Exam Code: 209004 **Paper Code: 4210**

Programme: Master of Science (Physics) Semester: IV

Course Title: Particle Physics

Course Code: MPHL-4391

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 16 marks.

Section A

1. Explain the methods to determine the mass and spin of neutral pion. (16)

2. (a) Suppose π^- is captured by a deuteron in s-state to proceed the reaction: $\pi^- + d \rightarrow n + n$. Find the parity of π^-. Spin-parity of deuteron is 1^+. (8)

2. (b) Determine the mass of π^+ by applying kinematic approach on the decay process:

$$\pi^+ \rightarrow \mu^+ + \nu_\nu$$ (8)

Section B

3. (a) Discuss the conservation law of baryon number, lepton number and strangeness? (12)

3. (b) What was Pais's rule for the conservation of strangeness? How did Gellman correct this rule? (4)

4. Discuss the phenomenon of CP violation and strangeness oscillation in the case of K^0 and $\overline{K^0}$ doublet. (16)

Section C

5. (a) What is helicity of a particle? How a neutrino is distinguished from an antineutrino on the basis of helicity? (4)

5 (b) How the helicity of neutrino is measured from the decay of ^{152}Eu nucleus? (12)

6. How did Cabibbo theory explain the suppression of strangeness changing weak interactions?

(16)

Section D

7. Obtain field equations for particles with spin-0, spin-1/2 and spin-1.

(16)

8. What is a gauge transformation? Discuss global and local gauge transformations.

(16)

Exam Code: 209004 **Paper Code: 4211**
(30)

Programme: Master of Science (Physics)
Semester-IV

Course Title: Statistical Mechanics

Course Code: MPHL-4392

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section. Each question carry 16 marks.

Section-A

1. (a) Derive equation of state of ideal gas and Discuss statistics of classical ideal gas in detail. 12
   (b) Define Gibb's free energy, Helmholtz energy, entropy and phase space. 4
2. (a) Making use of the fact that entropy S (N,V,E) of a thermodynamic system is an extensive quantity, show that $N\,(dS/dT)_{V,E} + V\,(dS/dV)_{N,E} + E\,(dS/dE)_{N,V} = S$. 4
   (b) Discuss the contact between statistics and thermodynamics. 12

Section-B

3. (a) Discuss cluster expansion of ideal gas. 6

(b) Define ensembles and discuss the statistics of micro canonical ensemble using example of classical ideal gas. 10

4. (a) Discuss the energy fluctuations in canonical ensemble and show its correspondence with micro canonical ensemble. 8
   (b) Derive expression for grand partition function. 6
   (c) Define fugacity. 2

Section-C

5. Discuss the statistical thermodynamics of electron gas in magnetic field and hence discuss its contradictions. 16

6. (a) Discuss the various ensembles in quantum statistics. 12
   (b) Define quantum states and phase space. 4

Section-D

7. Discuss thermo dynamical behaviour of ideal Fermi gas in detail. 16
8. (a) Discuss black body radiation in detail. 8
   (b) Discuss Pauli paramagnetism in Fermi gas. 8

Exam Code: 209004 **Paper Code: 4212**
(30)

Programme: Master of Science (Physics)
Semester-IV

Course Title: Radiation Physics

Course Code: MPHL-4393 (Opt-II)

Time Allowed: 3 Hours **Max Marks: 80**

ATTEMPT FIVE QUESTIONS, SELECTING ATLEAST ONE QUESTION FROM EACH SECTION. THE FIFTH QUESTION CAN BE ATTEMPTED FROM ANY SECTION. EACH QUESTION CARRIES 16 MARKS EACH. 16X5=80

SECTION —I

1. WHAT IS RADITION DOSE AND ITS TYPES, DISCUSS BRAGG GRAY PRINCIPLE IN DETAIL. 16
2. WRITE NOTES ON FOLLOWING:
KERMA, ABSORBED DOSE, DOSE EQUIVALENT, QUALITY FACTOR 4X4=16

SECTION-II

3. DISCUSS HEMICAL DETECTORS AND NEUTRON DETECTORS IN DETAIL AND HENCE DISCUSS THEIR APPLICATIONS. 16

4. DISCUSS BOTH FILMS Ir-115 and CR-39 IN DETAIL AND EXPLAIN WHICH ONE IS BETTER FOR RADITION DOSE MEASUREMNETS. 16

SECTION-III

5. (A) DEFINE RED WASTE AND DISCUSS ITS MANAGEMENT.
   (B) DISCUSS PERMISSIBLE DOSE TO OCCUPATIONAL WORKERS WITH SUITABLE EXAMPLES. 16
6. (A) DISCUSS RELATIONSHIP BETWEEN RBE AND LET.
   (B)DISCUSS FOLLOWING: ALARA, ALI, MIRD 16

SECTION-IV

7. DISCUSS TYPES OF SHIELDING MATERIALS AND HENCE DISCUSS SHIELDING REQUIREMENTS FOR MEDICAL AND INDUSTRIAL FIELDS WITH APPROPRIATE EXAMPLES. 16
8. (A) WRITE SHORT NOTE ON BIOLOGICAL SHIELDING
   (B) BUILD UP FACTOR
   (C) WHAT THICKNESS OF LEAD SHIELDING IS REQUIRED TO REDUCE THE DOSE RATE FROM Cs-137 SOURCE FROM 175 mrem/hr to 5 mrem.hr? 16

Exam Code: 209004 **Paper Code: 4213**
(30)

Programme: Master of Science (Physics)
Semester-IV

Course Title: Material Science

Course Code: MPHL-4394 (Opt-V)

Time Allowed: 3 Hours **Max Marks: 80**

Note: Attempt five questions in all, selecting at least one question from each section. Fifth question may be attempted from any section. Each question carries equal 16 marks.

Section-A

1. What are Epitaxial Films? Discuss its types in detail. 16
2. Explain the evolution of microstructure of polycrystalline thin films. 16

Section-B

Master of Science (Physics) – IV
Course Title: Material Science
Course Code: MPHL-4394 (Opt. – V)
Section – B

3. b. What are different types of composites? Explain their properties and applications. (8 Marks)

(4,4)

4. (a) How do environmental factors such as temperature, pressure, corrosion and moisture, affect the performance and durability of engineering materials? 8
   (b) What are the main Challenges in designing and developing new engineering materials and how are they overcome? 8

Section-C

5. Explain in detail Principles of scanning electron microscopy. What are different components of SEM instrumentation? 16
6. Explain in detail Principles of tunneling electron microscopy. What are different components of TEM instrumentation? 16

Section-D

7. Compare SIMS spectroscopy with other surface analysis techniques, such as X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES), in terms of their principles, advantages, and limitations. 16

8. Write a detailed description on principle and instrumentation of Auger electron spectroscopy. 16