SEMESTER-III
PHY03(T)
Thermal Physics, Optics

(Lectures: 90)
(Full Marks: 75)

UNIT I (25 Lectures)

Review of kinetic theory of gases. Limitations of the perfect gas equation PV=RT. Van der Waals correction, Van der Waals equation and evaluation of critical constants of a gas. Law of equipartition of energy (without proof) and its application to obtain γ ($=C_P/C_V$) of monatomic and diatomic gases.

Transport phenomena: Concept of calculation of mean free path, Claussius mean free path and estimation of molecular diameter. Viscosity and thermal conductivity of a gas. Einstein theory of Brownian motion.

Laws of thermodynamics: The zeroth law, indicator diagram, work done, the first law, internal energy. Reversible and irreversible changes, Carnot cycle, Carnot theorem, second law of thermodynamics, entropy as thermodynamic variable, principle of increase of entropy, entropy of a perfect gas, entropy and unavailable energy. Thermodynamic scale of temperature and its identity with perfect gas scale. Impossibility of attaining absolute zero, third law of thermodynamics.

UNIT II (10 Lectures)

Liquefaction of gases: Adiabatic expansion, Joule Thomson effect, Boyle temperature and inversion temperature. Principle of regenerative cooling and cascade cooling.

Black body radiation: spectral distribution of black body radiation, Planck's quantum postulates, derivation Planck's Law, Rayleigh Jeans law, Stefan-Boltzmann law, and Wein's displacement law from Planck's law.

UNIT III (20 Lectures)

Fermat's principle: Principle of extremum path. Application of Fermat's principle to reflection and refraction at plane and curved boundaries.

General theory of image formation: Cardinal points of an optical system, refraction through a thick lens, relation between the distances of cardinal points, combination of thin lens separated by a distance.

Ideas of matrix optics, lens formula by matrix method.

Aberration in images: Chromatic aberration, achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reductions, aplanatic points of a sphere with proof, oil immersion objectives.

Optical instruments: eyepieces- Ramsden and Huygens eyepieces and their cardinal points. Relative merits and demerits of Ramsden and Huygen's eyepiece.

UNIT IV (26 Lectures)

Interference of light: Condition for sustained interference, Fringes produced by a wedge-shaped thin film, fringes of equal thickness and equal inclination, Haidinger fringes. Theory of Newton's rings and experimental determination of wavelength of monochromatic light.

Michelson interferometer, construction and production of fringes, its applications for the determination of wavelength, wavelength difference.

Intensity distribution in multiple beam interference. Fabry-Perot interferometer, construction and production of fringes.

Diffraction of light: Fresnel diffraction, Fresnel half period zones, zone plates, straight edge, rectilinear propagation. Fraunhoffer diffraction: Diffraction from a double-slit, N slits, theory of plane diffraction grating. Resolution of images, resolving power of Fabry-Perot interferometer and plane transmission gratings.

Polarization: Methods of polarization, methods of producing elliptically and circularly polarized light. Quarter wave plate and half wave plate, double refraction in uniaxial crystals (qualitative idea). Rotation of plane of polarization, Fresnel's theory of optical rotation.

Unit V (9 Lectures)

Absorption bands, normal and anomalous dispersion. Qualitative idea of Rayleigh's scattering

Laser: Condition for laser action, existence of metastable state, population inversion by pumping and cavity. He-Ne laser (basic principle).

Fibre Optics: Basic principle and its applications.

Text Books:

1. **Heat and Thermodynamics**: Brij Lal and N. Subrahmanyam and P.S. Hemne, S Chand, New Delhi, 2012.
2. **A text Book of optics**: D.N. Subrahmanyam, Brij Lal and M.N. Avadhanulu, S Chand, New Delhi, 2012.

Reference Books:

1. A.K.Ghatak, Physical Optics, Tata McGraw Hill of India, 2nd Edition, 1997.
2. A.B. Gupta, Modern Optics, Books and Allied (P) Ltd., 2006.
3. M.W. Zemansky & R.H. Dittman, Heat and Thermodynamics, McGraw Hill, Singapore, 7th Edition, 1997.

SEMESTER-III

PHY03(P)

Experimental Physics-II

(Full Marks : 25)

(Minimum eight experiments to be performed)

List of experiments

1. Determination of the co-efficient of linear expansion of a solid by using Pullinger's apparatus and optical lever.
2. Determination of the specific heat of a liquid by the method of cooling.
3. Determination of the co-efficient of thermal conductivity of a good conductor by Searle's method.
4. Determine the mechanical equivalent of heat by Joule's calorimeter.
5. Determination of the refractive index of a prism by a spectrometer using monochromatic light.
6. Determination of the radius of curvature of a lens by Newton's ring method.
7. Determination of the grating constant by using a spectrometer.
8. Determine the wavelength of a laser beam using plane diffraction grating.
9. Determination of the refractive index of the materials of convex lens by measuring its focal length (displacement method) and radii of curvature (using spherometer).
10. To study the frequency response of a series and parallel LCR circuit.

Text Books:

1. **B.Sc. Practical Physics**, C.L. Arora, S Chand and Co., 2005.
2. **A Text Book of Practical Physics**, S. Ghosh, New Central Book Agency, Kolkata, 2004.
3. **A Text Book on Practical Physics**, K.G. Mazumdar, Shreedhar publisher, Kolkata, 2006.