Minor Courses offered by the Department of Physics

MINOR STREAM - I

a) With Minor Stream I (Within the Department)

Year / Sem	Type of Course	Course Code	Title of the Course	Credits	Teaching Hours
1st Year (Semester-I & II)	MID-1		**Minor Chemistry - I**	4	5
	MID-2		**Minor Mathematics - I**	4	5
2nd Year (Semester-III & IV)	MID-3		**Minor Mathematics - II**	4	5
	MID-4		**Minor Chemistry - II**	4	5
3rd Year (Semester-V & VI)	MID-5		**Minor Mathematics - III**	4	5
	MID-6		**Minor Chemistry - III**	4	5

***Note:** For other Department Courses, Syllabus and Course Codes are given by the respective Departments.

MINOR STREAM - II

b) With Minor Stream II

(Course offered for the Mathematics / Chemistry / other Science Students)

- These courses are meant for students from mathematics, chemistry, biology, geology, computer science, and other science departments.
- A minimum of 10 students should register to offer the minor papers.

Year / Sem	Type of Course	Course Code	Title of the Course	Credits	Teaching Hours
1st Year (Semester-I & II)	MID-1	**PHYS 1111**	**Concepts in Mechanics**	4	5
	MID-2	**PHYS 1211**	**Concepts in Electromagnetism**	4	5
2nd Year (Semester-III)	MID-3	**PHYS 2101**	**Minor Physics Laboratory (Laboratory training)**	4	5

PHYS - 1111 - CONCEPTS IN MECHANICS (4 Credits - 60 hours)

UNIT–I **(12 hours)**

Classification of differential equations as linear, nonlinear, homogeneous, inhomogeneous and coupled equations - Distinction between initial value and boundary value problems - Method of integrating factor – Method of separation of variables – Second order differential equations – Solving Homogeneous and inhomogeneous equations with variable coefficients - Wronskian and principle of superposition - Method of undetermined coefficients - Method of variation of parameters - Applications to electrical and mechanical vibrations and forced oscillations - Problems solving.

UNIT–II **12 hours**

Harmonic oscillations - Calculation of kinetic energy, potential energy, total energy, and their time-average values - Damped and Forced oscillations – Solution to damped and forced oscillators - Transient states and steady states – Resonance and sharpness of resonance - Logarithmic decrement, Relaxation time, Quality factor - Power dissipation - Rate of Work done - Examples of electrical (vibration) systems like LCR resonance – Problems solving.

UNIT–III **12 hours**

Gradient, divergence, and curl of a vector - Velocity and acceleration in cartesian and polar coordinates - Addition of forces - Polygon of forces - Condition for the equilibrium of a particle under several forces – Lami's theorem and problems based on it - Forces along and perpendicular to the inclined plane - Limiting equilibrium (about to slide) of a particle kept on an inclined plane – Friction laws (static and dynamic) – Calculation of acceleration of sliding objects down an inclined plane – Moment of a force – Conditions for the equilibrium of a rigid body – Resultant of forces – Three parallel forces acting at the vertices of a triangle – Three forces acting along the sides of a triangle – Defining couple and moment of a couple – Resultant of several coplanar forces – Problems solving.

UNIT–IV **12 hours**

Degrees of freedom of a rigid body - Relation between angular momentum, angular velocity, and moment of inertia - Fixed axis rotations - Parallel and perpendicular axes theorem - Definition of pure rolling - Inclined plane with rolling - Pure rolling of symmetrical bodies - Angular momentum of a rigid body - Uniformly rotating frame - centrifugal and Coriolis forces - Calculation of moments of inertia of (i) a circular ring, (ii) circular lamina, (iii) solid sphere, (iv) spherical shell - Calculation of center of mass of objects like an arc of a circle, a rectangle with a cavity, triangle, and similar objects - Center of mass of a system of particles - Problems solving.

UNIT–V **12 hours**

Newton's law of Gravitation - Kepler's Laws - Two-body problem and reduced mass concept - Equation of motion in plane polar coordinates for the Kepler problem - Turning points in potential energy curve - Derivation of equation of circular and elliptic orbits - Escape velocity - Calculation of gravitational potential inside and outside of (i) a spherical shell, (ii) a solid sphere - Work energy theorem - Conservative force - Conservation laws for systems of particles – Derivation of potential energy of a multi-particle system - Calculation of gravitational self energy of a sphere - Problems solving.

Text Books

1. Boyce and Diprima, Elementary Differential Equations, Wiley.
2. H. J. Pain. The Physics of Vibrations and Waves, John Wiley, (2005), 6th Edition.
3. I. G. Main. Vibrations and Waves in Physics, Cambridge University Press, 1993.
4. P Duraipandian and M Jayapragasam. Mechanics, S. Chand.

Supplementary Readings

1. David Morin. Introduction to Classical Mechanics. Cambridge University Press.
2. Resnick, Halliday, and Walker. Fundamentals of Physics. Wiley.
3. N. K. Bajaj. Waves and Oscillations. Tata McGraw Hill.

PHYS - 1211 - CONCEPTS IN ELECTROMAGNETISM (4 Credits - 60 hours)

UNIT–I **12 hours**

Kirchoff's laws - Bridge networks – Y to Delta and Delta to Y conversion – Superposition theorem – Thevenin's theorem – Millman's theorem – Substitution theorem – Reciprocity theorem - Series LCR resonant circuit – Q-factor – Variation of impedance with frequency – Selectivity of a series resonant circuit – Parallel LCR resonant circuit – Q-factor - Capacitor networks – Resistor-inductor (RL) transients – Average and effective values of alternating waveform – Response of basic R, L, and C elements to a sinusoidal signal – Voltage divider rule for a.c circuits – Problems solving.

UNIT–II **12 hours**

Classification of Conductors, insulators, and semiconductors based on energy band diagram - Intrinsic and extrinsic semiconductors. P-type and N-type semiconductors. Formation of PN junction diode - Forward and reverse characteristics - Diode resistance-Effect of temperature on extrinsic semiconductors, halfwave, Centre tap, and Bridge rectifiers, Expression for average DC voltages, qualitative ideas of filters, clipping and clamping circuits-their general applications. Zener diode - Current-voltage characteristics - Problems solving.

UNIT–III **12 hours**

Divergence, curl, gradient operators, and vector identities - Vector integration, line, surface, and volume integrals of vector fields – Gauss divergence theorem and Stoke's theorem of vectors and their significances - Electric field due to an infinitely long line charge, a sheet of charge, a ring of charge, a charged disk, an electric dipole, and other charge distributions – Derivation of Gauss's law from Coulomb's law – Application to symmetric charge distributions like an infinite sheet of charge, uniformly charged sphere (solid and shell), cylinder, and similar objects. – Electric dipole in an electric field - Discontinuity of electric field on the surface of a conductor – Problems solving.

UNIT–IV **12 hours**

Discontinuity of electric field on the surface of a conductor – Convection and conduction current and deriving Ohms law $J = \sigma E$ – Continuity equation and relaxation time - Dielectric polarization – Definition of electric polarization – Dielectric breakdown – Electric susceptibility and permittivity - Gauss's law in the presence of linear dielectrics –Capacitors with dielectrics - Calculating the capacitance (in presence of dielectrics) of a parallel plate capacitor, a cylindrical capacitor, a spherical capacitor, coaxial cylindrical capacitor, concentric spherical capacitor and for an isolated spherical capacitor - Bound charges, Displacement density vector - Problems solving.

UNIT–V **12 hours**

Divergence of the magnetic field - Introduction to magnetic vector potential - Non-existence of magnetic monopoles – Magnetic field due to symmetric current distributions like a solenoid and toroid – Equivalence of current-carrying loop and a magnetic dipole – Motional e.m.f – Eddy currents - Self-induction and mutual induction – Energy stored in a magnetic field – Calculation of magnetic energy density - Lorentz Force and motion of charged particles in electric and magnetic fields - Linear homogeneous isotropic magnetic materials – Ampere's law in material media – Problems solving.

Textbooks

1. Boylsted and Nashelsky, Electronic Devices and Circuits, Pearson, 2009.
2. Robert L. Boylestad, Introductory Circuit Analysis, Prentice-Hall.
3. M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Press

Supplementary Readings

1. Alexander and M. N. O. Sadiku, Fundamentals of Electric Circuits, McGraw Hill.
2. D. Halliday, R. Resnick, and J. Walker, Fundamentals of Physics, John Wiley.

PHYS - 2101 - MINOR PHYSICS LABORATORY (3 CREDITS)

Choose **seven experiments** from the list**.**

LIST OF EXPERIMENTS

1. Young's modulus - Non-Uniform bending - Pin & Microscope
2. Rigidity modulus - Torsional oscillations without masses.
3. Comparison of coefficient of viscosity.
4. Surface tension of a liquid and interfacial surface tension by drop weight method.
5. Spectrometer - Refractive index of a liquid - Hollow prism.
6. Spectrometer - Grating - N determination by normal incidence method.
7. Spectrometer - Grating-wavelength determination by minimum deviation method.
8. Newton's Rings.
9. Thermal conductivity of a bad conductor - Lee's disc method
10. Post office box - Laws of resistance and specific resistance.
11. Melde's apparatus - Determination of frequency.
12. Meter Bridge - Temperature coefficient of the material of a coil of wire
13. Potentiometer - Calibration of low range voltmeter .
14. Potentiometer - Calibration of ammeter (0-1.5 amps).
15. Figure of merit of a periodic moving coil galvanometer.
16. Field along the axis of the circular coil carrying current - Determination of magnetic field
17. Newton's law of cooling and specific heat determination
18. Frequency measurement by forming Lissajous figures
19. Study of half-wave rectifiers.
20. Transistor characteristics - CE mode - only transfer characteristics.

Textbooks

1. Ouseph and V. Srinivasan, Practical Physics- Part-I &II.

Supplementary Readings

1. Mathchan Lazarus and others- Practical Physics.