Paper VI: Modern Physics
(For Maths Combinations)
V Semester

Work load: 60 hrs per semester **4 hrs/week**

UNIT-I (12 hrs)

1. Atomic and molecular physics

Introduction –Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II (12 hrs)

2. Matter waves & Uncertainty Principle

Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification

UNIT-III (12 hrs)

3. Quantum (wave) mechanics

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

UNIT-IV(12 hrs)

4. General Properties of Nuclei

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model

5. Radioactivity decay:

Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V (12 hrs)

6. Crystal Structure

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law.

7. Superconductivity:

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - applications of superconductors.

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.

3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Modern Physics by G. Aruldhas & P. Rajagopal. Eastern Economy Edition.
5. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
6. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
7. Nuclear Physics, Irving Kaplan, Narosa publishing House.
8. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
9. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
10. Solid State Physics, A.J. Dekker, McMillan India.

Practical Paper VI:Modern Physics

Work load: 30 hrs **2 hrs/week**

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.
11. A.C Impedance and power factor.
12. Half adder and full adder.
13. Carry Foster, s Bridge-Determination of specific resistance of a given wire.
14. Bridge rectifier-Filters.

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L. Arora Published by S.Chand & Co, New – Delhi may be followed.

Scheme of Valuation

Practical	**50 marks**
Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment - Few problems may be given to the students from the different units and asked them to solve.

Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and

QUESTION BANK

UNIT – 1(Atomic and molecular physics)

Essay Questions(10M)

1. Describe Stern-Gerlach experiment with neat diagram and necessary theory.
2. Explain the quantum numbers associated with vector atom model.
3. What is Raman effect. Describe an experimental arrangement for the study of Raman efeect.

Short Answers (5M)

1. What are the drawbacks of Bohr atomic model?
2. Write a short note on Coupling schemes.
3. Write a short note on relativistic correction.
4. Explain the quantum theory of Raman effect.
5. What are the applications of Raman effect?

UNIT – 2(Quantum (wave) mechanics I)

Essay Questions(10M)

1. What are Matter waves? Explain de Broglie's hypothesis for matter waves. Derive expressions for wavelength of matter waves.
2. Describe Davisson and Germer experiment with a neat diagram and necessary theory.
3. Explain Heisenberg's uncertainty principle for position and momentum and extend it for energy and time.

Short Answers (5M)

1. What are the Properties of matter waves?
2. Describe γ_ ray microscope

UNIT – 3(Quantum (wave) mechanics II)

Essay Questions(10M)

1. Write the basic postulates of quantum mechanics and derive Schrodinger time independent wave equation.
2. Write the Physical interpretation of wave function. Derive Schrodinger time dependent wave equation.
3. Apply Schrodinger wave equation to particle in one dimensional infinite box.

Short Answers (5M)

1. Write the Physical interpretation of wave function.

UNIT – 4

Essay Questions(10M)

1. Explain the basic properties of nucleus
2. Explain the liquid drop model for nucleus. What are the drawbacks in this model. What are the drawbacks in this model?
3. What are magic numbers? How these are explained in shell model?
4. Explain Gamow's theory of α-decay.

Short Answers (5M)

1. Write a short note on binding energy.
2. Write a short note on β – decay.

UNIT – 4(Nuclear Physics)

Essay Questions(10M)

1. Derive Bragg's law. Describe the construction and working of Bragg's spectrometer.
2. Describe Laue's method to determine the crystal structure.
3. Describe powder method to determine the crystal structure.
4. What is Meissner effect? Write about Type I and type II superconductors.

Short Answers (5M)

1. Write a short note on Miller indices.
2. What is isotopic effect on super conductivity.

3. What are the applications of super conductors.

6.explain the principle of transformer

UNIT-IV(Varying and Alternating currents)

Essay Questions(10M)

1.Derive an expression for the growth and decay of current in an inductance- resistance circuit.

2.discuss the nature of growth and decay of current in a capacitance –resistance circuit.

3.Discuss the growth and decay in a circuit containing resistance ,inductance and capacitance when direct e.m.f is applied.

Short Answer (5M)

1.Write a short note on power factor?

2.Write a short note on Q-factor?

3.Discuss the growth of charge in C-R Circuit.

4.Write about the growth and decay of current in L-R Circuit.

5.Derive the decay of charge in L-C-R Circuit.

6.Calculate the impedance of L,C, and R in series of an A.C.circuit

7.What is electric resonance? Distinguish between series and parallel resonance.

UNIT-V(Maxwell's equations)

Essay Questions(10M)

1.write Maxwell's equations in differential and integral forms. Derive an expression for energy flow by electromagnetic waves

2.Describe Hertz experiment for the production and detection of electromagnetic waves

3.what is pointing vector? what is its significance?

4.write down maxwell's equation for electromagnetic fields and explain what each equation represents. Show that electromagnetic waves are transverse in nature.

Short Answer (5M)

1.write down the Maxwell's equation in differential form.

2.what is meant by Poynting vector? Discuss the use in electromagnetic principles.

3.Show that electromagnetic waves are transverse in nature.

hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurementskills