Learning Outcome based Curriculum Framework (LOCF)

For

Choice Based Credit System (CBCS)

Syllabus

B.Sc.(Generic Elective) in Physics

w.e.f. Academic Session 2020-21

Kazi Nazrul University

Asansol, Paschim Bardhaman

West Bengal 713340

Semester-I

Course Name: Mechanics
Course Code: BSCHPHSGE101

Course Type: **Core (Theory & Practical)**	Course Details: **GE-I**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand vector calculus, classical mechanics of single as well as system of particles within the scope the Newtonian formulation.*
2. *Describe general properties of bulk matter and different types of simple harmonic linear oscillations.*
3. *Discuss classical mechanics of rotating systems and particle under central force.*
4. *Introduce Einstein's special theory of relativity and the classical mechanics of fast moving particles.*

Course Content:

Theory

1. Elementary Vector Calculus: Directional derivatives, gradient, divergence, curl of a vector, line integrals, Gauss's theorem **(6L)**

2. Mechanics of a Single Particle

Velocity and acceleration of a particle in (i) plane polar coordinates - radial and cross-radial components; Time and path integral of force; work and energy; Conservative force and concept of potential; Conservation of energy; Dissipative forces; Conservation of linear and angular momentum.

(6L)

3. Mechanics of a System of Particles

Linear momentum, angular momentum and energy - centre of mass decomposition; Equations of motion, conservation of linear and angular momentum. **(6L)**

4. Rotational Motion

Moment of inertia, radius of gyration; Energy and angular momentum of rotating systems of particles; Parallel and perpendicular axes theorems of moment of inertia; Calculation of moment of inertia for simple symmetric systems. **(6L)**

5 .Central force Motion

Motion of a particle under a central force field. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS).

(6L)

6. Elasticity: Elastic moduli and their relations (deduction not required), qualitative idea on bending of beam, torsional oscillation **(3L)**

5. Oscillations:

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **(8L)**

7) Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

(4 L)

Practical

1. Determination of Young's modulus by flexure method.
2. Measurement of the rigidity modulus of a wire by dynamic method.
3. Measurement of surface tension of a liquid by capillary tube method and verification of Jurin's law (capillary tubes of different bores to be supplied).
4. To draw the frequency – resonance length curve of a sonometer wire and to determine an unknown frequency of a tuning fork
5. Measurement of the velocity of sound by Kundt's tube
6. To determine Coefficient of Viscosity of water by Capillary Flow Method.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum/ Kater's .pendulum.
9. Determination of surface tension of a liquid by Jaeger's method.
10. To study the Motion of Spring and calculate (a) Spring constant, (b) ***g*** and (c) Modulus of rigidity.
11. To determine the Moment of Inertia of a Flywheel/regular shaped body.

References/ Suggested Readings:

1. Classical Mechanics – J. Goldstein (Narosa Publ. House).
2. Principles Of Mechanics - John. L Synge and Byron. A Griffith,
3. Theoretical Mechanics - M. R. Spiegel, (Schaum's Outline Series) (McGraw-Hill).
4. Mechanics - K. R. Symon (Addison-Wesley).
5. Introduction to Classical Mechanics - R. G. Takwale and P. S. Puranik (Tata McGraw-Hill).
6. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw-Hill).
7. The Feynman Lectures on Physics – Vol I (Addison-Wesley).
8. Mechanics – H. S. Hans and S. P. Puri (Tata McGraw-Hill).
9. Berkeley Physics Course, Vol – I (Mechanics) (Mc Graw Hill).
10. Mechanics – D. S. Mathur (S. Chand and Company).
11. Waves and Oscillations by N K Bajaj
12. Waves and Oscillations by R N Chowdhury

.

Semester-II

Course Name: Electricity and Magnetism

Course Code: BSCHPHSGE201

Course Type: **Core (Theory & Practical))**	Course Details: **GE-II**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Explain the properties of (i) the electric field produced due to charges at rest; (ii) the magnetic field produced due to steady current, both in free-space and inside matter.*
2. *Describe the basic idea of electromagnetism, through Maxwell's equation, hence the generation of EM waves.*
3. *Describes on the electrical circuits and bridges in presence of AC current.*

Course Content:

Theory:

1. Electric Field and Electric Potential:

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. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. **(12L)**

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor.

(6L)

2. Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate) filled

with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(4L)**

3. Magnetic Field: Magnetic force between current elements and definition of Magnetic Field **B**. Biot- Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole. Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential (qualitative idea). Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(6L)**

4. Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(2L)**

5. Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. **(3L)**

6. 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, transverse nature of EM waves. **(8 L)**

6. Electrical 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. **(4L)**

Practical

1. Use a multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown low resistance using Potentiometer.
4. To determine an unknown low resistance using Carey Foster's Bridge.
5. To verify the Thevenin and Norton 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 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.

9. To study the response curve of a parallel LCR circuit and determine its (a) anti-resonant frequency and (b) Quality factor Q.
10. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
11. Determine a high resistance by leakage method using Ballistic Galvanometer.

References/ Suggested Readings:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Electricity and Magnetism… By Rakshit and Chatterjee
3. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
4. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
5. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
6. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw-Hill Education

Semester- III

Course Name: Fundamentals of Thermal and Statistical Physics

Course Code: BSCHPHSGE301

Course Type: **Core(Theory & Practical)**	Course Details: **GE-II**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Realize the kinetic theory of ideal classical gas.*
2. *Explain radiative process of heat transfer*
3. *Understand the laws of thermodynamics and their applications in simple system.*
4. *Introduce (i) classical (MB) and quantum (BE, FD) distributions as most-probable micro-canonical distributions; (ii) different thermodynamic quantities (viz., entropy, pressure, chemical potential etc.) (iii) black-body radiation and BE condensation.*

Course Content:

Theory:

1. 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, Un attainability of absolute zero.

(16 L)

2. Kinetic Theory of Gases: Brownian motion; Pressure expression (elementary calculation); Derivation of Maxwell's law of distribution of velocities and its experimental

verification, Mean free path (Elementary calculation), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical flow), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

(11L)

3.Theory of Radiation: Blackbody 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. **(8 L)**

4.Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity -Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics (Derivation not required) Qualitative discussion on Fermi Level, B-E Condensation. (**10 L**)

Practical

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
4. To determine the Temperature Coefficient of Resistance/boiling point by Platinum Resistance Thermometer
5. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
6. To determine temperature co-efficient of resistance by meter-bridge.
7. Determination of coefficient of linear expansion by optical lever/travelling microscope.

References/ Suggested Readings:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Thermal Physics by Roy Gupta

Semester-IV

Course Name: Fundamentals of Waves and Optics

Course Code: BSCHPHSGE401

Course Type: **Core (Theory & Practical)**	Course Details: **GE-IV**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Find the resultant of two collinear and mutually perpendicular SHMs and, explain progressive elastic wave.*
2. *Understand the manifestations of optical wave (viz., interference, diffraction and polarisation).*

Course Content:

Theory

1. Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). **(5 L)**

2. Superposition of two perpendicular Harmonic Oscillations: Analytical Methods. Lissajous Figures (1:1) and their uses. **(2 L)**

3. Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

(4 L)

4. Interference of light waves

Young's experiment; spatial and temporal coherence; intensity distribution; Fresnel's

biprism, interference in thin film; fringes of equal inclination and equal thickness; Newton's ring.Michelson's interferometer, Multiple beam interference – reflected and transmitted pattern. Fabry- Perot interferometer. **(9 L)**

5. Diffraction of light waves

Fresnel and Fraunhofer class, Fresnel's half period zones; explanation of rectilinear propagation of light; zone plate. Fraunhofer diffraction due to a single slit, double slit and circular aperture (qualitative). Plane diffraction grating (transmission). Rayleigh criterion of resolution; resolving power of transmission grating **(10 L)**

6. Polarisation

Different states of polarisation; double refraction, Huygen's construction for uniaxial crystals; polaroids and their uses. Production of plane, circularly and elliptically polarised light; Analysis of plane and unpolarised light; retardation plates; rotatory polarisation and optical activity; Fresnel's explanation of optical activity; Biquartz and half shade polarimeter. **(6 L)**

Practical

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized light by using a Babinet's compensator.
4. Determination of angle of prism and to determine refractive index of the Material of a prism using sodium source.
5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light using Newton's Rings.
8. To determine wavelength of (1) sodium source and (2) spectral lines of mercury source using plane diffraction grating.
9. Determine the refractive index of the material of a convex lens with the help of a 'plane mirror and lens arrangement' for the same.
10. Determine refractive index of a liquid [water (say)] with the help of a plane mirror and a convex lens / travelling microscope.
11. Determine focal length of a concave lens with the help of an auxiliary lens (convex) by displacement method.

12. Determine focal length and power of a concave lens with the help of an auxiliary lens (convex) by displacement method. Also compare the powers of the two lenses (concave & convex). [Focal length of the convex lens may be supplied].

References/ Suggested Readings:

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Optics (Classical & Quantum) -R.K. Kar (Books and Allied)
8. Waves and Oscillations by N K Bajaj
9. Waves and Oscillations by R N Chowdhury
10. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
11. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, KitabMahal
12. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
13. A Laboratory Manual of Physics for undergraduate classes, D. P. Khandelwal, 1985, Vani Pub.