Code No. 7122 / CORE / N

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, December 2018 / January 2019

Subject : Physics & Applied Electronics

Paper – I : Mathematical Physics

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

Note : Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

PART – A (8 x 4 = 32 Marks)
(Short Answer Type)

1 Evaluate $\int_0^\infty x^6 e^{-2x} dx$ using Gamma functions.

2 Show that $P_n(-x) = (-1)^n P_n(x)$.

3 Show that $H_{2n}(0) = \frac{(-1)^n (2n)!}{n!}$.

4 Show that $L_n^1(x) = nL_{n-1}^1(x) - nL_{n-1}(x)$.

5 State and explain properties of Laplace transforms.

6 Find the Fourier transform of $f(x) = e^{-a|x|}$. where $a > 0$ and $-\infty < x < \infty$.

7 Determine the eigen value of the matrix $A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$.

8 Define covariant and contravariant Tensors with suitable examples.

PART – B (4 x 12 = 48 Marks)
(Essay Answer Type)

9 (a) Solve the Bessel differential equation of zero order using infinite series solution method.

OR

(b) Prove the following recurrence relations

(n+1) $P_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x)$ and $nP_n(x) = xP_n^1(x) - P_{n-1}^1(x)$

10 (a) Solve Laguerre's differential equation

$$x^2 \frac{d^2y}{dx^2} + (1-x)\frac{dy}{dx} + ny = 0$$

OR

(b) Show that $\int_{-\infty}^{+\infty} e^{-x^2} H_n(x) H_m(x) dx = 2^n \cdot n! \sqrt{\pi}$ if m = n.

11 (a) Find $L^{-1}\frac{1}{(s^2+a^2)^2}$ using convolution theorem.

OR

(b) State and prove the shifting and scale changing property of Fourier transforms.

12 (a) Verify Cayley – Hamilton theorem for the matrix $A = \begin{bmatrix} 3 & 2 \\ -1 & 4 \end{bmatrix}$.

OR

(b) Explain contraction of tensor, Quotient law, the rank of the tensor, symmetric and skew symmetric tensors.

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Code No. 7124 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, December 2018 / January 2019

Subject : Physics & Applied Electronics

Paper – II : Classical Mechanics

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

Note : Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

PART – A (8 x 4 = 32 Marks)
(Short Answer Type)

1 Explain Galilean transforms.
2 What is Minkowski space? Explain briefly.
3 Explain about different types of constraints.
4 Set up Lagrangian for a simple pendulum.
5 Express Hamilton's equations in Poisson Bracket form.
6 Comment on cyclic coordinates.
7 Discuss on principal axis transformation.
8 What are normal modes? Explain it.

PART – B (4 x 12 = 48 Marks)
(Essay Answer Type)

9 (a) State and prove the principle of conservation of Linear momentum and Angular momentum.

OR

(b) What are space set of axes and body set of axes? Obtain Eulers equations of motion for a rigid body.

10 (a) Explain the importance of generalized coordinates. Obtain Lagrange's equation of motion for conservative systems.

OR

(b) State and explain Hamilton's principle. Using it find the Lagrange's equations of motion.

11 (a) Discuss about generating function. Using it express the Hamilton's equations from old set of coordinates to new set of coordinates.

OR

(b) Obtain Hamilton's equations. Apply it to the motion of a particle in a central force field.

12 (a) Analyze the vibrations of a linear tri atomic molecule.

OR

(b) Apply Lagrangian formulation for continuous systems.

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Code No. 7125 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, December 2018 / January 2019

Subject : Physics & Applied Electronics

Paper – III : Quantum Mechanics – I

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

Note : Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

PART – A (8 x 4 = 32 Marks)
(Short Answer Type)

1 Explain Dirac's and Bra notation.
2 What is meant by normalization of a wave function? Discuss its significance in quantum mechanics.
3 Distinguish between the Schrodinger and Heisenberg pictures.
4 What is a number operator? Discuss its significance.
5 Show that the Hamiltonian is the generator of infinitesimal time translations.
6 What is a parity operator? Show that it is hermitian.
7 What are Clebsch – Gordon coefficient? Give any three properties.
8 What are the properties of pauli spin matrices?

PART – B (4 x 12 = 48 Marks)
(Essay Answer Type)

9 (a) Derive the uncertainty relation between any two non commuting operators A and B.

OR

(b) (i) Show that the eigen values of Hermitian operator are real.
(ii) Find the possible energy values and energy eigen states for a system with Hamiltonian given by the matrix.

$$H = \begin{bmatrix} a & -a & 0 \\ -a & a & 0 \\ 0 & 0 & -a \end{bmatrix}$$

Show that the eigen states are orthonormal.

10 (a) Obtain the eigen values and eigen functions of a linear harmonic oscillator using operator method.

OR

(b) Describe and distinguish between the Heisenberg and interaction picture.

11 (a) Discuss the conservation laws for linear momentum and angular momentum.

OR

(b) Construct the time reversal operator for spin zero and spin non zero particles.

12 (a) Obtain the eigen values and the simultaneous eigen states of J^2 and J_z.

OR

(b) What are Clebsch – Gordon coefficients? Deduce the matrix of (Clebsch – Gordon coefficient for the addition of $J_1 = ½$ and $J_2 = ½$.

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Code No. 7126 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, December 2018 / January 2019

Subject : Physics / Applied Electronics

Paper – IV : Solid State Physics

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

Note : Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

PART – A (8 x 4 = 32 Marks)
(Short Answer Type)

1 Write a note on Bravais lattice.
2 Explain the geometrical structure factor.
3 Write a note on phonon mean free path.
4 Explain the origin of thermal expansion.
5 What is Bloch theorem?
6 Explain the Hall Effect in semiconductor.
7 What are the colour centres and their models?
8 Write a note on Grain boundaries.

PART – B (4 x 12 = 48 Marks)
(Essay Answer Type)

9 (a) Describe the experimental method of X-ray diffraction of crystal and determine the cubic crystal unit cell parameters.

OR

(b) Write the concept of reciprocal lattice and Brilliouin zones.
(c) Explain the elements of neutron and electron diffraction.

10 (a) Describe the Einstein and Debye theories of lattice heat capacity.

OR

(b) Discuss the vibration modes of a diatomic linear lattice and dispersion relations.

11 (a) Discuss the Kronig – Penny model for energy band formation.

OR

(b) Obtain the expression for electron and hole concentrations in extrinsic semiconductors.

12 (a) Explain the experimental technique of crystal growth from melt and crystal growth from vapour phase.

OR

(b) Write short notes on :
(i) Ionic conductivity
(ii) Kirkendal effect
(iii) Edge and screw dislocations

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