



S.V. University 4-Year Honours Degree Programme
BSc (Physics) Honours Degree Syllabus (W.E.F. AY-2026-27)

**Model Syllabus for 4-Year UG Honours in B.Sc. (Physics) as Major in
consonance with Curriculum framework w.e.f. AY 2026-27**

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	5	Atomic, Molecular & Nuclear physics	3	3
			Atomic, Molecular & Nuclear physics-Practical	2	1
		6	Basic Electronics	3	3
			Basic Electronics-Practical	2	1
		7	Applied Optics	3	3
			Applied Optics-Practical	2	1

SEMESTER-III

COURSE 7: APPLIED OPTICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVE:

This course aims to introduce students to the core principles of optics and the functioning of various optical instruments. The objective is to provide a clear understanding of ray optics, aberrations, lasers, optical fibers, holography, and their applications in modern optical systems such as microscopes and telescopes.

LEARNING OUTCOMES:

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

1. Understand the fundamentals of geometrical optics using ray matrices and apply them to complex lens systems.
2. Analyze and distinguish various types of optical aberrations and methods to minimize them.
3. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
4. Understand the basic principles of fibre optic communication and explore the field of Holography and Nonlinear optics and their applications.
5. Gain knowledge of various optical instruments including microscopes and telescopes, their types, and real-world applications

UNIT-I: GEOMETRICAL OPTICS

(9 hrs.)

Ray optics assumptions, Fermat principle, Translation matrix, Reflection matrix, Refraction matrix, ABCD matrices system matrix, Thick lens formula, Thin lens formula, Ramsden eyepiece, Huygens eyepiece, Two lens formula - (i) separated by a distance and (ii) in contact.

UNIT-II: ABERRATIONS

(9 hrs.)

Fresnel theory of Reflection and Refraction. Monochromatic aberrations, Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance.

UNIT-III: LASERS

(9 hrs.)

Lasers: Introduction, Spontaneous emission, Stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Types of lasers: He-Ne laser, Ruby laser, Semiconductor laser, Applications of laser.

UNIT-IV: OPTICAL FIBERS AND HOLOGRAPHY

(9 hrs.)

Principle of Optical fibers, Acceptance angle, Acceptance cone, Numerical aperture, Types of optical fibers - Graded and Stepped index, Types Signal attenuation mechanisms in optical fibers, Applications of Optical fibers - Sensors, Imaging, Communication.

Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

UNIT-V: APPLICATIONS OF OPTICAL INSTRUMENTS

(9 hrs.)

Introductory ideas and applications of various microscopes *viz.*, (i) Optical microscopes (Compound microscope, Confocal microscope) (ii) Electron microscopes – SEM, Introductory ideas and applications of various telescopes *viz.*, (i) Optical telescopes (ii) Radio telescopes (iii) Solar telescopes (iv) Infrared telescope (v) Ultraviolet telescope

REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad.
2. Optics - principles and applications Kailash K. Sharma
3. An introduction to Lasers M N Avadhanulu
4. Lasers Tyagarajan Ghatak 2nd Ed.
5. Introduction to Fiber Optics Tyagarajan Ghatak
6. Principles of Laser material processing Elijah Kannatey Asibu
7. Quantum optics An introduction Mark Fox

SEMESTER-III

COURSE 7: APPLIED OPTICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To provide hands-on experience with optical components and instruments, and to reinforce theoretical concepts through practical applications involving lasers, optical fibers, microscopes, and ray optics techniques.

LEARNING OUTCOMES:

1. Understand and apply geometrical optics principles through practical experiments involving lens combinations, matrix methods, and measurement of focal lengths using systems like the two-lens setup.
2. Demonstrate hands-on understanding of monochromatic and chromatic aberrations by working with diffraction gratings and measuring resolving powers of optical components like gratings and telescopes.
3. Explore the operational principles and characteristics of lasers, including wavelength measurement using diffraction gratings and analysis of laser beam behavior through reflection and refraction experiments.
4. Operate and analyze optical fiber systems by determining the numerical aperture, acceptance angle, and exploring their applications in communication and light guiding.
5. Investigate holographic concepts by understanding the role of laser light in interference-based techniques and identifying the limitations of basic holographic setups.
6. Examine and interpret the working of various optical instruments such as microscopes and telescopes by studying resolution, power, and optical limitations through practical experiments and simulations.

Minimum of 6 experiments to be done and recorded

1. Wavelength of laser using Diffraction grating
2. Refractive index of liquid using Hollow prism
3. Resolving power of telescope
4. Resolving power of grating
5. Spectrometer: i-d curve
6. Laser Reflection grating using metal scale
7. Optical fiber - Numerical Aperture
8. Rabi Oscillations Octave program
9. Two lens system power pairs plot (Python/Octave)
10. Focal length and verification of matrix method for thick and thin lenses
11. Achromatic combination of two lenses – in contact and at a distance
12. Measurement of beam divergence and spot size of a laser
13. Verification of Malus' Law using a laser and polarizers
14. Study of diffraction pattern from circular aperture (Airy disk) – resolving limit
15. Young's double-slit experiment using laser – interference fringes and fringe width
16. Study of bending losses in optical fiber

STUDENT ACTIVITIES

Unit-I: Geometrical Optics

Activity: Lens Matrix Simulation and Eyepiece Comparison

Students can use Python or Octave to simulate the behavior of optical systems using ABCD matrices. They can plot system matrices for single and double-lens setups and analyze the effective focal length. Additionally, students may perform a comparative analysis between Ramsden and Huygens eyepieces using ray diagrams and matrix methods, presenting their findings through short presentations or lab reports

Unit-II: Aberrations

Ask students to observe and sketch the different images produced by the lens at different distances. Build a simple optical system with two lenses in contact and ask students to calculate the focal length and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the effects of chromatic aberration and ask students to observe and discuss the changes in the image produced.

Unit-III: Lasers

Activity: Laser Communication Demo – Group project to transmit voice using a laser beam and photodiode.

Unit-IV: Optical fibers and Holography

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

UNIT-V: Applications of Optical Instruments

Activity: Comparative Analysis of Optical and Electron Microscopes and Telescope Technologies
Students will form groups to study various microscopes (compound, confocal, SEM) and telescopes (radio, solar, UV, IR). Each group will create a model or infographic that illustrates the working principles, resolution limits, and applications of these instruments. Presentations will focus on how optics is tailored to different wavelength regimes.

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**4- Year UG Honours, Major
Syllabus
(2026-27)
Semester-III**

Model Question Paper

Time : 3hrs

Marks:75

Part-A

Answer any Five Questions. Each Question carries 3 Marks.

5x3=15

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

Answer the following questions. Each question carries 12 Marks

5x12=60

11. a) Unit-I
(Or)
b) Unit-I

12. a) Unit-II
(Or)
b) Unit-II

13. a) Unit-III
(Or)
b) Unit-III

14. a) Unit-IV
(Or)
b) Unit-IV

15. a) Unit-V
(Or)
b) Unit-V