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Code No. 0135 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, January / February 2020

Subject : Physics

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 Show that $\int_0^\infty \frac{e^{-st}}{\sqrt{t}}\ dt = \sqrt{\pi/s}$.

2 Evaluate $\int_0^{\pi/2} \sqrt[3]{Tan\theta}\ d\theta$.

3 Show that $H_n'(x) = 2nH_{n-1}(x)$.

4 Prove that recurrence relation $L_n'(x) = nL_{n-1}'(x) - nL_{n-1}(x)$.

5 State and prove the first shifting theorem in Laplace transforms.

6 Find the Laplace transform of $\frac{sint}{t}$.

7 Define covariant and contravariant tensors and write down their transformations rule for rank 2.

8 State the properties of the determinants of a matrix.

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

9 (a) Show that $(n+1)p_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x)$ *and* $P_n(-x) = (-1)^n P_n(x)$.

OR

(b) Show that $J_o(x) + 2\sum_{n=1}^{\infty} J_{2n}(x) = 1$.

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

OR

(b) State and prove the Rodrique's formula for Laguerre polynomial.

11 (a) Verify the Perseval's identify for the Fourier transform of

$f(x) = 1 \quad for\ |x| < a$

$= 0 \quad for\ |x| > a$

and show that $\int_0^\infty \frac{sin^2 u}{u^2}\ du = \pi/2$

OR

(b) Find the inverse Laplace transform of $\frac{1}{(s^2-1)}$ using convolution theorem.

12 (a) State Caley-Hamilton theorem. Verify Caley-Hermilton theorem for matrix

$A=\begin{bmatrix} 3 & 2 \\ -1 & 4 \end{bmatrix}$.

OR

(b) Find the eigen values of eigen vectors of the matrix

$A=\begin{bmatrix} 5 & 7 & -5 \\ 0 & 4 & -1 \\ 2 & 8 & -3 \end{bmatrix}$

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Code No. 0137 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, January/February 2020

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 the Euler's angles with a neat diagram.
2 Explain the momentum four vector.
3 What are constraints? Illustrate with examples.
4 Write a note on generalized coordinates.
5 Explain briefly the principle of least action.
6 What are cyclic coordinates? Explain.
7 Explain the importance of Eigen value equation.
8 What is principal axis transformation?

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

9 (a) Explain Euler angles. Derive Euler's equations of motion for a rigid body.

OR

(b) Briefly explain Minkowski space. Derive Lorentz transformation in four space.

10 (a) State D'Alembert's principle Derive Lagrange's equations of motion from D'Alembert's principle.

OR

(b) State Hamilton's principle. Derive Lagrange's equations from Hamilton's principle.

11 (a) Define Lagrange and Poisson brackets. Find a relation between them.

OR

(b) Discuss Hamilton – Jacobi theory. Discuss its importance.

12 (a) Define normal coordinates. Obtain normal coordinates for a system of linear tri-atomic molecule.

OR

(b) Explain the difference between the Lagrangian and Hamiltonian formulations. Briefly discuss the conservation theorem.

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Code No. 0139 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, January / February 2020

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 Discuss Dirac's Ket and Bra notation.
2 Write the difference between commuting and non-commuting operators with examples.
3 Obtain the equation of motion in Heisenberg picture.
4 What is number operator, explain?
5 Explain the effect of parity operator, on position and momentum.
6 Explain why time-reversal operator is not linear.
7 Evaluate the commutation relation of $[L^2, L_z]$.
8 Obtain Pauli spin matrices and write their properties.

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

9 (a) Define a Hermitian operator. Show that eigen functions of Hermitian operator are real and with different eigen values they are orthogonal to each other.

OR

(b) Prove that the matrix representation of an operator with respect to its own eigen functions is diagonal and the matrix elements are the eigen values of the operator.

10 (a) State Schrodinger and Heisenberg pictures obtain the equation of motion for interaction picture.

OR

(b) Obtain eigen values and eigen functions to a linear harmonic oscillator by operator method.

11 (a) Obtain time reversal operator for zero spin and non-zero spin particles.

OR

(b) Discuss space inversion and intrinsic parity.

12 (a) State the eigne value – eigen vector relations for the operators J^2 and J_z. Obtain the matrices for J^2 and J_z.

OR

(b) What are Clebsch – Gordan coefficients? Obtain Clebsch-Gordon coefficient for $J_1 = J_2 = ½$.

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Code No. 0141 / CORE

FACULTY OF SCIENCE

M. Sc. I – Semester Examination, January / February 2020

Subject : Physics & Applied Electronics

Paper – IV : General 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 What are Miller indices?
2 Explain Bragg's law.
3 What are phonons? What is phonon mean freepath?
4 Explain Infrared absorption in ionic crystals.
5 What is the Hall Effect? What is its significance?
6 Explain the effective mass of electron.
7 What is the Kirkendal effect?
8 What are colour centers?

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

9 (a) Determine the unit cell parameters of a cubic system with X-ray Powder diffraction method.

OR

(b) Discus the neutron diffraction and comment on its significance.

10 (a) Describe the vibrational model of a diatomic linear lattice and dispersion relations.

OR

(b) Discuss Lattice thermal conductivity of a solid.

11 (a) Describe the Kroning-penny model for periodic lattice. What is E Verses K relations?

OR

(b) Derive the expression for electron and hole concentrations in extrinsic semiconductor.

12 (a) Explain the experimental techniques of growth of single crystals from melt and vapour phase.

OR

(b) Derive the expression for equilibrium concentrations of Schottky and Frenkel defects in ionic crystal.

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