Cooch Behar Panchanan Barma University

Syllabus for Physics

UNDER NEP 2020

Cooch Behar Panchanan Barma University

Cooch Behar, West Bengal

Preamble

University Grants Commission (UGC) introduced, in 2018, a major reform in the higher education sector in India. Accordingly, Learning Outcomes-based Curriculum Framework (LOCF) took the centre-stage to make the curriculum student-centric, interactive and outcome-oriented with well-defined aims and objectives. The Physics Undergraduate Board of Studies of Cooch Behar Panchanan Barma University took the initiative to implement the reforms and frame the syllabus so as to increase the spirit of enquiry, analytical ability and comprehension skills among the students.

Credit Scheme

1^{st} SEM	Cr
Major-1	6
Minor-1	6
MDC-1	3
SEC-1	3
AEC-1	4
	22

2^{nd} SEM	Cr
Major-2	6
Minor-2	6
VAC-1	3
SEC-2	3
INTRN	4
	22

CERTIFICATE	44

3^{rd} SEM	Cr
Major-3	6
Major-4	6
Minor-3	6
SEC-3	3
MDC-2	3
	24

4^{th} SEM	Cr
Major-5	6
Major-6	6
Minor-4	6
AEC-2	4
	22

DIPLOMA	90

5^{th} SEM	Cr
Major-7	6
Major-8	6
Major-9	6
MDC-3	3
	21

6^{th} SEM	Cr
Major-10	6
Major-11	6
Major-12	6
VAC-2	3
	21

DEGREE	132

Paper	Distribution of marks		
	Theory	Lab	Internal
Major	50	25	25
Minor	50	25	25
SEC		35	15
MDC	35		15
AEC	35		15
VAC	35		15

w/o RESEARCH

7^{th} SEM	Cr
Major-13	6
Major-14	6
Minor-5	6
Major-15	6
Major-16	6
	30

8^{th} SEM	Cr
Major-17	6
Major-18	6
Minor-6	6
Major-19	6
	24

DEGREE (HONOURS)	186

w RESEARCH

7^{th} SEM	Cr
Major-13	6
Major-14	6
Minor-5	6
Research-1	6
	24

8^{th} SEM	Cr
Major-15	6
Major-16	6
Minor-6	6
Research-2	6
	24

DEGREE (RESEARCH)	180

MULTIDISCIPLINARY COURSE (PHYSICS)

Semester I

Physics - MDC : Physics I
(Credits: 03)
Theory: 45 Lectures

Module 1: Physical World and Measurement Introduction to physics; nature of physical laws, need for measurement; units of measurement; systems of units; fundamental and derived units; dimension analyses; order of magnitudes of physical quantities; structure of the macroscopic and microscopic world.

Module 2: Scalars and Vectors Scalar and vector quantity; general vectors and notation; position and displacement vectors; equality of vectors; addition and subtraction of vectors; unit vector; rectangular components; scalar and vector product and their significance.

Module 3: Kinematics Frame of reference; Rest and motion; distance and displacement; average speed and instantaneous speed; average and instantaneous velocity; average and instantaneous accelerations; motion in straight line; projectile motion; uniform circular motion.

Module 4: Laws of motion Intuitive concepts of force; discussion and fundamental forces; inertia; newton's laws of motion; Pseudo forces; Friction (Qualitative discussion).

Module 5: Work, Energy and Power Kinetic energy; work done; work energy theorem; potential energy; gravitational and elastic potential energy; Conservation of mechanical energy.

Module 6: Gravitation Kepler's laws of planetary motion; the universal law of gravitation; acceleration due to gravity and its variation with altitude, depth and rotation of earth; escape velocity (qualitative discussion); orbital velocity of satellites.

Module 7: Properties of Bulk Matter Elastic behaviour; stress-strain relationship; Hook's law; Young modulus; bulk modulus.

Pressure due to a fluid column; Pascal's law and its applications.

Viscosity; coefficient of viscosity; Stokes' law, terminal velocity; streamline and turbulent motion; critical velocity and Reynold's number.

Surface energy and surface tension; angle of contact; excess pressure; applications of surface tension: liquid drops, bubbles and capillary rise.

Heat and temperature; principle of calorimetry; heat transfer- conduction, convection and radiation.

Module 8: Current Electricity Electric current; flow of electric charge in a conductor; drift velocity; Ohm's law; electrical resistance; Series and parallel combination of resistances; temperature dependence of resistance.

V-I characteristics; electrical energy and power; electrical resistivity and conductivity; EMF of a cell; AC and DC (qualitative discussion).

Module 9: Semiconductor Energy bands in conductor, semiconductor and insulators; types of semiconductors; I-V characteristics of p-n junction diode.

Semester III

Physics - MDC : Physics II
(Credits: 03)
Theory: 45 Lectures

Module 1: Electric Charges and Fields Electric Charges. Conservation of charge. Coulomb's law-force between two point charges. Forces between multiple charges. Superposition principle. Continuous charge distribution. Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).

Module 2: Electrostatic Potential and Capacitance Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges. Equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Module 3: Current Electricity Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current. Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and EMF of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge. Potentiometer: Principle and its applications to measure potential difference and for comparing EMF of two cells, Measurement of internal resistance of a cell.

Module 4: Moving Charges and Magnetism Concept of magnetic field: Oersted's experiment. Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

Module 5: Magnetism and Matter Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field. Bar magnet as an equivalent solenoid. Magnetic field lines. Earth's magnetic field. Magnetic elements. Para-, dia- and ferro - magnetic substances, with examples.

Semester V

Physics - MDC : Physics III
(Credits: 03)
Theory: 45 Lectures

Module 1: Optics Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.

Scattering of light – blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia and hypermetropia) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Wave optics: Wavefront and Huygens' principle, reflection and refraction of plane wave at a plane surface using wavefronts. Proof of laws of reflection and refraction using Huygens' principle. Interference, Young's double hole experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarised light; Brewster's law, uses of plane polarised light and Polaroids.

Module 2: Dual Nature of Matter and Radiation Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation – particle nature of light. Matter waves – wave nature of particles, de Broglie relation. Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained.)

Module 3: Atoms and Nuclei Alpha - particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivity – alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and fusion.

Module 4: Electronic Devices Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors; semiconductor diode – I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

Reference Books

[1] H.C. Verma, Concept of Physics, vol. 1 & 2, Bharati Bhawan.
[2] David Halliday, Robert Resnick and Kenneth S. Krane, Physics, vol. 1 & 2, Wiley.