BSC PHYSICS 3rd SEMESTER

BRANCH	SubjectTitle	SubjectCode
B.Sc.(Physics– MINOR/GENERICEL ECTIVECOURSE)	ELECTRICITY MAGNETISM AND ELECTROMAGNETIC	

CourseLearningoutcomes

- **To introduce the basic mathematical concepts related to electromagnetic vector fields.**
- **To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.**
- **To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.**
- **To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations.**
- **To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.**
- **Understand the basic mathematical concepts related to electromagnetic vector fields. .**
- **Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.**
- **Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.**
- **Understand the concepts related to Faraday's law, induced emf and Maxwell's equations.**
- **Apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation**

CONTENT

UNIT 1

Electrostatics

1. An overview of thermal and hydroelectric power plants in Madhya Pradesh.

Lectures 12

2. Electrostatic field; Electric flux; Gauss's theorem of electrostatics; Applications of Gauss theorem: Electric field due to infinite long charged wire; Uniformly charged spherical shell and solid sphere; Charged plate, Conservative nature of electrostatic field; Laplace and poisons equations; Uniqueness theorem.

3. Dielectrics; Polar and non-polar molecules; Parallel plate

capacitor with a dielectric, Electrical susceptibility and

dielectric constant; Polarization and Polarization vector

(P); Displacement vector (D); Intensity of Electric field

(E); Relationship between D, E and P.

4. Gauss's law in dielectrics; Clausius-Mossotti relation,

Langevin-Debye formula; Ferroelectric and Paraelectric

materials; Hysteresis loop for ferroelectrics.

Keywords/Tags:.Hydroelectric power plant, Electrostatic field, Dielectrics, Polarization vector, Displacement vector.

UNIT 2

Magnetostatics

1. Lorentz force equation and magnetic field B; Bio-Savart's

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law; Calculation of magnetic intensity H for solenoid and anchor ring.

2. Ampere's circuital law and its applications for solenoid and Toroid: Basic law of magnetostatics in differential form V.B-0, VXB-J; Free and bound currents; Magnetization and magnetization vector M; Magnetic permeability and susceptibility; Derivation of VXM-J, for a non-uniformly magnetized substance; Relationship between B, H and M.

3. Diamagnetic, Paramagnetic and Ferromagnetic substances; B-H Curve and Hysteresis loss.

4. General idea about AC and DC motors, Motor winding.

Keywords/Tags: Magnetic field, Magnetization, Hysteresis loss, Motor winding,

UNIT-3

Current electricity

1. Network theorems: Concept of ideal current and voltage sources; Thevenin's theorem; Norton's theorem; Millman's theorem; Maximum power transfer theorem.

2. Transient current: Growth and decay of current in LR circuit; Charging and discharging of a capacitor through resistor, Measurement of high resistance by leakage; Charging and discharging of a condenser through ant inductance and resistance.

3. Alternating currents: Complex number and their applications in alternating current circuits (RL, RC and LC); Series LCR (acceptor) and parallel LCR (rejector) circuits; Power factor.
4. A.C. bridges: Maxwell's bridge; Owen's bridge; Anderson's bridge; Kelvin's bridge.

Keywords/Tags: Network theorems, Transient current, A.C. bridges.

UNIT-4

Motion of charged particles in electric and magnetic field

1. Motion of charged particles in electric and magnetic field: Construction and working principle of Cyclotron and Betatron; Thomson's method for the determination of specific charge (e/m) of electron.

2. Ballistic galvanometer: Torque on a current loop; Current and charge sensitivity; Electromagnetic damping; Logarithmic damping; CDR.

3. Introduction to CRO: Block Diagram of CRO; Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

4. Electromagnetic induction: Faraday's law; Lenz's law; Self and mutual inductance; Reciprocity theorem; Self-mutual of coil; Mutual inductance of two coils; Energy stored in magnetic field.

Keywords/Tags: Motion of charged particles, specific charge,

Ballistic galvanometer, CRO, Electromagnetic induction.

UNIT -5

Electrodynamics

1. Equation of Continuity for current; Maxwell's displacement current; Derivation of Maxwell's equations; Poynting theorem.

2. Electromagnetic wave equations; Plane electromagnetic wave in vacuum and dielectric media; Reflection and refraction at a plane boundary of dielectric; Polarization by reflection and Fresnel's equation; Brewster's Law.

3. Electromagnetic Waves in conducting medium; Reflection and refraction of Electromagnetic wave by the ionosphere; Secant law; Skip distance and maximum usable frequency.

Keywords/Tags: Displacement current, Poynting Electromagnetic wave, Polarization by reflection.

PRACTICALS

- To draw the B-H curve and determination of Hysteresis loss.
- Determination of voltage, frequency and phase difference using CRO.
- Study of sensitivity of CRO.
- Verification of the Thevenin's theorem.
- Verification of the Norton's Theorem.
- Verification of the maximum power transfer theorem.
- Verification of the superposition theorem. Measurement of self-inductance using Maxwell's bridge.
- Measurement of unknown inductance using Kelvin's bridge.
- Determination of self-inductance by Anderson's bridge. To study of the charging and discharging of a condenser through a resistor.
- Determination of impedance and power factor using LCR Circuit.
- Study of frequency response curve of a seriesLCR circuit and determination of resonant frequency, Quality factor and Band width.
- To study of frequency response curve of a parallel LCR circuit and determination of anti-resonant frequency and Quality factor.
- Determination of Dielectric constant of Kerosene by resonance method.
- Determination of Self Inductance of a Coil by Rayleigh's Method using Ballistic Galvanometer.
- Verification of Millman's theorem
- To study the magnetic field along the axis of a circular coil.
- Determination of M and H using vibrational magnetometer and deflection magnetometer.
- Comparison of capacity of two capacitors using Ballistic Galvanometer.

BSC PHYSICS 4th SEMESTER

BRANCH	SubjectTitle	SubjectCode
B.Sc.(Physics– MINOR/GENERICEL ECTIVECOURSE)	**WAVES AND OPTICS**	

Learning Outcomes

Upon successful completion, students will have the knowledge and skills to:
On satisfying the requirements of this course, students will have the knowledge and skills to:

1. Appreciate the efficacy of Fourier transforms and their application to physical systems.
2. Understand linear, time-invariant systems.
3. Understand the role of the wave equation and appreciate the universal nature of wave motion in a range of physical systems
4. Understand dispersion in waves and model dispersion using Fourier theory.
5. Understand diffraction and imaging in terms of Fourier optics and gain physical and intuitive insight in a range of physics via the spatial Fourier Transform.
6. Understand optical phenomena such as polarisation, birefringence, interference and diffraction in terms of the wave model.
7. Understand the foundations of fluid dynamics.
8. Through the lab course, understand the principles of measurement and error analysis and develop skills in experimental design.

UNIT 1

1. Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle: (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

2. Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods; Lissajous Figures (1:1 and 1:2) and their uses.

3. Wave Motion: Transverse waves on a stretched string; Travelling and standing waves; Normal Modes of a string; Phase velocity; Group velocity; Plane and Spherical waves; Wave intensity.
Keywords/Tags: Harmonic Oscillation, Superposition Principle,Wave Motion.

UNIT 2

Sound and light wave

1. Sound: Simple harmonic motion; Forced vibrations and resonance; Fourier's Theorem; Application to saw tooth wave and square wave; Intensity and loudness of sound; Decibels, Intensity levels; Musical notes; Musical scale.

2. Acoustics of buildings: Reverberation and time of reverberation; Absorption coefficient; Sabine's formula; Measurement of reverberation time; Acoustic aspects of halls and auditoria.

3. Wave optics: Electromagnetic nature of light; Wave front; Huygens Principle.

4. Electro-optic, Magneto-optic and acousto-optic effects (elementary idea).

Keywords/Tags: Sound, Musical notes, Acoustics of buildings,

Wave optics.

UNIT-3

Interference of light

1. Interference: Interference by Division of amplitude and division of wavefront; Young's Double Slit experiment; Lloyd's Mirror and Fresnel's Biprism.
2. Interference in Thin Films: Stokes' Law; Interference in parallel and wedge-shaped films; Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes); Applications of thin films interference: Antireflection coating: Dielectric Mirrors; Interference filter.

3. Newton's Ring: Measurement of wavelength and refractive index.

4. Michelson's Interferometer: (1) formation of fringes, (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, (5) Visibility of fringes.

Keywords/Tags:

Interference,Thin films interference, Michelson's Interferometer.

UNIT-4

Diffraction

1. Introduction; Distinction between interference and diffraction; Types of diffraction; Distinction between Fresnel and Fraunhofer diffraction.

2. Fresnel's diffraction: Fresnel's Assumptions; Huygens - Fresnel's Theory; Half period zone; Construction and theory of Zone plate; Diffraction at straight edge;

Diffraction at a circular aperture.

3. Fraunhofer diffraction: Diffraction due to single, double

and N slits; Plane diffraction grating.

4. Resolving and dispersive power: Rayleigh's criterion; Limit of resolution of the eye; Resolving power of Grating and Telescope; Expression for dispersive power of prism.

Keywords/Tags: Diffraction, Zone plate, Plane diffraction grating, Resolving power.

UNIT -5

Polarisation

1. Introduction: Polarized light and its representation; Difference in Polarized and unpolarized light; Types of Polarisation; Application of polarization: Sunglasses; Three-dimensional movies; Photography.

2. Production of polarized light: Production of polarized light by reflection, refraction, scattering and selective absorption; Brewster's Law; Polaroid sheets; Polarizer and analyzer; Malus law.

3. Anisotropic Crystals: Doubly refracting crystals (Uniaxial); Extra-ordinary rays and Ordinary rays; Polarization by double refraction and Huygens theory: Nicol prism; Retardation plates: Quarter-wave plate and Half-wave plate.

4. Optical Activity: Optical rotation; Specific rotation; Half shade &Biquartzpolarimeter.
Keywords/Tags: Polarized light, Anisotropic Crystals, Optical Activity.

PRACTICALS

- To determine the Frequency of an Electrically Maintained Tuning Fork by Melde’s experiment.
- To determine the Refractive Index of the Material of a given Prism using Sodium Light.
- To study Lissajous Figures with the help of CRO.
- To determine the angle of minimum deviation using i- 8 curve by spectrometer.
- To determine Dispersive Power of the Material of a given To determine wavelength of sodium light using Fresnel
- To determine the refractive index of a liquid using Newton's rings.
- To determine Cauchy constant for the material of a prism using the spectrometer
- Determine the radius of curvature of a plano-convex lens by Newton's rings.

- To determine wavelength of Sodium light (D1 and D2 lines) using plane diffraction Grating
- To determine the Resolving Power of a Plane Diffraction Grating
- Determination of specific rotation of sugar solution by polarimeter.
- Determination of resolving power of a telescope.
- To determine diameter/thickness of a thin wire by diffraction method.
- To determine the wavelength of sodium source using Michelson's interferometer.
- Study of diffraction at straight edge.
- Verification of Brewster's law with the help of spectrometer.
- To determine the wavelength of laser light with the help of plane transmission grating.
- Calculation of height of a object with the help of Sextant.

Calculation of H and H. of calcite/quartz with the help of spectrometer