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 2025-2026)

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	DSC Subject – I *Mechanics and Properties of Matter*	1	2	2	DSC Subject – I *Electricity and Magnetism*	1	2	2
	DSC Subject – II	1	2	2	DSC Subject – II	1	2	2
M.D/I.D Subject - I	#M.D/I.D – I *Physics of the Earth and Atmosphere (Earth Structure and Dynamics)*	1	4	-	#M.D/I.D – II *Physics of the Earth And atmosphere (Foundations of Atmospheric Science)*	1	4	-
MD/ID Subject - II	M.D/I.D – I		2	2	M.D/I.D – II		2	2
SEC/AEC	*Field work/SEC (*Basic Electronics*)/ Communication Skills	1	2	-	*AMSC/Field Work/SEC *(Testing of Electric and Electronic Components)***	1	--	2
VAC	Understanding and connecting with environment	1	2	--	Life Skills & personality development	1	2	-
Total		6	14	6		6	12	8

 # 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 any one course from Field Work/Skill Enhancement Course (SEC)/ Communication Skills in one semester, and any one course from Additional Multidisciplinary Skill Course (AMSC)/ Field Work/ Skill Enhancement Course (SEC) in the other semester.***

****Evaluation Process for "Testing of Electric and Electronic Components": 30% Internal Test + 70% Design and Study of an Electric or Electronic Device**

NHEQF Level 4.5	***Student on exit after successfully completing 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 related field/discipline/subject***

- ***Field Work:*** *In addition to providing students with practical, experience-based learning, field work aims to expose them to real-world socio-economic and societal challenges, allowing them to bridge the gap between theory and practice and develop effective solutions to real-life problems.*
- ***AMSC:*** *Additional Multidisciplinary Skill Course (is offered as SEC)*
- *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)***

B.Sc. (Physics) Semester I

DSC-I: Mechanics and Properties of Matter
Credits - 02

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 axis, 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-I: Mechanics and Properties of Matter (Practical)

Credits - 02

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 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 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 Physics Practical's, 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-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, paleomagnetism, 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.), *Encyclopedia of Solid Earth Geophysics*
5. Seth Stein & Michael Wysession, *An Introduction to Seismology, Earthquakes and Earth Structure*

B.Sc. (Physics) Semester I

SEC: Basic Electronics
Credits: 2

Vacuum Tubes: Diode, Triode, Tetrode, Pentode, and their characteristics; Conductors, insulators, and semiconductors, Intrinsic and Extrinsic Semiconductors, n-type and p-type semiconductors, Active and passive devices, Nodal and loop circuits, Thevenin theorem, Norton Theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer Theorem, Principles of CRO.

Formation and characteristics of p-n junction diode, Diffusion of charge carriers and formation of the depletion region, Breakdown voltage, Zener diode, Schottky diode, Tunnel diode, Varactor diode, Light emitting diode, Half-wave and full-wave rectifiers, L-section, T-section, and π-section filters, Regulated power supply.

Bipolar junction transistor, p-n-p and n-p-n transistors, emitter, base, and collector regions, Input and output characteristics in common base and common emitter configurations, JFET, depletion-type and enhanced-type MOSFETs, Characteristics of SCR, DIAC, TRIAC, and UJT.

Reference Books:

1. Electronic Principles: A.P. Malvino, D.J. Bates, P.E. Hoppe, McGraw-Hill
2. Electricity and electronics: Saxena, Arora, and Prakash, Pragati Prakashan Meerut
3. Electronics Devices and Circuit Theory: R.L. Boylestad and L. Nashelsky, Pearson Education India
4. Principles of electrical engineering and electronics: V K Metha and Rohit Mehta, S. Chand Publication, Delhi
5. A Textbook of Basic Electronics: J.B. Gupta, Rajeev Manglik, Rohit Manglik, S.K. Kataria & Sons

B.Sc. (Physics) Semester II

DSC-I: Electricity and Magnetism

Credits - 02

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-I: Electricity and Magnetism (Practical)

Credits – 02

List of Experiments

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, and (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 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

MD/ID-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, 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 II

SEC: Testing of Electric and Electronic Components
Credits: 2

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.