UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN PHYSICS
SYLLABUS WITH EFFECT FROM 2020-2021

BPS-CSC07

CORE-VII: OPTICS & SPECTROSCOPY
(Common to B.Sc.Physics with Computer Applications-III Sem.)

Lecture: 60 Hours Tutorial: 15 Hours Credits:4

Course Objective :

To understand the defects in lenses and rectifying methods.
To study the applications of Interference, diffraction and polarisation.
To gain overall knowledge in spectroscopic techniques.

Learning Outcomes :

After completing the course, the student will be able to

- Know the methods of rectifying different defects in lenses.
- Work with interferometers and other optical instruments.
- Distinguish between resolving power and dispersive power.
- Understand the rectilinear propagation of light.
- Be conversant with production and detection of different types of polarized light.
- Extract the dynamic information about the molecules using the spectroscopic techniques

UNIT I: GEOMETRICAL OPTICS (12 Hours)

Aberration in lenses - Spherical aberration in a lens - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (In and out of contact) - Dispersion produced by a thin prism - Achromatic prisms - Combination of prisms to produce (i) Dispersion without deviation (ii) Deviation without dispersion - Direct vision spectroscope.

Eyepieces -Ramsden's and Huygens's eyepieces -Construction, Theory

UNIT II: INTERFERENCE (12 Hours)

Analytical treatment of interference - Expression for intensity - Condition for maxima and minima in terms of phase and path difference - Coherent sources, Interference in thin films – transmitted and reflected - Colour of thin films -Air wedge - Determination of diameter of thin wire - Test for optical flatness - Determination of wavelength of light using Newton's rings - Haidinger's fringes - Michelson's Interferometer – Theory - Applications - Determination of wavelength - Thickness of thin transparent material and resolution of interferometer.

UNIT III: DIFFRACTION (12 Hours)

Fresnel diffraction - diffraction at a circular aperture and narrow wire – Fraunhofer diffraction - Single slit - Double slit - (Simple theory) - Plane diffraction grating – Plane transmission grating element – Missing order - Overlapping spectra - Maximum number of orders - Determination of

wavelengths using grating - Normal incidence - Dispersive power of a grating - Rayleigh's criterion for resolution - Limit of resolution of the eye - Resolving power of Telescope and microscope - Resolving power of prism and grating - Difference between resolving power and dispersive power.

UNIT IV: POLARISATION (12 Hours)

Double refraction - Nicol prism - Polarizer and analyser - Huygens explanation of double refraction in uni-axial crystals - Dichroism - Polaroids and their uses - Double image polarizing prisms - Quarter wave plate and Half wave plate - Plane, elliptically and circularly polarized light - Production and detection - Babinet's Compensator - Optical Activity - Fresnel's explanation of optical activity - Specific rotatory power - Determination using Laurent's half shade polarimeter.

UNIT V: SPECTROSCOPY (12 Hours)

Introduction to spectroscopy - Electromagnetic spectrum - Characterization of electromagnetic radiation - Quantization of energy - Regions of the spectrum – Classification of molecules – Microwave spectroscopy – Rigid rotator - Vibrational spectroscopy – Harmonic oscillator - Raman effect - Experimental set up - Characteristics of Raman lines -Ultraviolet spectroscopy- Origin and theory of ultraviolet spectra- Introduction to Nuclear Magnetic Resonance – Quantum description of NMR- Larmor equation - Chemical shift (Qualitative study)

BOOKS FOR STUDY:

1. Optics, AjayGhatak, Tata McGraw-Hill publishing Co. Ltd., New Delhi (1998).
2. A Text book of Optics, Subrahmanyam N., BrijLal and M. N. Avadhanulu, S. Chand & Co., New Delhi (2006).
3. Molecular Structure and Spectroscopy, Aruldhas, Prentice Hall of India Pvt. Ltd., New Delhi (2005).
4. Optics and Spectroscopy, R. Murugesan and KiruthigaSivaprasath, S. Chand & Co., New Delhi (2006).

BOOKS FOR REFERENCE:

1. Optics, Khanna D. R. &Gulati H. R., S. Chand & Co., New Delhi (1979).
2. Fundamental of optics, Jenkins & White, McGraw Hill 4th edition (1981).
3. Fundamentals of Physics, D. Halliday, R. Resnick and J. Walker, Wiley, 6th Edition, New York (2001).
4. H. Lipson and D.S Tannhauser, S.G. Lipson, Optical Physics, (3rd edition), Cambridge University press (1995).
5. Miles V. Klein and Thomas E.Furtak, Optics, John Wiley & sons(2nd edition) (1987)

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