



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 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

Theory

Credits: 3

3 hrs/week

COURSE OBJECTIVE:

The course aims to introduce students to the principles of atomic structure, molecular spectroscopy, and fundamental nuclear physics. It covers key experimental methods and theoretical models, helping students understand how microscopic interactions lead to observable physical phenomena in atoms, molecules, and nuclei.

LEARNING OUTCOMES:

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

1. Understand the principles of atomic structure and spectroscopy.
2. Understand the principles of molecular spectroscopy.
3. Develop critical understanding of concept of Matter waves and Uncertainty principle.
4. Describe nuclear properties, binding energy, and nuclear models such as the liquid drop and shell model.
5. Explain the working of nuclear detectors and accelerators and classify elementary particles and their interactions.

UNIT-I: INTRODUCTION TO ATOMIC STRUCTURE AND SPECTROSCOPY (9 hrs.)

Introduction to Bohr's model of the hydrogen atom, Vector atom model and Quantum numbers associated with it, Stern and Gerlach experiment, Coupling Schemes (LS & JJ), Spectral terms and spectral notations, Selection rules, Zeeman effect, Experimental arrangement to study Zeeman effect and expression for Zeeman shift.

UNIT-II: MOLECULAR SPECTROSCOPY (9 hrs.)

Molecular rotational and vibrational spectra, electronic energy levels and electronic transitions, Raman effect, Characteristics of Raman effect, Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect. Spectroscopic techniques: IR and UV-Visible.

UNIT-III: MATTER WAVES & UNCERTAINTY PRINCIPLE (9 hrs.)

Matter waves, de Broglie's hypothesis, Properties of matter waves, Davisson and Germer's experiment, Heisenberg's uncertainty principle for position and momentum & energy and time, Illustration of uncertainty principle using diffraction of beam of electrons (Diffraction by a single slit) and photons (Gamma ray microscope).

UNIT-IV: INTRODUCTION TO NUCLEAR PHYSICS**(9 hrs)**

Nucleus: Properties of nucleus, Mass defect, Binding energy – binding energy curve; Nuclear forces: Characteristics of nuclear forces, Yukawa's meson theory; Nuclear Models- Liquid drop model- Semi empirical mass formula, Shell model, magic numbers.

UNIT-V: NUCLEAR DETECTORS AND NUCLEAR ACCELERATOR**(9 hrs)**

Nuclear detectors: Geiger- Muller counter, Cloud chamber (expansion type), Scintillation counter. Nuclear Accelerators: Cyclotron-construction, working and applications; Synchrocyclotron-construction, working and applications. Classification of elementary particles, Types of interactions- strong, electromagnetic and weak interactions;

REFERENCE BOOKS:

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Atomic Physics by J.B. Rajam; S. Chand & Co.,
3. Modern Physics by R. Murugesan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
5. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
6. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
7. Atomic and Nuclear Physics (Vol.2), S.N. Ghoshal, S. Chand & Co. (1994).
8. Nuclear Physics, D.C. Tayal, Himalaya Pub. (1997).

SEMESTER-III

COURSE 5: ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

Practical

Credits: 1

2 hrs/week

COURSE OBJECTIVE:

To develop practical skills and experimental understanding in atomic and nuclear physics, including spectral line measurements, particle detection, and verification of quantum and nuclear models.

LEARNING OUTCOMES:

1. Demonstrate a deep understanding of the principles and theories of modern physics through hands-on experimentation and data analysis.
2. Analyze and interpret experimental data using statistical methods and error analysis, drawing meaningful conclusions and relating them to theoretical concepts.
3. Design and conduct independent experiments or investigations related to modern physics, demonstrating the ability to plan, execute, and analyze experimental procedures and results.
4. Gain a solid understanding of fundamental concepts in nuclear physics.
5. Understand the principles and operation of laboratory equipment and instruments specific to nuclear physics experiments.
6. Develop proficiency in conducting experiments related to nuclear physics.

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method
2. Determination of Planck's constant using a photocell
3. Verification of inverse square law of light using photovoltaic cell
4. Determination of work function of the filament material using directly heated vacuum diode
5. GM counter – Determination of dead time
6. Study of characteristic curve of GM counter and estimation of its operating voltage
7. Estimation of efficiency for a gamma source using GM counter
8. Estimation of efficiency for a beta source using GM counter
9. Study of sodium doublet using a diffraction grating
10. IR or UV-Vis spectroscopy of samples using a portable spectrometer
11. Single slit diffraction of laser beam to illustrate uncertainty principle
12. Study of absorption of beta particles in aluminum sheets
13. Study of Compton scattering (demo or simulation)
14. Study of counting statistics using GM counter
15. Study of plateau region and dead time using a counting system

STUDENT ACTIVITIES

UNIT-I: Introduction to Atomic Structure and Spectroscopy

Spectroscopy Experiment

Divide the students into small groups and provide each group with a spectrometer or spectroscope, a light source, and different samples or elements for analysis.

Instruct the students to carefully observe the spectra produced by the samples using the spectrometer. Encourage them to note the presence of specific spectral lines or patterns.

Data Collection

Have the students record their observations in their lab notebooks or worksheets. They should note the wavelengths or colors of the observed spectral lines and any patterns they observe.

Analysis and Discussion: Guide a class discussion on the observed spectra and their significance. Discuss how the observed spectral lines correspond to specific energy transitions in the atoms. Ask students to compare the spectra of different samples or elements and identify any similarities or differences.

Discuss the concept of energy levels and how electrons transition between them, emitting or absorbing photons of specific wavelengths.

UNIT-II: Molecular Spectroscopy

Begin the activity with a brief introduction to molecular structure, discussing concepts such as chemical bonds, molecular geometry, and the importance of molecular structure in determining the properties and behavior of substances. Explain the principles of spectroscopy, focusing on vibrational and rotational spectra and how they relate to molecular vibrations and rotations.

UNIT-III: Matter waves & Uncertainty Principle

Begin the activity by introducing the concept of matter waves and the uncertainty principle. Discuss how the wave-particle duality of matter is a fundamental principle in quantum mechanics. Provide a brief overview of the historical development of the uncertainty principle and its implications for our understanding of the behavior of particles on a microscopic scale.

UNIT-IV: Introduction to Nuclear Physics

Provide students with a computer simulation or interactive app that allows them to explore radioactive decay processes. Ask students to observe and analyze the decay patterns of different isotopes, including the concept of half-life. Guide students to make connections between the simulation results and the fundamental principles of nuclear physics.

UNIT-V: Nuclear Detectors and Nuclear Accelerators

Activity: Detector Comparison Chart – Students create a comparative table of detector types, operation principles, advantages, and use-cases.

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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