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PGIS-046-A-22

M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Mathematical Physics - I

Paper : SCT - 1.1

(New)

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

Answer all the question of **15** marks each and any two questions of **10** marks each.

1. a) Describe a method of obtaining a general solution to non-homogeneous linear differential equation of second order: $a_2(x)y'' + a_1(x)y' + a_0(x)y = r(x)$

   b) Find the general solution to $y''+4y'+3y=3x$. **(10+5)**

(OR)

2. a) Obtain the series solution of Bessel's equation, $x^2y'' + xy' + (x^2 - n^2)y = 0$.

   b) Show that when n is an integer, $J_{-n}(x) = (-1)^n J_n(x)$. **(10+5)**

3. a) Explain with examples the Hermitian, unitary and orthogonal operators.

   b) Write a note on Cauchy sequence. **(10+5)**

(OR)

4. a) Find the eigen value and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 1 & -3 \\ 3 & -3 & -3 \end{bmatrix}$.

   b) Diagonalize $B = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$ **(10+5)**

5. a) Obtain expressions for the gradient ∇ and Laplacian ∇^2 in spherical polar coordinates.

b) Show that symmetry is an intrinsic property of a tensor and is independent of the coordinate system. **(8+7)**

(OR)

6. a) Given the components of second rank tensor T_{ij}, construct a scalar, an antisymmetric tensor and a symmetric tensor using them.

b) If A_r^{pq} and B_r^{pq} are tensors, prove that sum and difference are tensors. **(9+6)**

7. a) List all 6 elements of the permutation group S_3. Show that S_3 forms a non-abelian group under multiplication.

b) Define the representation of a group. Discuss the criterion for the reducible and irreducible representation of a group. **(7+8)**

(OR)

8. a) Explain the method of construction of character tables and hence discuss the character table of D_3 group.

b) Define the matrix group SU(2). Show that the group can be characterized by 3 real parameters. **(10+5)**

9. Obtain the orthogonality relation for the Legendre polynomials. **(10)**

10. Is the matrix $A = \begin{bmatrix} \cos a & \sin a \\ -\sin a & \cos a \end{bmatrix}$ orthogonal ? Justify. **(10)**

11. What is the physical meaning of contravariant and covariant vectors? Explain . **(10)**

12. Explain isomorphism and homomorphism of groups. **(10)**

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PGIS-045-A-22

M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Introductory Quantum Mechanics

Paper : HCT - 1.3

(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all questions of 15 marks and two questions of 10 marks each.

1. a) Describe stern-Gerlach experiment and state its limitations.

   b) Explain briefly the Bohr's model of Hydrogen atom. (10+5)

(OR)

2. a) State and explain the principle of superposition.

   b) Show that the Ehrenfest's theorem is the quantum equivalent of equation of motion of a classical particle. (7+8)

3. Solve the problem of square well potential with rigid walls or eigen values and eigen functions. (15)

(OR)

4. What are spherically symmetric potentials? Write down schrodinger equation for a spherically symmetric potential and separate it into radial and angular parts. (15)

5. Obtain eigen values and eigen functions for a linear harmonic oscillator by matrix method. (15)

(OR)

6. Apply time independent perturbation theory for a non-degenerate system and obtain expressions for first order corrections to eigen value and eigen function. (15)

7. a) Discuss the basic principle of variation method.

   b) Show that the ground state of Helium can be obtained using variation principle.(5+10

(OR)

8. A particle is elastically scattering while moving in a spherically symmetric potential. Discuss the phase shift analysis for this case and obtain an expression for the scattering amplitude in terms of phase shift. **(15)**

9. Write a note on inadequacy of classical physics. **(10)**

10. What is an eigen value problem? Explain degeneracy of eigen values and give its physical meaning. **(10)**

11. Write a note on Bohr-Sommerfeld quantum condition. **(10)**

12. Explain the Born approximation for scattering. **(10)**

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PGIS-043-A-22

M.Sc I Semester (CBCS) Degree Examination

PHYSICS

Classical Mechanics

Paper : HCT - 1.1

(New)

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidate

Answer all question of **15** marks each and any two questions of **10** marks each.

1. a) Describe the conservation of linear momentum, angular momentum and energy of a single particle system.
   b) Discuss Atwood's machine as an example for a conservative system. **(10+5)**

(OR)

2. a) What is bounded and unbounded motion? Explain with examples.
   b) Obtain the equation of motion for equivalent one-body problem. **(5+10)**
3. a) Explain constraints and their types with suitable examples.
   b) What are generalized coordinates? Obtain the generalized coordinates of a spherical pendulum. **(8+7)**

(OR)

4. a) Explain the concept of virtual displacement and work.
   b) Derive the Lagrange's equations of motion using D'Alembert's principle. **(5+10)**
5. a) Describe the Hamilton's equations of motion and show that Hamiltonian of the system is conserved.
   b) Distinguish between Hamiltonian and Lagrangin formulations. **(10+5)**

(OR)

6. a) What are Poisson Brackets ? Write down their properties.
   b) Show that the transformation:

$Q = \sqrt{2q}e^{\alpha} \cos p, P = \sqrt{2q}e^{-\alpha} \sin p$ in canonical, where α is a constant. **(10+5)**

7. Describe the concept of four vectors, four velocity, four momentum, four acceleration and four forces in relativistic mechanics. **(15)**

(OR)

8. a) Explain the principle of covariance.

   b) Derive the equation of continuity in continuum mechanics. **(7+8)**

9. Write a note on Kepler's laws of planetary motion. **(10)**

10. Write a note on cyclic coordinates and associated laws of conservation. **(10)**

11. Write a note on canonical transformations. **(10)**

12. Write a note on Lorentz covariant form of equation of motion. **(10)**

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PGIS-047-A-22

M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Applied Physics

Paper : SCT - 1.2

(New)

Time : 3 Hours **Maximum Marks : 80**

Instructions to Candidates:

Answer **all** question of **15** marks each and two questions of **10** marks each.

1. a) Explain the principle and characteristics of Lasers.
   b) Describe population inversion technique to attain lasing action. (7+8)

(OR)

2. a) Distinguish between spatial and temporal coherence of lasers. .
   b) Describe with a neat diagram the construction and working of Nd: YAG laser. (5+10)
3. a) Explain biological complementarity principle.
   b) Describe the molecular basis of life. (7+8)

(OR)

4. a) Describe various types of cells with their structure.
   b) Explain molecular recognition. (8+7)
5. a) Explain plasma properties and parameters.
   b) Explain fluid description of plasma. (8+7)

(OR)

6. a) Explain pondermotive force.
   b) Describe plasma diagnostic techniques. (5+10)

7. a) Write a note on H-R diagram.

   b) Describe the stellar structure model. (8+7)

(OR)

8. a) Distinguish between pulsars and quasars.

   b) Write a note on black holes. (8+7)

9. Write a note on Fiber optic communication. (10)

10. Write a note on intermolecular interaction. (10)

11. Explain the motion of charged particles in time varying fields. (10)

12. Write a note on Supernova. (10)

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PGIS-044-A-22

M.Sc I Semester (CBCS) Degree Examination

PHYSICS

Electrodynamics

Paper : HCT - 1.2

(New)

Time : 3 Hours Maximum Marks : 80

Instructions:

Answer all question of 15 marks each and any two questions of 10 marks each.

1. a) Show that electrostatic field can be expressed as the negative gradient of a scalar potential.

   b) Show that the work done in moving an electric charge through a closed path against an electrostatic field is zero. (8+7)

(OR)

2. a) What are electric multipoles? Explain. Arrive at the multipole expansion of electrostatic potential.

   b) Obtain Poisson and Laplace equations. Explain how electrostatic boundary conditions help to solve them. (10+5)

3. Starting from Biot-Savart law arrive at the divergence and curl of magnetostatic field. Obtain their integral forms and thereby explain their physical significance. (15)

(OR)

4. a) State Ampere's law in differential form. Obtain its integral form and explain its significance.

   b) Discuss the behaviour of material medium in a magnetostatic field and obtain the differential form of Ampere's law in a medium. (6+9)

5. a) Explain how Maxwell modified Ampere's law and discuss the consequences of this modification.