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PGIS-N-244 A-21

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 questions of **15** marks each and any **Two** questions of **10** marks each.

1. a) Describe the method of obtaining the general solution of linear differential equation of first order : $\frac{dy}{dx} + p(x)y = f(x)$. **(10+5)**

b) Solve the differential equation $\frac{dy}{dx} + 2xy = 2e^{-x^2}$.

(OR)

2. a) Obtain the Legendre polynomial of first kind. **(10+5)**

b) Prove that $p_n(-x) = (-1)^n P_n(x)$

3. a) Explain inner product space, function space, dual space and Cauchy sequence. **(10+5)**

b) Write a note on direct sum of function space.

(OR)

4. a) Find the eigen values and normalized eigen vectors of the matrix $A=\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 1\\ 0 & 1 & 1\end{bmatrix}$ **(10+5)**

   b) Explain symmetric and orthogonal matrices.

5. a) Explain contraction and inner product of tensors. **(10+5)**

   b) If A^{μ} and B_{μ} are two vectors, one contravariant and the other covariant, then prove that $A^{\mu} B_{\mu}$ is invariant.

(OR)

6. a) Find the covariant derivative of covariant vector. **(10+5)**

   b) Define contravariant and covariant vectors.

7. a) Explain the concept of a group with any two examples. **(5+10)**

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

(OR)

8. a) What is unitary group? Explain the irreducible representation of SU(2) group. **(10+5)**

   b) Explain reducible and irreducible representation of groups.

9. Obtain the generating function for Laguerre polynomials. **(10)**

10. Explain linear, Hermetian, Unitary and Orthogonal operators. **(10)**

11. Explain Quotient law with an example. **(10)**

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

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M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Classical Mechanics

Paper : HCT 1.1

(Old)

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

Instructions to Candidates:

Answer **All** the questions of **15** marks each and any **Two** questions of **10** marks each.

1. a) State and explain the laws of Newton for motion of a macroscopic body. **(5+10)**

b) Describe the conservation of angular momentum and energy of a single particle system.

(OR)

2. a) Distinguish between bounded and unbounded motion. **(7+8)**

b) Explain two-body central force field motion.

3. a) What are holonomic and non-holonomic constraints? Explain with few examples. **(8+7)**

b) Setup the Lagrangian of a spherical pendulum and deduce the equation for simple pendulum.

(OR)

4. a) Explain why generalized coordinates are used in place of Cartesian coordinates. **(5+10)**

b) State D Alembert's principle and hence derive the Lagrange's equations of motion.

5. a) What are Legendre transformations? Obtain Hamilton's equation of motion using Legendre transformations. **(10+5)**

b) Briefly explain the salient features of Hamiltonian formulation.

(OR)

6. a) Explain Hamilton's variational principle. **(8+7)**

b) Explain the properties of Poisson brackets.

7. Describe the four-dimensional formulation of relativistic mechanics. **(15)**

(OR)

8. a) What are the basic concepts of continuum mechanics? Explain. **(6+9)**

b) Derive the equation of continuity for motion of fluids.

9. Write a note on conservation of energy of a system of particles. **(10)**

10. Write a note on Atwood's machine. **(10)**

11. What are canonical transformations ? Explain . **(10)**

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

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M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Classieal Mechanics

Paper : HCT 1.1

(New)

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

Instructions to Candidates:

Answer **All** the questions of **15** marks each and any **Two** questions of **10** marks each.

1. a) List the various applications of Newtonian mechanics. (7+8)

   b) State and explain Kepler's laws of planetary motion.

(OR)

2. a) Derive the equation of motion for equivalent one body problem. (10+5)

   b) Give an account of different forms of forces in nature and describe the motion of a particle under constant force.

3. a) What are constraints? Explain their types with examples. (8+7)

   b) What are cyclic coordinates? Explain.

(OR)

4. a) State and explain the D Alembert's principle. (5+10)

   b) Derive the Lagrange's equations of motion using D Alembert's principle.

5. a) Derive the Hamilton's equations of motion and show that Hamiltonian is conserved when Lagrangian is not an explicit function of time. **(10+5)**

b) Comment on Hamiltonian formulation.

(OR)

6. a) Write down the properties of Poisson brackets. **(10+5)**

b) Show that the transformation $p = m\omega \cot Q$ *and* $P = m\omega q^2 / 2\sin^2 Q$ is canonical.

7. a) What are the basic concepts of continuum mechanics? Explain. **(7+8)**

b) Derive the Navier-Stoke's equation for an imperfect fluid.

(OR)

8. What is Minkowski space? Describe the four vector formulations in relativistic mechanics. **(15)**

9. Describe the conservation of angular momentum, energy of a single particle. **(10)**

10. Write a note on degrees of freedom and generalized coordinates. **(10)**

11. Explain Hamilton-Jacobi theory. **(10)**

12. Explain the equation of continuity for motion of fluids. **(10)**

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PGIS-O-245 A-21

M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Applied Physics

Paper : SCT 1.2

(Old)

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

Instructions to Candidates:

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

1. a) Describe Nd : YAG laser and its applications.

   b) Explain spatial and temporal coherence of laser. (8+7)

(OR)

2. a) Describe specific applications of different types of lasers.

   b) What is holography? Explain its applications with the help of examples. (7+8)

3. a) Explain with suitable examples how Biophysics plays a role in life-order or in chaos.

   b) What is biological complimentarity principle? Give an account of biological complimentarity of structure and function with examples. (8+7)

(OR)

4. a) Compare plant and animal cells and discuss its constituents.

   b) Write a note on intermolecular interaction and its consequences. (8+7)

5. a) Describe nature and occurrences of plasma.

b) Explain particle drift in plasma physics and describe motion of charged particles in time dependent magnetic field. (7+8)

(OR)

6. a) Discuss different types of plasma diagnostics techniques.

b) Derive magneto-hydrodynamic equations. (8+7)

7. a) What are pulsars and Quasars? Explain.

b) What are Neutron stars and why they are called so? Discuss different types of neutron stars. (8+7)

(OR)

8. a) Explain how Neutron stars cause gravitational waves.

b) How does a star become a red giant? Explain it with an example. (8+7)

9. Discuss different population inversion techniques. **(10)**

10. Describe biological molecules and their functions. **(10)**

11. Give an account of applications of plasma with examples. **(10)**

12. What is a black hole ? How do black holes form? **(10)**

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PGIS-N-245 A-21

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** the questions of **15** marks each and any **Two** questions of **10** marks each.

1. a) Explain the criterion for the lasing action. **(5+10)**

   b) Describe the construction and working of Nitrogen laser with necessary diagrams.

(OR)

2. a) With neat diagrams explain the recording and reconstruction of holograms. **(10+5)**

   b) Write a note on applications of holography.

3. a) Distinguish between and plant and animal cells. **(5+10)**

   b) Explain the structure and function of various cell constituents.

(OR)

4. a) What are biological molecules ? Discuss their structure and function. **(10+5)**

   b) What do you mean by molecular recognition? Explain.

5. a) Discuss the various plasma parameters. **(5+10)**

b) Give the kinetic and fluid descriptions of plasma.

(OR)

6. a) Discuss the motion of charged particles in uniform electric and magnetic fields. **(10+5)**

b) Write a note on Ponderomotive force.

7. a) Explain the evolution of stars to the main sequence. Discuss the conditions under which a star may become a neutron star. **(10+5)**

b) Explain the properties of quasars.

(OR)

8. a) What are white-dwarfs? Obtain an expression for the Chandrasekhar's mass limit. **(10+5)**

b) What are black holes? Explain their characteristics.

9. Discuss the population inversion techniques used for lasing action. **(10)**

10. State and explain the biological Complementarity principle. **(10)**

11. Explain the various plasma properties. **(10)**

12. Discuss with a sketch, the constituents of H-R diagram. **(10)**

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PGIS-O-243 A-21

M.Sc. I Semester (CBCS) Degree Examination

PHYSICS

Introductory Quantum Mechanics

Paper : HCT 1.3

(Old)

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

Instructions to Candidates:

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

1. a) Discuss inadequacies of classical physics.

   b) Show that uncertainty principle explains non-existence of electron inside the nucleus. **(7+8)**

(OR)

2. a) Explain the physical significance of wave function. Explain boundary and continuity conditions on a wave function.

   b) Develop time independent Schrodinger equation for a free particle. **(8+7)**

3. Obtain eigen values and eigen functions of hydrogen-like atoms. **(15)**

(OR)

4. Obtain eigen values and eigen functions for a linear harmonic oscillator by Schrodinger's method. **(15)**

5. a) Explain matrix representation of an operator. List the properties of matrix elements.

   b) Discuss the Heisenberg picture of quantum dynamics. **(8+7)**

(OR)

6. a) Write a note on bra and ket notation for vectors.

   b) Explain Hermetian, unitary and projection operators. **(6+9)**

7. a) Obtain scattering cross section for s-wave scattering by a square well potential.

   b) Explain the significance of Briet-Wigner formula. **(10+5)**

(OR)

8. Obtain an expression for the scattering amplitude using the technique of partial wave analysis to analyze scattering by the central field potential. **(15)**

9. Discuss the postulates of quantum mechanics. **(10)**

10. What is eigen value problem? Give the physical interpretation of eigen values and eigen functions. **(10)**

11. Write a note on expectation values. **(10)**

12. Discuss the scattering from screened coulomb potential. **(10)**