JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: IV**

PHYSICS PAPER IV
PHYSICS OF WAVES, GEOMETRICAL OPTICS, PHYSICAL OPTICS AND LASER

Course Code: 18IVPH4 **No. of Hours: 60**

COURSE OBJECTIVES:

- To develop an awareness and understanding motion of wave in matter
- To develop knowledge and an understanding of the properties of light
- To gain knowledge and skills to develop optical devices
- To develop an understanding of interference, diffraction and basic Laser principles, Laser behaviour, Properties of laser radiations, Different types of Lasers and Laser applications

LEARNING OUTCOMES:

- Students will be able apply knowledge of light waves to explain natural physical processes and related technological advances.
- They develop an understanding of the wave properties of light and study how light waves interfere with each other.
- They gain knowledge of how light diffracts when it encounters an aperture or edge.
- They will be able to explain different Laser used in real life and make a comparison between them

UNIT I

CHAPTER 1 WAVE PROPAGATION IN MATTER **7 HRS**

Review of particle vibrations and wave motion with their mathematical representation. Equation for Simple Harmonic wave.Superposition of waves.Beats.Derivation of expressions for energy and power transported by a wave.Waves in a solid. Setting up longitudinal wave equation in a solid rod and its solution for a rod fixed at both ends. Theory of Kundt's tube experiment. Seismic waves and Shock waves (qualitative). Problems

CHAPTER 2 GEOMETRICAL OPTICS **4 HRS**

Fermat's principle and it's explanation. Focal length of combination of two lenses separated by aconstant distance by deviation method. Velocity of light –Michelsons experiment for the determination of velocity of light. Kerr cell method of determination of speed of light in free space with theory. Problems

CHAPTER 3 EYE PIECES **4 HRS**

Review of spherical and chromatic aberration in lenses. Huygen's and Ramsden's eyepieces with theory, comparison of their working

UNIT II

CHAPTER 1 WAVE THEORY **3 HRS**

Huygen's wave theory of light.Huygen's principle and construction of a wavefront. Proof of laws of reflection and refraction of a spherical wavefront at a plane surface

CHAPTER 2 INTERFERENCE **12 HRS**

Interference – a Review

Coherent sources and their production; conditions for observing interference; Conditions for constructive and destructive interference.

Coherent Sources by Wavefront Division

Biprism – theory and working, experiment to determine the wavelength; Effect of thin film in the path of one of the beams; calculation of thickness of the film

Coherent Sources by Amplitude Division

Interference at thin films- reflected lightcolors of thin films; Theory and experiment of air wedge; Theory and experiment of Newton's rings.

UNIT III

CHAPTER 1 FOURIER THEOREM **4 HRS**

Fourier theorem and its significance.Evaluation of Fourier coefficients.Fourier analysis of a saw-tooth wave.Fourier spectrum.

CHAPTER 2 DIFFRACTION OF LIGHT **11HRS**

Review of diffraction of light. Fresnel's diffraction.Division of a plane wavefront into half period zones.Construction and theory of a zone plate.Comparison of a zone plate with a lens.Theory of diffraction of a cylindrical wavefront at a straight edge.Fraunhofferdiffraction.Theory of diffraction at a single slit and its extension to multiple slits.Plane diffraction grating.Theory of normal and oblique incidence.Dispersive power of a grating.Resolving power and Rayleigh's criterion.Comparison between prism spectrum and grating spectrum. Problems

UNIT IV

CHAPTER 1 POLARIZATION OF LIGHT **6 HRS**

Review of polarized light.NicolPrism Polarization by double refraction. Huygen's explanation of double refraction (for oblique incidence on a negative crystal with the optic axis in the plane of incidence, inclined to the surface).Retarding plates. Theory of quarter wave plate and half wave plate. Production and detection of circularly, elliptically and linearly polarized light. Problems

CHAPTER 2 OPTICAL ACTIVITY **3 HRS**

Biot's laws of optical activity.Action of Laurent's half shade device. Fresnel's theory of optical activity Determination of optical activity of a solution. Problems

CHAPTER 3 LASER **6 HRS**

General principles, Absorption and Spontaneous and induced emissions, Optical pumping, Resonance cavity, active medium, Population inversion, Conditions for laser action.Einstein's constants A and B and derivation of expressions for them. Purity of a spectral line,

Time and Spatial coherence, He-Ne laser construction and working.Applications of lasers.Bloodless surgery.

Problems

REFERENCES

1. Acoustics, *L Kinsler and Frey*, John-Wiley Publications, 2000
2. A textbook of Sound, *Brijlal&Subramaniam*, Vikas Publishing, II Edition
3. Fundamentals of Physics, *Halliday&Resnick*, VI edition
4. Principles of Optics, *B. K. Mathur*, Wiley Eastern Ltd., 1999
5. Contemporary Optics, *A. K. Ghatak and K. Thyagarajan*, TMH, 1977
6. Optics, *Brijlal&Subramaniam*, S. Chand & Co., 2001
7. Optics, *Jenkins & White*, Tata McGraw Hill, III Edition
8. Fundamentals of Optics, *M.G.Raj*, Anmol Publications, 2001
9. Optics and Spectroscopy, *R.Murugeshan*, S.Chand& Co, 2005
10. Optics and Atomic Physics, *SatyaPrakash*, RatanPrakashanMandir, 1995
11. Optics, *C.L.Arora*, S.Chand& Co., 1999

Note: It is recommended to browse the NET for latest information on each topic

PHYSICS PRACTICAL – IV

1. Determination of focal length of a combination of lenses with constant distance of separation
2. Determination of refractive index of a liquid by parallax method
3. Determination of diameter of a wire by setting up an air wedge
4. Determination of radius of curvature of a convex lens by setting up Newton's rings
5. Determination of wavelengths of spectral lines of a mercury vapor source using a plane diffraction grating by normal incidence / minimum deviation method
6. Determination of specific rotation of sugar solution using a polarimeter
7. Determination of refractive index of a prism material by total internal reflection
8. Determination of resolving power of a telescope.
9. Determination of refractive index of water contained in a hollow prism using a spectrometer
10. Determination of refractive index of a transparent medium by total internal reflection
11. Wavelength of light He-Ne laser

Note:

1. A minimum of 8 experiments to be performed
2. Practical instructions manual to be prepared by faculty of Physics
3. Demonstration experiments to be considered as Group Project Work

REFERENCES

1. Physics through Experiments, Volume 1, *B.Saraf* et al, Vikas Publishing House Pvt. Ltd., 1978
2. Advanced Practical Physics 1, *S.P.Singh*, PragatiPrakashan, 1990
3. An Advanced Course in Practical Physics, *D.Chattopadhyay et al*, New Central Book Agency (P) Ltd., 2002
4. B.Sc. Practical Physics, *Harnam Singh*, S.Chand& Co. Ltd., 2001
5. Advanced Physics Laboratory Manual, *Raj Kumar, UditNarain&P.K.Yadav*, KedarNath Ram Nath& Co., 2005
6. Advance Level Practical Physics, *M.Nelkon&J.M.Ogborn*, ELBS, 4th Edition
7. B.Sc. Practical Physics, *C.L.Arora*, S.Chand& Co. Ltd., 2006
8. University Practical Physics, *J.C.Mohanty&D.K.Mishra*, Kalyani Publishers, 1995
9. Advanced Practical Physics, *B.L.Worsnop&H.T.Flint*, Asia Publishing House, 1965
10. University Practical Physics with viva-voce, *C.K.Bhattacharya*, CBS Publishers, 1986
11. Fundamental Practical Physics, *D.R.Khanna&H.R.Gulati*, Modern Book Depot Educational Publishers, 5th Edition
12. Practical Physics, *Induprakash&H.Ramakrishna*, KitabMahal, 1986