VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

Physics

III Semester Syllabus

Bachelor of Science

With effect from 2021-22 and onwards

Name of the Department: Physics

Semester-III

DSC 3: Wave Motion and Optics

Course Title: Wave Motion and Optics	**Course code: :** 21BSC3C3PHL
Total Contact Hours: 55	**Course Credits: 04**
Internal Assessment Marks: 40 marks	**Duration of SEE: 03 hours**
Semester End Examination Marks: 60 marks	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Analyse superposition of harmonic waves sound waves using fundamentals of waves.
2. Identify the formation of standing waves in physical systems.
3. Identify the physical parameters and materials for good acoustics.
4. Use interference of light to interpret physical phenomena.
5. Analyse the difference between Fraunhofer and Fresnel diffractions.
6. Explain polarization of light and its application.
7. Describe the fundamentals of lasers.

DSC 3: Wave Motion and Optics

Unit	Description	Hours
1	**Waves:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive Wave and its equation, Wave Equation – Differential form (derivation). Particle and Wave Velocities: Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton's Formula for Velocity of Sound. Laplace's Correction (Derivation). Brief account of Ripple and Gravity Waves. (Text Book : 1-4) (5 Hours) **Superposition of Harmonic Waves :** Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular Harmonic Oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous' figures. (Text Book : 1-4) (6 Hours)	11
2	**Standing Waves :** Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string. Vibrations in rods – longitudinal and transverse modes (qualitative). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator. (Text Book : 1-4) (8 Hours)	11

	Acoustics: Absorption coefficient, Reverberation and Reverberation time, Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. (Text Book : 1-4) (3 Hours)	
3	**Nature of light :** The corpuscular model of light-The wave model - Maxwells electromagnetic waves, Wave Particle Duality (Text Book No 5; Sections 2.1 to 2.4 and 2.8) (2 Hours) **Interference of light by division of wave front:** Huygen's theory-Concept of wave-front-Interference pattern produced on the surface of water-Coherence-Interference of light waves by division of wavefront-Young's double slit experiment- derivation of expression for fringe width-Fresnel Biprism Interference with white light (Text Book No 5; Sections 12.1 to 12.2, 14.1 to 14.5, 14.7 to 14.9) (4 Hours) **Interference of light by division of amplitude:** Interference by division of amplitude-Interference by a plane parallel film illuminated by a plane wave-Interference by a film with two non-parallel reflecting surfaces-color of thin films - Newton's rings-(Reflected light), Michelson Interferometer - Determination of wavelength of light (Text Book No 5; Sections 15.1 to 15.2, 15.8 to 15.11) (5 Hours)	11
4	**Fraunhofer diffraction :** Introduction - Fraunhofer diffraction- Single slit diffraction pattern-position of Maxima and Minima (Qualitative arguments)- Two slit diffraction pattern-position of Maxima and minima-Theory of plane diffraction Grating-Grating spectrum- normal and oblique incidence, Resolving power and dispersive power of a grating, Single slit; Double Slit. Multiple slits Diffraction grating. (Text Book No 5; Sections 18.1 to 18.2, 18.6,18.8 to 18.9) (7 Hours) **Fresnel Diffraction-** Fresnel half period zones-Diffraction by a circular aperture-diffraction by an opaque disc-The zone plate -comparison between zone plate and convex lens. (Text Book No 5; Sections 20.1 to 20.3) (4 Hours)	11
5	**Polarisation:** Introduction-Production of polarized light- The wire Grid polarizer and Polaroid, Superposition of two disturbances - Phenomenon of double refraction-Quarter wave plates and half wave plates- Analysis of polarized light, optical activity. (Text Book No 5; Sections 22.1, 22.3,22.4,22.6 to 22.8) (4 Hours) **Lasers:** Absorption, Spontaneous emission and Stimulated emissions, Einstein coefficients and their relations, Population inversion, Metastable states, Components of laser: active medium, pump and optical resonator, Steps of lasing action, Pumping schemes : Three level and four level, Ruby laser, He-Ne laser, Applications of lasers (qualitative): medical, industry, defense and entertainment. (7 Hours)	11

Text Books:

1. The Physics of Waves and Oscillations, N K Bajaj Tata McGraw-Hill Publishing Company Ltd., Second Edition, 1984
2. Waves and Oscillations N Subramanyam and Brij Lal Vikas Publishing House Pvt. Ltd., Second Revised Edition 2010
3. A Text Book of Sound D R Khanna and R S Bedi Atma Ram & Sons, Third Edition 1952

4. Oscillations and Waves Satya Prakash, Pragathi Prakashan, Meerut, Second Edition 2003
5. Optics Ajoy Ghatak McGraw Hill Education (India) Pvt Ltd 2017
6. A text Book of Optics BrijLal, M N Avadhanulu & N Subrahmanyam S. Chand Publishing 2012.

Reference Books:

1. Berkeley Physics Course – Waves, Frank S Crawford Jr. Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition,. 2011
2. Optics Eugene Hecht Pearson Paperback 2019
3. Introduction To Optics Pedrotti and Frank L , Pearson India 3rd Edition
4. Fundamentals of Optics Francis Jenkins Harvey White McGraw Hill Education 2017

Name of the Department: Physics

Semester-III

DSC 3: Wave Motion and Optics Lab

Course Title: Wave Motion and Optics Lab	**Course code:** 21BSC3C3PHP
Total Contact Hours: 56	**Course Credits: 02**
Internal Assessment Marks: 25	**Duration of SEE: 03 hours**
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Design experiments based on Wave motion and optics.
2. Execute experiments based on Wave motion and optics.
3. Analyse experimental results based on Wave motion and optics.

DSC 3: Wave Motion and Optics Lab

List of Experiments

1. Velocity of sound through a wire using Sonometer.
2. Frequency of AC using Sonometer.
3. Study of Lissajous' Figures
4. To verify the laws of transverse vibration using Melde's apparatus.
5. Helmholtz resonator using tuning fork.
6. Helmholtz resonator using electrical signal generator.
7. To determine refractive index of the Material of a prism using sodium source.
8. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
9. To determine the wavelength of sodium source using Michelson's interferometer.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
13. To determine wavelength of spectral lines of Hg source using plane diffraction grating.
14. To determine dispersive power and resolving power of a plane diffraction grating.
15. Determination of wavelength of laser light.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

References:

1. Advanced Practical Physics for students B.L. Flint and H.T. Worsnop Asia Publishing House. 1971.
2. A Text Book of Practical Physics I. Prakash & Ramakrishna Kitab Mahal, 11th Edition 2011.
3. Advanced level Physics Practicals Michael Nelson and Jon M. Ogborn Heinemann Educational Publishers, 4th Edition 1985.
4. A Laboratory Manual of Physics for undergraduate classes D.P.Khandelwal Vani Publications. 1985.