(2024 Batch Onwards)

PS1FPHC600 Reg. No.: | | | | | | | | |

St Aloysius (Deemed to be University)

Mangaluru

School of Physical Sciences (PG Programme)

M.Sc. (Physics) - Semester III – P.G. Examination

October/November- 2025

CONDENSED MATTER PHYSICS II

Time: 2 ½Hours **Max Marks: 60**

SECTION – A

Answer any FIVE of the following. **(5x2=10)**

1. The energy required to remove a pair of ions, Na^+ and Cl^- from NaCl is approximately 2 eV. Calculate the approximate number of Schottky imperfections present in the NaCl crystal at 300 K.
2. Describe the difference between spin-lattice and spin-spin relaxation in NMR. How do these processes influence the NMR signal?
3. Briefly describe Hund's rules for determining the ground state of an atom. How does Russell-Saunders (R-S) coupling influence the magnetic properties of rare earth ions?
4. Explain the difference between diamagnetism and paramagnetism in terms of electron shell configurations. Why do atoms with completely filled shells exhibit diamagnetism?
5. Briefly describe the pulse echo method in NMR.
6. Define dielectric susceptibility and explain its relationship with the dielectric constant. How does polarization contribute to the dielectric response of a material?

SECTION - B

Answer any FIVE of the following. **(10x5=50)**

7. Derive LST equation for ionic crystal.
8. Derive the Clausius Clapeyron equation for first order phase transitions in solids. Compare its thermodynamic basis with Landau theory for second order phase transition.
9. Discuss the Langevin theory of paramagnetism.
10. Under what condition do you observe paramagnetic resonance? Explain the fine structure of paramagnetic resonance.
11. Explain the NMR coupling for solids and liquids.
12. Discuss the classical derivation of magnon dispersion relation.
13. Explain the terms I) Complex dielectric constant II) Dielectric strength III) Dielectric loss.
14. Describe stacking faults in FCC and HCP crystals. Explain the concept of a twin boundary and how it differs from a stacking fault in terms of crystal structure.

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PS1FPHC601 Reg. No.: | | | | | | | | |

St Aloysius (Deemed to be University)

Mangaluru

School of Physical Sciences (PG Programme)

M.Sc. (Physics) - Semester III – P.G. Examination

October/November - 2025

THERMODYNAMICS AND STATISTICAL PHYSICS

Time: 2 ½Hours **Max Marks: 60**

SECTION – A

Answer any FIVE of the following. **(5x2=10)**

1. What are the ensembles? How are they classified?
2. Write a note on Flutuations.
3. State second law of thermodynamics.
4. What is Gibb's paradox?
5. What are Bosons and Fermions?
6. What is Nyquist theorem? Explain.

SECTION - B

Answer any FIVE of the following. **(10x5=50)**

7. State and explain the principle of increase of entropy. Show that the entropy change of a system between two equilibrium states is independent of path.
8. Obtain heat capacity equation and explain its importance in thermodynamics.
9. Explain the phenomena of BE condensation and discuss its properties.
10. Derive Liouville's theorem for the charge of density of distribution with time and show that density of space point is conserved.
11. On the basis of Quantum theory, calculate translation vibrational and rotational partition function for a single diatomic molecule.
12. State Langevin equation and what do you mean by velocity correlation function?
13. Obtain Fokker-Plank equation.
14. Give Boltzmann's statistical definition of entropy and present its physical meaning briefly but clearly. Derive $S=k\ln\Omega$

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PS1FPSC621 Reg. No.: | | | | | | | | |

St Aloysius (Deemed to be University)

Mangaluru

School of Physical Sciences (PG Programme)

M.Sc. (Physics) - Semester III – P.G. Examination

October/November - 2025

RELATIVITY AND COSMOLOGY

Time: 2 ½Hours **Max Marks: 60**

SECTION – A

Answer any FIVE of the following. **(5x2=10)**

1. What is Aberration of light?
2. Write lorentz transformation equations. Show that it reduces to Galilean transformation for $v \ll c$.
3. Define contravariant vector.
4. How did Einstein relate gravity to geometry?
5. From Robertson-Walker metric, which are the various types of universes possible based on curvature?
6. What is cosmic microwave background radiation?

SECTION - B

Answer any FIVE of the following. **(10x5=50)**

7. Derive $E = mc^2$ and $E^2 = p^2c^2 + m_0^2c^4$
8. Explain Relativistic force? What is Minkowski force? Also explain relativistic mass.
9. Explain the properties of covariant derivatives.
10. Show that Christoffel symbol is not a tensor.
11. What are the various shortcomings of the standard model of particle physics.
12. Write the Einstein field equation also explain any two predictions of Einstein's general relativity.
13. What are four vectors? Write Lorentz transformation in four vector notation. Define velocity and momentum four vectors.
14. Explain evolution of early stages of universe based on predictions of particle physics.

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