**201PH24**

**ASSIGNMENT - 1**
**M.Sc. DEGREE EXAMINATIONS, DECEMBER -2025**

**Second Semester**

**PHYSICS**

# Paper-1- STATISTICAL MECHANICS

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. State and explain equipartition theorem.
2. Define phase space and explain its importance in statistical mechanics
3. What is ensemble?
4. Distinguish between micro, macro and grand canonical ensembles.
5. State and explain Gibb's paradox.
6. How is it resolved?
7. Obtain the thermodynamical function for grand canonical ensemble.
8. Discuss about energy fluctuation in micro canonical ensemble.
9. What is meant by energy fluctuation in statistical mechanics?

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**PHYSICS**

## Paper-1- STATISTICAL MECHANICS

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. Derive an expression for Bose-Einstein distribution and write the
2. Significance of Einstein condensation.
3. Derive an equation for the vibrational partition function.
4. Using this partition function, find the specific heats at both above and below the Debye temperature.
5. Derive an equation for the rotational partition function.
6. Apply the above partition function to solids.
7. Give an account of magnetic susceptibilities of free electrons.
8. Explain briefly about Brownian motion of a molecule.
9. What is meant by Bose-Einstein condensation?
10. Explain about Ladon diamgnetism.

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## Paper-II: SOLID STATE PHYSICS

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. What are the types of three-dimensional lattices? Explain.
2. What is the index system for crystal planes?
3. Explain the FCC cubic structure.
4. Describe the sodium chloride and zinc sulphide crystal structures.
5. Describe Powder method to determine crystal structure.
6. Derive scattered wave amplitude.
7. What is geometrical structure factor? Explain.
8. Explain electron diffraction in lattices.
9. Explain Acoustic and Optical modes in lattice vibrations.

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**PHYSICS**

## Paper-II: SOLID STATE PHYSICS

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. Describe the origin of thermal expansion.
2. Derive the expression for specific heat of solids using Debye model.
3. Explain Fermi-Dirac distribution function.
4. Derive the expression for density of states.
5. Explain the thermal conductivity of metals.
6. What is Hall effect? Explain to determine Hall coefficient.
7. What is the wave equation in a periodic potential?
8. Distinguish metals, semiconductors and insulators.
9. What is Bloch Theorem? Explain Kronig- Penny model to determine band structure in the crystals.

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**Second Semester**

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# Paper-III- QUANTUM DYNAMICS AND SCATTERING THEORY

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. Explain Pauli spin matrices.
2. Explain the matrices $J^2$,Jx,Jy and Jz matrices.
3. Discuss Wigner-Eckart theorem.
4. Explain tensor operator.
5. Obtain the equation of motion using interaction picture.
6. Obtain the expression for energy levels of harmonic oscillator using Heisenberg picture.
7. Obtain the equation of motion in Schrodinger picture.
8. Discuss how the unitary operator connects the Heisenberg picture and Schrodinger picture.
9. State the vector space for a system of particles.
10. What is the correspondence between Schrodinger picture and Heisenberg picture?

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# Paper-III- QUANTUM DYNAMICS AND SCATTERING THEORY

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. What is an operator write about creation and annihilation operators.
2. Discuss the quantum dynamics of identical particles
3. What is scattering and scattering cross section?
4. Explain the scattering of Wave packet.
5. Discuss the theory of partial wave analysis.
6. Obtain the expression for scattering cross section in case of square Well potential by partial wave method.
7. Discuss in detail Born-Oppenheimer approximation to a molecule.
8. Outline the theory of Valence bond method of a hydrogen molecule.
9. Discuss in detail molecular orbital method of a hydrogen molecule.
10. Write the theory of Heitler-London method of hydrogen molecule.

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## Paper IV- COMPUTATIONAL METHODS AND PROGRAMMING

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. Using Newton – Raphson method, find the roots of the equation
2. $x^3-6x^2+11x-6 = 0$.
3. Explain false-position method for finding roots of an equation.
4. Discuss the Gauss Elimination method for solving a systems of Simultaneous linear equation.
5. Write algorithm for Gauss-Seidel method.
6. Write algorithm for Newton's interpolation.
7. Derive Simpson's 1/3 rule.
8. Explain the Lagrange's interpolation formula.
9. Explain the data types in 'C' language.

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**Second Semester**

**PHYSICS**

# Paper IV- COMPUTATIONAL METHODS AND PROGRAMMING

**MAXIMUM MARKS: 30**
**ANSWER ALL QUESTIONS**

1. What are the identifiers and keywords on ‘C’ language ?
2. What are different types of ‘operators’ in ‘C’ language ? Explain.
3. Write the control statements in ‘C’ language.
4. Write a ‘C’ program for addition of two matrices.
5. Explain the user-defined functions in ‘C’ language.
6. What is an array ? Explain.
7. Explain creating, saving , plots printing matrices and vectors in Matlab.
8. Discuss on elementary math functions in Matlab.
9. Find the eigen value and eigen vectors in Matlab.
10. Write a Matlab program for polynomial curve fitting on the fly.