a suitable data acquisition system
10. To calibrate the Resistance Temperature Device (RTD) using the Null Method/Off-Balance Bridge Reference

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Practical Physics, Michael Nelson and Jon M. Ogborn, 4 th 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 III

SEC Major – IV: Foundations of Digital Systems

Credits – 03

Basics of Digital Systems: Analog vs. digital signals; Number systems: binary, octal, decimal, hexadecimal; Binary arithmetic and codes (BCD, Gray, ASCII, Excess-3); Boolean algebra and simplification of logic expressions.

Logic Gates and Combinational Circuits: Basic logic gates: AND, OR, NOT, NAND, NOR, XOR, XNOR; Truth tables and logic implementation; Combinational circuits: adders, subtractors, multiplexers, demultiplexers; Encoders, decoders, and comparators.

Sequential Circuits and Applications, Flip-flops: SR, JK, D, T types; Counters (synchronous, asynchronous) and registers; Clock signals, timing diagrams, and memory elements; Applications in microprocessors, digital communication, and embedded systems.

Suggested Readings:

1. Fundamentals of Digital Circuits, A. Anand Kumar, Prentice Hall India.
2. Modern Digital Electronics, R.P. Jain & Kishor Sarawadekar, McGraw Hill
3. Digital Electronics, A.K. Tripathi, MECHASOFT PUBLISHERS
4. Digital Logic and Computer Design, M. Morris Mano, Pearson Education
5. Digital Fundamentals, Thomas L. Floyd, Pearson

B.Sc. (Physics) Semester III

MD/ID (M) – III: Physics of the Earth and Atmosphere

(*Remote Sensing Basics*)

Credits – 04

Introduction to Remote Sensing: Definition and scope of remote sensing, Electromagnetic spectrum and energy interaction with Earth surface; Active and passive types of remote sensing, Remote sensing platforms - ground-based, aerial, satellite, Concept of resolution - spatial, spectral, temporal, radiometric

Sensors and Satellite Systems: Overview of satellite sensors - LISS, PAN, AWiFS, MODIS, Landsat, Indian Remote Sensing satellites - IRS, Cartosat, Resourcesat, Satellite orbits - geostationary and sun-synchronous, Data acquisition and preprocessing basics, Introduction to aerial photography

Image Interpretation and GIS Basics: Visual and digital image interpretation, Elements of image interpretation - tone, texture, pattern, shape, Basics of image classification - supervised and unsupervised, Introduction to Geographic Information System (GIS), Integration of remote sensing with GIS

Applications of Remote Sensing: Land use and land cover mapping, Agricultural monitoring and drought assessment, Forest cover and biodiversity mapping, Water resource management and flood mapping, Urban planning and disaster management

Suggested Readings:

1. Remote Sensing and Image Interpretation, T.M. Lillesand, R.W. Kiefer & J.W. Chipman, Wiley
2. NRSC/ISRO training modules and manuals, NRSC/ISRO websites
3. Introductory Digital Image Processing, J.R. Jensen, Pearson
4. Remote Sensing: Principles and Interpretation, Sabins F. Floyed, Waveland Pr Inc
5. Remote Sensing and Geographical Information Systems, M. Anji Reddy, BS Publications

B.Sc. (Physics) Semester IV

DSC Major – V: Waves and Acoustics

Credits – 04

Oscillations and Superpositions: Simple harmonic motion (SHM), Differential equation of Simple harmonic motion and its solutions and characteristics, Kinetic and Potential Energy, linearity and superposition principle, rotating vector (phasor) representation of SHM, motion of simple and compound pendulum, loaded spring, Superposition of collinear harmonic oscillations with equal phase difference and with equal frequency differences, Concept of Beats, Superposition of perpendicular harmonic oscillations: Graphical and Analytical Methods, Lissajous Figures for equal and unequal frequencies, effect of phase variation.

Vibrations and Resonance: Free, damped, and forced vibrations, Differential equation of damped harmonic oscillator, steady state solution, resonance, quality factor and sharpness of resonance, Power dissipation, Coupled oscillators and normal modes, Energy transfer in coupled systems, normal mode representation of di-atomic molecules, general solution as a linear combination of normal modes.

Wave Motion: Concept of wave, transverse and longitudinal waves, Wavelength, frequency, amplitude, phase, and velocity of waves, One-dimensional wave equation and its general solution, Harmonic waves and the superposition principle, Concept of standing wave, travelling and standing waves on a stretched string, Normal Modes of a string, Group velocity and phase velocity, Plane and Spherical waves, Wave intensity, Reflection and transmission of waves at boundaries

Sound Waves and Acoustics: Production and propagation of sound waves, Intensity, loudness, and decibel scale, Doppler effect in sound, Acoustic impedance and reflection of sound, Reverberation, absorption coefficient, and Sabine's formula, Interference of waves: conditions and applications, Beats and Lissajous figures, Diffraction and Huygens-Fresnel principle (qualitative), Polarisation of transverse waves, Analogy between mechanical and electromagnetic waves, Introduction to Fourier analysis of periodic waveforms.

Suggested Readings:

1. Waves and Oscillations, N. Subrahmanyam & Brij Lal, Vikas Publishing House Pvt Ltd
2. Oscillations and Waves, Suresh Garg, C.K. Ghosh & Sanjay Gupta, PHI Learning.
3. Vibrations and Waves, A.P. French, CBSPD - NEW DELHI
4. Waves and Oscillations, J.C. Upadhyaya, Himalaya Publishing House
5. Waves and Oscillations, D.C. Tayal & Praveen Tayal, Book Land DU
6. The Physics of Vibrations and Waves, H.J. Pain, John Wiley & Sons, Inc.
7. The Physics of Waves and Oscillations, N.K. Bajaj, McGraw-Hill Education
8. The Science of Sound, Thomas Rossing, Richard Moore & Paul Wheeler, Pearson
9. Waves, Oscillations and Acoustics, S.L. Kakani, CBS Publishers.
10. Acoustics: An Introduction to Its Physical Principles and Applications, Allan D. Pierce, Springer Nature.

B.Sc. (Physics) Semester IV

DSC Minor – IV: Wave and Oscillatory Motions

Credits – 03

Fundamentals of Waves: Transverse and longitudinal waves, wavelength, frequency, amplitude, phase, velocity, one-dimensional wave equation and its general solution, travelling and standing waves on a string, Normal modes of vibration, group velocity and phase velocity, plane and spherical waves, wave intensity; reflection and transmission of waves at boundaries

Oscillations: Simple harmonic motion, differential equation, solutions, and characteristics of SHM, kinetic and potential energy, energy conservation, linearity and superposition principle, motion of simple pendulum, compound pendulum, and loaded spring systems, beats and superposition of harmonic oscillations, rotating vector representation of SHM

Vibrations and Resonance: Free, damped, and forced vibrations, differential equation of damped harmonic oscillator, steady-state solution, resonance, quality factor and sharpness of resonance; power dissipation in oscillatory systems, coupled oscillators and normal modes (introductory treatment), Energy transfer in coupled systems

Suggested Readings:

1. Waves and Oscillations, N. Subrahmanyam & Brij Lal, Vikas Publishing House Pvt Ltd
2. Vibrations and Waves, A.P. French, CBSPD - NEW DELHI
3. The Physics of Vibrations and Waves, H.J. Pain, John Wiley & Sons, Inc.
4. Waves and Oscillations, D.C. Tayal & Praveen Tayal, Book Land DU
5. The Physics of Waves and Oscillations, N.K. Bajaj, McGraw-Hill Education

B.Sc. (Physics) Semester IV

DSC Major – V: Waves and Acoustics (Practical)

DSC Minor – IV: Waves and Oscillatory Motion (Practical)

Credits – 01

List of Experiments:

1. To determine the coefficient of damping, relaxation time and quality factor of a damped simple harmonic motion using a simple pendulum.
2. To investigate the motion of coupled oscillators
3. Study of conservation of momentum in two-dimensional oscillations.
4. Study of the damping of a bar pendulum under various conditions.
5. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify the λ^2 – T Law.
6. To determine the frequency of an electrically maintained tuning fork or an A.C. mains supply using a sonometer.
7. To study the coupling of two simple pendulums and determine the coupling coefficient and frequency of oscillations.
8. Study the oscillation of a spring-mass system to find the spring constant (k) and mass of the spring.
9. Measure the wavelength of sound in a liquid medium.
10. To study Lissajous Figures

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Practical Physics, Michael Nelson and Jon M. Ogborn, 4 th 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 IV

SEC Major – VI: Fundamentals of Computers

Credits – 03

Introduction to Computers: Evolution and history of computers; Classification: analog, digital, hybrid, micro, mini, mainframe, supercomputers; Basic organisation: input, output, storage, processing, CPU; Number systems.

Hardware, Software & Operating Systems: Hardware components: motherboard, processor, memory, storage devices, I/O devices; Software types: system software, application software, utility programs; Operating systems: functions, types (batch, time-sharing, real-time, distributed), File management and user interfaces.

Data, Networking & Applications: Data representation: characters, codes, multimedia data; Basics of computer networks: LAN, WAN, Internet, protocols; Applications: word processing, spreadsheets, databases, multimedia, e-governance; Emerging trends: cloud computing, cybersecurity, AI basics.

Suggested Readings:

1. Fundamentals of Computers, V. Rajaraman & N. Adabala, Prentice Hall India
2. Computer Fundamentals, P.K. Sinha, Priti Sinha, BPB Publications
3. Introduction to Computers, P. Norton, McGraw-Hill
4. Computer Fundamentals, Anita Goel, Pearson Education India
5. Computer Networking: A Top-Down Approach, J. Kurose & K. Ross, Pearson

B.Sc. (Physics) Semester IV

MD/ID (M) – IV: Physics of the Earth and Atmosphere

(*Renewal Energy and Sustainability*)

Credits – 04

Energy Fundamentals: Global and Indian energy demand and supply scenario, Limitations of conventional energy sources (coal, oil, natural gas), Need for non-conventional/renewable energy sources, Energy units, conversions, and efficiency, Overview of India's renewable energy policies and initiatives (MNRE, National Solar Mission, Wind Atlas, etc.)

Solar Energy: Solar radiation: measurement and estimation, Solar thermal systems: water heating, cooking, drying, power generation, Solar photovoltaic (PV) systems: principles, materials, efficiency, applications, Grid-connected and off-grid solar systems, Case studies of solar energy projects in India

Wind, Biomass, and Other Sources: Wind energy: principles, wind turbines, site selection, Indian wind farms, Biomass energy: biogas, gasifiers, biofuels, rural applications, Small hydro power: principles, Indian potential and projects, Geothermal energy: resources, technologies, Indian prospects, Ocean energy: tidal, wave, and OTEC (overview)

Energy Storage, Integration, and Sustainability: Energy storage technologies: batteries, supercapacitors, hydrogen storage, Hybrid renewable systems (solar-wind, solar-biomass), Smart grids and integration of renewables, Environmental impacts and sustainability assessment, Future prospects of non-conventional energy in India

Suggested Readings

1. Non-Conventional Energy Sources, G.D. Rai, Sterling Book Centre
2. Principles of Solar Engineering, D.Y. Goswami, CRC Press
3. MNRE (Govt. of India) – Reports and Policy Documents. MNRE Website
4. Solar Energy: Principles of Thermal Collection and Storage, S.P.Sukhatme, McGraw-Hill Inc.
5. Solar Photovoltaics: Fundamentals, Technologies and Applications, C.S. Solanki, PHI Learning