JADAVPUR UNIVERSITY

B. Sc. Generic Elective Papers (GE)

PHYSICS

Generic Elective courses

Semester	Course type	Course name	Course code	Teaching mode	Credit	Marks
I	GE	GE1	UG/SC/GE/PHY/TH/01	Theory	4	50
			UG/SC/GE/PHY/PR/01	Practical	2	50
II	GE	GE4	UG/SC/GE/PHY/TH/04	Theory	4	50
			UG/SC/GE/PHY/PR/04	Practical	2	50

Program Outcomes (POs) of Science Faculty:

PO1: Foundational Scientific Knowledge: Apply the knowledge of mathematics and natural sciences to the solution of scientific problems.

PO2: Critical Thinking and Problem Analysis: Identify the problems and formulate various methodologies for obtaining their solutions.

PO3: Design/Development of Solutions: Design a system and prepare formal methodical plans, leading to solutions.

PO4: Conduct investigations of complex problems: Formulate the structure and components of a complex problem and investigate it for obtaining a solution

PO5: Usage of Modern Methods and Tools: Develop/ select and apply appropriate methods/tools for solving problems with an understanding of their limitations.

PO6: The Science and Society: Apply scientific knowledge to assess and address critical societal issues.

PO7: Environment and Sustainability: Appreciate social and environmental issues and provide scientific know-hows for the use of renewable resources.

PO8: Ethics: Understand professional, ethical, legal, societal and security issues, and responsibilities.

PO9: Individual and team work: Build capacity to work independently and also as a team member within an organization.

PO10: Communication: Develop skills to communicate effectively with superiors, colleagues, other team members as well as the society at large.

PO11: Project Management and Finance: Understand the management principles and appreciate financial implications/issues pertaining to any scientific project.

PO12: Life-long learning: Identify contemporary issues due to changing technical, political and social scenarios and engage in lifelong learning to update himself/herself.

Program Specific Outcomes (PSOs) of Physics Department:

PSO1: Interpret fundamental and advanced knowledge in Physics and their applications in solving scientific problems.

PSO2: Develop problem solving skills, thinking and creativity through assignments.

PSO3: Formulate and analyze various methods and techniques for designing the solution of the problems.

PSO4: Apply various concepts of Physics in solving real life problems associated with science, social science and technology.

Generic Elective courses (GE)

GE 1

Elements of Basic Physics Credits: 4

Paper code: UG/SC/GE/PHY/TH/01

Theory: 60 Lectures

Vector Analysis: Scalar and vector fields, Gradient of a scalar field, Divergence and curl of a vector field, introduction of line integral, surface integral and volume integral, Gauss divergence theorem, Stokes' theorem (statement only). **[5 Lectures]**

Electrostatics: Electrostatic Field, Conservative nature of electrostatic field and concept of potential, Gauss's theorem of electrostatics and it applications, Dielectrics, Polarisation, Displacement vector, Gauss's theorem in dielectrics. **[7 Lectures]**

Magnetostatics: The magnetic field: Biot-Savart's law and its applications, Divergence & Curl of magnetic field, Magnetic vector potential, Amperes circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction to dia, para- and ferromagnetic materials. **[10 Lectures]**

Electromagnetic Induction: Faraday's law of electromagnetic induction, Lenz's law, self (L) and mutual (M) inductance , L of single coil, M of two coils, Energy stored in magnetic field. **[6 Lectures]**

Maxwell`s equations and Electromagnetic wave: Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through free space and isotropic dielectric medium. **[8 Lectures]**

Optics:

Geometrical Optics: Fermat's principle and its applications in reflection and refraction of light from plane surface.

Physical Optics:

Introduction: Electromagnetic nature of light. Concept of wave front, Huygens Principle.

Interference of light: Interference of light, Coherent sources : Division of wavefront and division of amplitude, Young's experiment, Conditions for sustained interference, Interference fringe width and shape, interference in a thin wedge-shaped film, Newton's rings.

Diffraction of light: Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to single slit, double slit and the plane transmission grating.

Polarization of light: Transverse nature of light waves, Polarization by reflection, Brewster's law, Double refraction, Nicol prism **[24 Lectures]**

Course Outcomes:

On completion of this course, the students are expected to

CO1. Learn the basics of vector analysis to solve various physical problems.

CO2. Understand the electrostatic and magnetostatic field and potentials to apply the same to solve various problems.

CO3. Introduce the concepts of Maxwell's equations and to use it for understanding the electro-magnetic wave propagation.

CO4. Gain knowledge in ray and wave optics.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	1	1	1								3	2	2	1
CO2	3	1	1	1	1								2	2	1	1
CO3	3	2	1	1	1								3	2	2	2
CO4	3	1	1	1	1								2	2	1	2

Elements of Basic Physics (Practical) Credits: 2

Paper code: UG/SC/GE/PHY/PR/01

List of experiments:

1. To determine the resistance of a Galvanometer by Thomson's Method.
2. To measure the resistance of a Galvanometer by Half-deflection method.
3. To determine the average resistance per unit length of the Metre bridge wire by Carey Foster 's method.
4. To determine the emf of a cell by using a potentiometer and a cell of known emf.
5. To determine the Horizontal Component of Earth's magnetic field with the help of Magnometer.
6. Verification of Biot Savart's law.
7. To determine the Refractive Index of a liquid with the help of a Travelling Microscope.
8. To determine the Refractive index of a liquid with the help of a Lens & a Plane Mirror.
9. Determination of the Refractive Index of the material of a given Prism by Minimum Deviation method with

help of a Spectrometer.

10. To determine dispersive power of the material of a prism using mercury light.

Course Outcomes:

On completion of this course, the students are expected to

CO1. Determine resistance using galvanometer and meter-bridge.

CO2. Verify the basic principles of electrostatic and magnetostatics.

CO3. Determine refractive indices of materials using different techniques.

CO4. Study the dispersion phenomenon by using prism.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	**3**	**2**	**1**	**1**	**1**								**2**	**2**	**3**	**1**
CO2	**3**	**1**	**1**	**1**	**1**								**2**	**2**	**2**	**1**
CO3	**3**	**2**	**1**	**1**	**1**								**2**	**2**	**3**	**1**
CO4	**3**	**1**	**1**	**1**	**1**								**2**	**2**	**2**	**1**

GE 4

Modern Physics Credits: 4

Paper code: UG/SC/GE/PHY/TH/04

Quantum theory of radiation: Blackbody Radiation; Difficulties with the classical theory; RayleighJean's law and Wien's law for black body radiation and their difficulties (qualitative), Planck's law for black body radiation, Photo-electricity, Explanation of photo electric phenomenon: Einstein's equation and Compton scattering. **[6 Lectures]**

Wave nature of matter: Wave particle duality and de-Broglie hypothesis, de Broglie wavelength and matter waves; Davisson-Germer's experiment, Wave description of particles by wave packets, Group and Phase velocities and relation between them, Heisenberg uncertainty principle. **[4 Lectures]**

Introduction to wave mechanics: Schrodinger equation for one dimensional motion; momentum and energy operators; stationary states; physical interpretation of a wave function, probability density and normalization; probability current density: conservation of probability, Eigen function, Eigen values, expectation values, time independent Schrodinger equation, Stationary states, One dimensional infinite potential well.

[15 Lectures]

Properties of Nucleus: Constituents of nucleus and their intrinsic properties, quantitative facts about mass, radii, mass defect, packing fraction, binding energy, binding fraction and its variation with mass number, main features of binding energy versus mass number curve, Liquid drop model, semi-empirical mass formula , N-Z plot.

Radioactivity: Stability of the nucleus; properties of $\alpha, \beta$and γ rays; Law of radioactive decay; Mean life and half-life; successive disintegration, transient and secular equilibriums;

Fission and fusion: Fission- generation of energy; Fission – nature of fragments and emission of neutrons, Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion **[15 Lectures]**

Crystal Structure: Solids- amorphous and crystalline materials. Lattice Translation Vectors, Lattice with a Basis, Unit Cell, Miller Indices, Reciprocal Lattice, Brillouin zones, Diffraction of X-rays by Crystals, Bragg's Law.

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia- and paramagnetic materials, quantum mechanical treatment of paramagnetism, Curie's law, Weiss's Theory of ferromagnetism and ferromagnetic domains. Superconductivity (qualitative view)

[20 Lectures]

Course Outcomes:

On completion of this course, the students are expected to

CO1. Introduce the concept and to learn the basic principles of Quantum physics.

CO2. Learn the basics of nuclear physics including properties and decays.

CO3. Introduce the basic concept of crystal structure of solid and its application in X-ray diffraction.

CO4. Learn the properties of magnetic materials.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	**3**	**2**	**1**	**1**	**1**								**3**	**2**	**2**	**1**
CO2	**3**	**1**	**1**	**1**	**1**								**3**	**2**	**2**	**1**
CO3	**3**	**2**	**1**	**1**	**1**								**3**	**2**	**2**	**1**
CO4	**3**	**1**	**1**	**1**	**1**								**3**	**2**	**2**	**1**

Modern Physics (Practical) **Credits: 2**

Paper code: UG/SC/GE/PHY/PR/04

List of experiments:

1. To determine value of Planck's constant using LEDs of atleast four different colours.
2. Photo-electric effect: Photocurrent versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
3. To determine value of Boltzmann constant using V-I characteristic of PN diode.
4. To determine the value of (e/m) by (a) Magnetic focusing or (b) Bar magnet.
5. To set up the Millikan oil drop apparatus and determine the charge of an electron.
6. To determine wavelength of sodium light using Newton's ring.
7. To study the diffraction pattern of a single slit with the help of a LASER source.
8. To determine the number of rulings of a grating from the diffraction pattern with the help of a LASER source.

Course Outcomes:

On completion of this course, the students are expected to

CO1. Verify various phenomena of Quantum physics.

CO2. Determine physical properties of elementary particles.

CO3. Gain knowledge of current-voltage characteristics of PN diode.

CO4. Understand the phenomena of interference and diffraction by LASER etc.

CO-PO Mapping :(3 – Strong, 2 – Moderate and 1 – Weak)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	**3**	**2**	**1**	**1**	**1**								**2**	**2**	**2**	**1**
CO2	**3**	**1**	**1**	**1**	**1**								**2**	**2**	**2**	**1**
CO3	**3**	**2**	**1**	**1**	**1**								**2**	**2**	**3**	**1**
CO4	**3**	**1**	**1**	**1**	**1**								**2**	**2**	**3**	**1**