Government Degree College (Autonomous), Baramulla

SEMESTER 4th **MAJOR / MINOR COURSE**

Subject: Physics

Course Title: Waves and Optics Course Code: BPH22C401
Credits: Theory: 04; Practical: 02 Contact Hours: Th 64 Hr, Pr 64Hr

Course Objectives
Optics is one of the basic bones of physics and is at the heart of all modern imaging and Communications technologies. This course provides students with an understanding of optical phenomena based on the wave description of light. The principles of polarization, interferenceand diffraction will be fully developed and optical devices that use these properties of light willbe described.

Course Outcomes
On completion of the course, students will be able to:

1. *Use the principles of wave motion and superposition to explain the physics of polarization, interference and diffraction.*
2. *Understand the idea of various kinds of polarization of light wave and their detection.*
3. *Get an idea of diffraction phenomenon and to study Fraunhofer and Fresnel diffraction.*
4. *Apply the idea of spatial and temporal coherence for the formation of interference fringesas well as to study the formation of fringes of equal inclination and equal thickness.*
5. *Describe the operation of optical devices including, polarisers, retarders, and inteferometers.*

Unit I:

Superposition of Collinear Harmonic oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.

Unit II:

Waves Motion- General: Transverse waves on a string, velocity of transverse waves. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

Sound: Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Unit III:

Wave Optics: Electromagnetic nature of light.Definition and Properties of wave front.Huygens Principle. Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment.Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: Idea of form of fringes (Basic Idea),

Unit IV:

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge,

Laser System: Purity of spectral line; coherence length and coherence time; spatial coherence of a source; Einstein A and B coefficients; spontaneous and induced emission; conditions of laser action; population inversion simple application laser.

Refrences:

1. Fundamentals of Optics, F A Jenkins and H E White
2. Optics by AjoyGhatak
3. Principles of optics by B K Mathur.
4. Fundamentals of optics by H R Gulati and D R Khanna
5. B. B. Laud; "Laser and Non-Linear Optics"; (Wiley Eastern)

Laboratory Work:

1 To investigate the motion of coupled oscillators
2 To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ2 – T Law.
3 To study Lissajous Figures
4 Familiarisation with Schuster`s focussing; determination of angle of prism.
5 To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). 6. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
6 To determine Dispersive Power of the Material of a given Prism using Mercury Light
7 To determine the value of Cauchy Constants of a material of a prism.
8 To determine the Resolving Power of a Prism.
9 To determine wavelength of sodium light using Fresnel Biprism
10 To determine wavelength of sodium light using Newton's Rings.
11 To determine the wavelength of Laser light using Diffraction of Single Slit.
12 To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
13 To determine the Resolving Power of a Plane Diffraction Grating.
14 To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

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SEMESTER 4th **MAJOR COURSE**

Subject: Physics

Course Title: Classical Mechanics Course Code: BPH22C402
Credits: Theory: 04; Practical: 02 Contact Hours: Th 64 Hr, Pr 64Hr

Course Objectives

Aim of this advanced level course on classical mechanics is to polish the learner's understanding of the subject, to learn how complex classical systems could be formulated and solved using the Hamiltonian and Lagrangian by observing symmetries of the system and/or through advanced co-ordinate transformation techniques such as canonical transformations of various kinds and action-angle variable technique. In addition to it the students also learn how to solve problems having large degrees of freedom such as rigid-bodies, complex and chaotic systems and small oscillations.

Course Outcomes

On completion of the course, students will be able to:

1. *Write and solve Lagrangian and Hamiltonian of the system, look for the symmetries associated with the system and employ the corresponding the law of conservations.*
2. *Understand, transform and solve the problems using various canonical transformations, Poisson bracket and action-angle variable techniques and classical perturbation-theory*
3. *Learn to perceive the symmetries and associated conservation laws and their applications to solve a classical system.*
4. *Understand how systems with large degrees of freedom such as rigid-bodies could be solved and be able to extract the interesting dynamics which is displayed by rigidbodies while in motion via Euler-angles technique.*

Unit I:

Mechanics of a System of Particles; Constraints; their classification, D' Alembert's Principle and Lagrange's equations, Hamilton's Variational Principle' generalized coordinates. Derivation of Lagranges Equations from Hamilton's principle, Conservation theorems and symmetry properties, Energy function and conservation of Energy.The Virial theorem.

Unit II:

Cyclic coordinates. Canonical momenta & Hamiltonian.Hamilton‟s equations of motion.Comparison of Newtonian, Lagrangian and Hamiltonian approaches of mechanics. Applications of Hamiltonian mechanics: Hamiltonian for a simple harmonic oscillator, solution of Hamilton‟s equations for simple harmonic oscillations (1-D), particle in a central force field – conservation of angular momentum and energy.

Unit III:

Principle of least action. Canonical Transformations, Examples of canonical transformations, Advantages of canonical transformations, solution of simple harmonic oscillator problem. Conditions for transformation to be canonical

Unit IV:

Poisson Brackets, Invariance of poisson brackets with respect to canonical transformation, equation of motion in poisson bracket form, Poisson's theorem, Jacobi Identity, Angular momentum and Poisson Brackets, Liouvilles Theorem.

Refrences:

1. Classical Mechanics, by H Goldstein, Pearson, 2004
2. Classical Mechanics, by N C Rana AND p s Joag (Tata McGraw-Hill, 1991)
3. Mechanics, by Sommerfeld (Academic Press, 1952)
4. Introduction to Dynamics, by I Perceival and D Richards (Cambridge Univ. Press. 1982
5. Classical Mechanics by J C Upadhyay Mechanics: Volume 1 (Course of Theoretical Physics S) by L D Landau, E.M. Lifshitz

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SEMESTER 4th **MAJOR COURSE**

Subject: Physics

Course Title: Mathematical Physics Course Code: BPH22C403
Credits: Theory: 04; Tutoroal: 02 Contact Hours: Th 64, Pr 32

Course Objectives
To develop required mathematical skills in the area of complex functions, special functions, integral transformations and vector calculus.
Course Outcomes
On completion of the course, students will be able to:
1. Understand the complex variables and complex function and use it to calculate residue and definite integrals.
2. Solve problems related with vector calculus with the help of differential operators like gradient, curl, divergence and Laplacian.
3. Apply the Fourier series to expand the (arbitrary) periodic functions.
4. Apply the integral transformations like Fourier and Laplace transformations to solve differential equations.

UNIT I

Basic Idea of Limits, continuity, differentiation and Integration.Intuitive ideas of continuous, differentiable functions and plotting of curves.

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients, Partial Differentiation

UNIT II

Review of complex number system,Argand Diagram, triangle inequality, De Moivere's theorem and its applications. Functions of Complex Variables.Analyticity and Cauchy-Riemann Conditions.Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable.Cauchy's Inequality.Cauchy's Integral formula.

UNIT III

Addition and Multiplication of Matrices.Null Matrices.Diagonal, Scalar and Unit Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices.Conjugate of a Matrix.Hermitian and Skew- Hermitian Matrices.Singular and Non-Singular matrices.Orthogonal and Unitary Matrices.Trace of a Matrix.Inner Product.Eigen-values and Eigenvectors.Diagonalization of Matrices.

UNIT IV

Fourier Series: Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients.Complex representation of Fourier series.

Integrals Transforms: Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples: Fourier transform of trigonometric, Gaussian, finite wave train & other functions.

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
7. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
8. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
9. T.M.Apostol,- Calculus I
10. Shanti Narayan- Diffrential Calculus.