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	2^{nd} SEM	Cr
Major 1	6	Major 2	6
Minor 1	6	Minor 2	6
SEC 1	3	SEC 2	3
MDC 1	3	VAC 1	3
AEC 1	4	INTRN	4
	22		22
CERTIFICATE	44		

3^{rd} SEM	Cr	4^{th} SEM	Cr
Major 3	6	Major 5	6
Major 4	6	Major 6	6
Minor 3	6	Minor 4	6
SEC 3	3		
MDC 2	3	AEC 2	4
	24		22
DIPLOMA	90		

5^{th} SEM	Cr	6^{th} SEM	Cr
Major 7	6	Major 10	6
Major 8	6	Major 11	6
Major 9	6	Major 12	6
MDC 3	3	VAC 2	3
	21		21
DEGREE	132		

Paper	Distribution of marks				
	Theory	Lab	Project/ Seminar/ Assignment	Continuous Evaluation	Attendance
Major	50	25	10	10	5
Minor	50	25	10	10	5
SEC		35		10	5
MDC	35			10	5
AEC	35			10	5
VAC	35			10	5

w/o RESEARCH			
7^{th} SEM	Cr	8^{th} SEM	Cr
Major 13*	6	Major 17	6
Major 14	6	Major 18	6
Minor 5	6	Minor 6	6
Major 15†	6		
Major 16	6	Major 19	6
	30		24
DEGREE (HONOURS)	186		

*Research Methodology & Ethics
†Seminar based paper
‡Elective paper
#Dissertation

w/ RESEARCH			
7^{th} SEM	Cr	8^{th} SEM	Cr
Major 13*	6	Major 17	6
Major 14‡	6	Major 18‡	6
Minor 5	6	Minor 6	6
Major 15†	6		
Major 16#	6	Major 19#	6
	30		24
DEGREE (RESEARCH)	186		

MINOR COURSES (PHYSICS)

Semester I (III)

Physics - Minor 1† (3‡) : Mechanics and General Properties of Matter (Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

†**Minor 1 for Mathematics (Major) students and**

‡**Minor 3 for Chemistry (Major) and Computer Science (Major) students**

Vector Calculus Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and Curl of a vector field. Del and Laplacian operators. Vector identities.

Vector Integration: Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes' Theorems and their applications (no rigorous proofs).

Orthogonal Curvilinear Coordinates: Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Fundamentals of Dynamics Reference frames. Inertial frames; Galilean transformations. Review of Newton's Laws of Motion. Projectile motion, Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum, Impulse. Momentum of variable-mass system: motion of rocket. Components of Velocity and Acceleration in plane polar, Cylindrical and Spherical Coordinate Systems.

Laws of physics in rotating coordinate systems, Centrifugal force. Coriolis force and its applications.

Work and Energy Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy. Stable and unstable equilibrium. Force as gradient of potential energy. Work done by non-conservative forces. Law of conservation of Energy. Elastic and inelastic collisions. Centre of Mass frame and Laboratory frame.

Rotational Dynamics Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Moment of Inertia, parallel and perpendicular axes theorem, moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Gravitation and Central Force Motion Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Physiological effects on astronauts.

Elasticity Hook's Law, Relation between Elastic constants. Poisons ratio, Strain energy in a stretched wire, Twisting torque on a Cylinder or Wire.

Fluid Motion Surface Tension: Surface Energy, Phenomena involving surface tension, Angle of Contact, Capillary rise.

Viscosity: Streamline flow, Turbulent motion, Stokes Law, Reynold's Number, Equation of Continuity, Bernoulli's Theorem, Poiseuille's equation for flow of a liquid through a Capillary Tube.

Reference Books

[1] R. Sengupta and H. Chatterjee, A Treatise on General Properties of Matter, New Central Agency.
[2] D.S. Mathur, Elements of Properties of Matter, S. Chand.
[3] R.P. Feynman, R.B. Leighton and M. Sands, The Feynman Lectures in Physics, vol.1, B I Publications.
[4] L. Pachuau and L. Sailo, A Textbook of Properties of Matter, Oscillations and Acoustics, PUC and GSC.

Physics - Minor 1 (3) Lab : Mechanics and General Properties of Matter 60 Lectures

Student should study the measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.

Experiments

1. To determine the height of a building using a Sextant.
2. To study the motion of Spring and calculate (a) Spring constant; (b) Acceleration due to Gravity.
3. To determine the Modulus of Rigidity of material of a cylindrical wire by Statical Method.
4. To determine the Modulus of Rigidity of material of a cylindrical wire by Dynamical Method.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine the Moment of Inertia of a cylindrical/rectangular bar.
7. To determine the value of g and velocity for a freely falling body using Digital Timing Technique.
8. To determine the Coefficient of Viscosity of a viscous liquid using Stokes' Law.
9. To determine Coefficient of Viscosity of water by Poiseuille's flow Method.
10. To determine the Young's Modulus of a Bar by Flexure Method.
11. To determine the Young's Modulus of a Wire by Optical Lever Method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
13. To determine the Young's Modulus of a wire by Searle's method.
14. To determine the value of g using Bar Pendulum.
15. To determine the value of g using Kater's Pendulum.

Reference Books

[1] B.L. Flint and H.T. Worsnop, Advanced Practical Physics for Students, Asia Publishing House, 1971.
[2] Michael Nelson and Jon M. Ogborn, Advanced Level Physics Practicals (4ed), Heinemann, 1985.

[3] I. Prakash and Ramakrishna, A Text Book of Practical Physics (11ed), Kitab Mahal, 2011.
[4] G.L. Squires, Practical Physics (4ed), Cambridge, 2015.

Semester II (IV)

Physics - Minor $2^{\dagger}$ ($4^{\ddagger}$) : Electricity and Magnetism (Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

†Minor 2 for Mathematics (Major) students and

‡Minor 4 for Chemistry (Major) and Computer Science (Major) students

Electric Field and Electric Potential Coulomb's Law, Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field and Potential. Potential energy of system of charges, Electrostatic energy of a charged sphere, Laplace's and Poisson equations. The Uniqueness Theorem. Electrostatic force on a charged particle. Electric dipole, Electric Potential and Field due to a dipole. Force, torque on a dipole, potential energy of a dipole.

Electric field in Conductor and Dielectric material Electric Field in conductor, Dielectric Polarisation ($\vec{P}$), Polarisation Charges. Electrical Susceptibility and Dielectric Constant. Displacement vector ($\vec{D}$). Relations between $\vec{E}$, $\vec{P}$ and $\vec{D}$. Gauss' Law in dielectrics.

Capacitance Capacitance of a conductor, Charging, discharging of a capacitor, Capacitance of parallel plate, spherical, cylindrical capacitor, combination of capacitors.

Magnetic Field Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to straight wire, Solenoid and Toroid. Properties of $\vec{B}$: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire. Torque on a current loop in a uniform Magnetic Field.

Magnetic Properties of Matter Magnetisation vector ($\vec{M}$). Magnetic Intensity ($\vec{H}$). Magnetic Susceptibility and Permeability. Relation between $\vec{B}$, $\vec{H}$ and $\vec{M}$. Dia-, Para- and Ferromagnetism. B-H curve and hysteresis.

Electromagnetic Induction Faraday's Law. Lenz's Law. Motional emf, eddy current, Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field.

Electrical Circuits DC Circuits: Transient phenomena, growth and decay of currents in LR, CR and LCR circuits. AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. LC oscillations, transformer.

Network theorems Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Reference Books

[1] H.K. Malik and A.K. Singh, Engineering Physics, McGraw Hill, 2018.

[2] D.J. Griffiths, Introduction to Electrodynamics (3ed), Prentice-Hall, 2002.
[3] E. M. Purcell, Electricity and Magnetism: Berkeley Physics Course vol. 2, McGraw Hill, 2017.
[4] D.C. Tayal, Electricity and Magnetism (4ed), Himalaya Publishing, 2019.
[5] D. Chattopadhyay and P.C. Rakshit, Electricity and Magnetism, Central Book Agency, 2005.

Physics - Minor 2 (4) Lab : Electricity and Magnetism
60 Lectures

Student should study the use a Multimeter for measuring (a) Resistances; (b) AC and DC Voltages; (c) Direct Current; (d) Capacitances; and (e) Checking electrical fuses.

Experiments

1. To determine an unknown Low Resistance using Potentiometer/fall of potential method.
2. To determine an unknown Resistance using Carey Foster's Bridge.
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 verify the Thevenin's and Norton's theorems.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To determine self inductance of a coil by Anderson's bridge.
8. To study the ac characteristics of a series CR Circuit.
9. To study the ac characteristics of a series LR Circuit.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency; (b) Impedance at resonance (c) Quality factor Q and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti resonance frequency; and (b) Quality factor Q.
12. To determine self-inductance of a coil by Rayleigh's method.
13. To determine the self-inductance of two coils separately by using Anderson's Bridge and the total equivalent inductance when they are connected in series and hence estimate the coefficient of coupling between the two coils.
14. To determine the horizontal component of the Earth's magnetic field and the magnetic moment of a magnet using a deflection and oscillation magnetometer.

Reference Books

[1] D. Chattopadhyay and P.C. Rakshit, Electricity and Magnetism, Central Book Agency, 2005.
[2] B. Ghosh, K.G. Mazumdar, Advanced Practical Physics, vol. 1, Sreedhar Publications, 2013.