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PGIS-N 1001 B- 14
M.Sc. Ist Semester (CBCS) Degree Examination
Physics
(Classical 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. Describe the mechanics of system of particles and prove the conservation of angular momentum and energy of the system of particles. **(15)**

OR

2. a) State and explain the Kepler's laws of planetary motion. **(6)**

b) Describe the motion of particle subjected to resistive force. **(9)**

3. a) What are constraints? Explain with examples. **(5)**

b) Derive the Lagrange's equations of motion for conservative holonomic System. **(10)**

OR

4. a) Describe the generalized coordinates with suitable examples. **(5)**

b) Obtain the Lagrangian for an Atwood's machine and deduce its acceleration. **(5)**

c) Derive Newton's equation of motion from Lagrange's equations. **(5)**

5. a) Derive the Hamilton's equations of motion and discuss the conservation of energy. **(10)**

b) Write down comments on Hamiltonian formulation. **(5)**

OR

6. a) Explain the canonical transformation and the condition for transformation to be canonical. **(10)**

b) Show that the transformation $P = \frac{1}{2}[p^2+q^2]$ and $Q=\tan^{-1}[q/p]$ is canonical. **(5)**

7. a) What are the basic concepts in continuum mechanics and deduce the Navier - Stoke's equation. **(8)**

b) Derive the Lorentz force in covariant form. **(7)**

OR

8. a) Describe the four vector, four velocity and four momentum **(8)**

b) Derive the equation of continuity for motion of fluid. **(7)**

9. Describe the scattering phenomenon and obtain differential as well as total scattering cross section. **(10)**

10. Sate and explain the Hamilton's principle. **(10)**

11. Explain the properties of Poisson brackets. **(10)**

12. Describe the Lorentz transformations in four position vector. **(10)**

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PGIS-O 1002 B-14
M.Sc Ist semester (Non-CBCS)Degree Examination
Physics
(Classical Mechanics)
Paper -1.1
(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer any **six** questions of 12 marks and **two** questions of 4 marks each

I. Discuss the connection between symmetry and conservation laws. Show that the translational symmetry implies the conservation of momentum **(12)**

2. Define scattering cross-section for central force. Obtain rutherford cross-section for the inverse square law of forces **(12)**

3. What are constraints? Obtain Lagrange's equations from D'Alembert's principle **(12)**

4. What are cyclic coordinates? Obtain Hamilton's equations from variational principle**(12)**

5. Obtain the Hamilton's equations of motion from Legendre transformations **(12)**

6. Outline the algebraic properties of Poisson brackets. Obtain Hamiltonian equation for simple pendulum **(12)**

7. Deduce the four vector formulation for velocity momentum and acceleration **(12)**

8. Give an account of basic concepts of continuity equation and explain their applications **(12)**

9. Write a note on motion in two body central force field **(4)**

10. What are generalized co-ordinates? Explain **(4)**

11. Obtain Hamilton-Jcobi equation for the following Hamiltonian **(4)**

$$H = \frac{1}{2m} P_x^2 + \frac{1}{2m} P_y^2 + mgy$$

12. Explain the lorentz covariant form of equation of motion **(4)**

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PGIS-N 1007 B- 14

M.Sc. Ist Semester (CBCS) Degree Examination

Physics

(Mathematical Physics)

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) Determine the method to solve the second order Homogeneous differential equations with constant coefficients.

b) Solve $y'' + y' - 2y = 0$ (10+5)

OR

2. a) Obtain the Laguerre's differential equation using power series method

b) Write down some important partial differential equations with physical applications. (10+5)

3. a) Explain function space and Dual space.

b) If A and B are symmetric matrices, then show that AB is symmetric if and only if A and B commute. (8+7)

OR

4. a) Define Linear operator, Unitary operator and orthogonal operator.

b) Define the inverse of a matrix and Calculate the inverse of the following matrix. (6+9)

$$A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

5. a) Define tensors and write a note on Tensors in Physics.

b) Explain the addition and sustraction of Tensors. (7+8)

OR

6. a) Write a note on Curvilinear coordinates.

   b) Define Christoffel symbols of second kind

   c) Write a note on Tensors in Physics. (5+5+5)

7. a) Explain reducible and irreducible representations.

   b) Give examples of finite groups. (10+5)

OR

8. a) Define subgroup.

   b) Give the three dimensional rotation group and its representation.

   c) Prove that the group of order three is always cyclic. (3+8+4)

9. Obtain the general solution of first order linear differential equation. (10)

10. Describe the matrix representation of linear operators. (10)

11. State and Explain quotient rule of tensors. (10)

12. Explain homomorphism and isomorphism. (10)

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PGIS-N 1003 B-14
M.Sc Ist semester(CBCS) Degree Examination
Physics
(Electrodynamics)
Paper -HCT-1.2
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

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

1. a) Define electric flux, arrive at Gauss's law in differential and integral form

b) Determine the field outside a uniformly charged sphere of radius 'a' **(7+8)**

Or

2. a) Obtain Laplace and Poisson's equations in electrostatics

b) Obtain an expression for the electric field inside a dielectric medium **(7+8)**

3. a) State Biot-savart law and arrive at the definition of an Ampere

b) Obtain an expression for the force and torque experienced by a current loop in an external uniform magnetic field **(7+8)**

Or

4. a) State and explain the ampere's circuital law in magneto-statics

b) Explain how electric and magnetic fields can be expressed in terms of scalar and vector potentials **(7+8)**

5. a) Obtain Faraday's law in integral and differential form

b) Express electric and magnetic fields in terms of scalar and vector potentials (7+8)

Or

6. a) What are lorentz gauge and coulomb gauge

b) Show that the lorentz condition is invariant under the above gauge transformations (7+8)

7. a) Explain the behavior of plane waves in free space

b) Outline propagation of plane electromagnetic wave in non-conducting media (5+10)

Or

8. a) What are Lienard -Wieechart potentials? Explain

b) Discuss covariant formulation of the laws of electrodynamics (5+10)

9. Explain the physical significance of various multi-poles (10)

10. Explain the magnetostatic boundary conditions (10)

11. Explain poynting theorem and energy momentum conservation (10)

12. Write a note on four vectors in electrodynamics (10)

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PGIS O 1004 B- 14

M.Sc. Ist Semester (Non - CBCS) Degree Examination

Physics

Quantum Mechanics - I

Paper : 1.2

(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

*Answer any **Six** questions of **12 marks** and two questions of **4 marks** each.*

1. a) Distinguish between the phase velocity and group velocity. Show that for non-relativistic free particle phase velocity is half of the group velocity.

   b) From the Schrodinger equation obtain the continuity equation. (6+6)

2. State and explain the Ehrenfests theorem. (12)

3. Setup the Schrodinger equation for linear harmonic oscillator and obtain the energy eigen value and eigen functgion? Discussion the importance of zero point energy. (12)

4. Setup and solve the Schrodinger equation for a particle confined in a three dimensional box. (12)

5. a) If $\hat{A}$ *and* $\hat{B}$ are two linear operators such that their simultaneous eigen states form a compelete set, then show that $\hat{A}$ *and* $\hat{B}$ commute.

   b) What is herminian operator? Show that the eigen values of a Hermitian operator are real and that the eigen functions corresponding to different eigen values are orthogonal. (6+6)

6. a) Explain the terms: Representation of states, Dynamical variables, expectation values and observables.

   b) Obtain an equation of motion in Heisenberg picture. (6+6)

7. Obtain the Bohr - Sommerfield quantum conditions using WKB approximation.(12)

8. Explain the principle of partial wave analysis and obtain the expression for total scattering cross section at low energy. (12)

9. Find the expectation values of position and momentum of particle whose wave function is $\psi(x) = n \exp\left[\left(-x^2 / 2a^2\right) + ikx\right]$ (4)

10. Show that the degeneracy associated with the energy level with principle quantum number n in a hydrogen like atom is n^2 (4)

11. Show that $\left[x, p^n\right] = i\hbar n p^{n-1}$ (4)

12. A linear harmonic oscillator is perturbed by $H^1 = \frac{1}{2} bx^2$, Calculate the first order corrections to its ground state. (4)

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PGIS-O 1006 B-14
M.Sc. Ist Semester (Non-CBCS) Degree Examination
Physics
(Electro Dynamics)
Paper : 1.3
(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

*Answer any **Six** questions of **12** marks and **Two** questions of 4 marks each.*

1. a) Explain clearly the concept of electrostatic energy in dielectric media.

b) Derive an expression for the electric field due to an electric quadrupole. (6+6)

2. Define electrostatic potential. Obtain the expression for the potential in terms of charge density. (12)

3. Describe the Magnetic Scalar and vector potential. (12)

4. Obtain an expression for the force between two steady current carrying elements and hence prove the Amperes force law. (12)

5. a) State and explain Faraday's law of electromagnetic induction

b) Set up Maxwell's equations with relevant physical explanation (4+8)

6. What is gauge transformation? Discuss Lorentz and Coulomb gauge transformations. (12)

7. Discuss the propagation of electromagnetic waves in conducting media. (12)

8. Give the principle of invariance. Discuss Lorentz transformations. (12)

9. Derive Gauss law in differential form. (4)

10. Discuss boundary conditions in Magnetostatics. (4)

11. Write a note on retarded potentials. (4)

12. Explain Four vectors in electrodynamics (4)

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PGIS-O 1008 B- 14

M.Sc. Ist Semester (Non-CBCS) Degree Examination

Physics

(Mathematical Physics & Computer Applications-I)

Paper : 1.4

(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

*Answer any **six questions** of 12 marks and **two questions** of 4 marks.*

1. What are partial differential equations? Give their classification and obtain conditions for a second order partial differential equation to be elliptic, hyperbolic and parabolic. (12)

2. a) Discuss the power series method of solving the Legendre equation. (7+5)

   b) Write down the Bessel function and state its properties. (7+5)

3. a) Define Fourier series and evaluate Fourier coefficients a_n and b_n. (7+5)

   b) Expand the following in Fourier series

   $$f(x) = x^2, -\pi \le x \le \pi$$

4. a) Define Fourier transform and obtain Fourier transforms of derivatives of a function.

   b) Find the Fourier transform. F (k) of the Gaussian distribution function, (6+6)

   $f(x) = N \exp(-\alpha x^2)$, where N and α are constants.

5. a) Obtain Laplace transforms of the following. (6+6)

   $$f(x) = \sin x, \qquad 0 \lhd x \lhd \pi$$
   $$= 0 \quad , \qquad \pi \lhd x \lhd 2\pi$$

   b) Solve the following differential equation by Laplace transform method

   $$\frac{d^2x}{dt^2} + \omega^2 x = con\,\omega t, l \rhd 0$$

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PGIS-N 1005 B-14
M.Sc. Ist Semester(CBCS) Degree Examination
Physics
(Introductory Quantum Mechanics)
Paper : HCT - 1.3
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to candidates:

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

1. Derive the time dependent schrodinger equation for a free particle. Explain the probability interpretation of the wave function and establish that the total probability must be conserved **(15)**

Or

2. a) What is group velocity & how it is related to the phase velocity? Show that the group velocity of a wave packet is equal to the velocity of the particle which determines the de-broglie wave length.

b) Find the de Broglie wave lenght of

i) an electron with energy 10ev.

ii) A neutron moving with a kinetic energy of 500 ev. The following data are given $h=6.626\times10^{-34}$Js

$Me = 9.109\times10^{-31}$kg. $Mn = 1.675\times10^{-27}$ kg

$lev = 1.6\times10^{-19}$J **(9+6)**

3. a) Given a finite square well potential

$$V(x)=\begin{cases}-v_o \ if \ -a \le x \le a \\ O \quad Otherwise\end{cases}$$

Obtain the graphical solution of the energy levels

b) Find the transmission probability for a particle incident on a one-dimensional potential barrier of height 'V_o' & width a for $E>V_o$. **(9+6)**

Or

4. a) Obtain the three-dimensional schrodinger equation in a spherical coordinates for a particle in a central potential & deduce the radial equation.

b) Show that eigen values of a unitary operator have absolute value equal to one **(12+3)**

5. a) Consider the following two kets

$$|\psi> = \begin{pmatrix} 5i \\ 2 \\ -i \end{pmatrix} \& |\phi> = \begin{pmatrix} 3 \\ 8i \\ -9i \end{pmatrix}$$

i) Find $|\psi>^* \& <\psi|$

ii) Is $|\psi>$ normalized? If not, normalize it

iii) find $\langle \psi / \phi \rangle$

b) In case of dimensional harmonic oscillator solved by matrix method, show that the cretion operator acting on a state vector $|n>$ is given by $\hat{a}t/n>=\sqrt{n+1}/n+1>$

(6+9)

Or

6. a) Discuss the schrodinger & Heisenberg representations for describing the dynamical behaviour of the system & hence obtain the Heisenberg equation of motion.

b) The basis vectors of a representation are $\begin{pmatrix} 1 \\ 0 \end{pmatrix} \& \begin{pmatrix} 0 \\ 1 \end{pmatrix}$. Construct a transformation matrix 'U' for the transformation to another representation having basis vectors $\begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix} \& \begin{pmatrix} \frac{-1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$

(12+3)

7. a) Derive an expression for the scattering amelitude in Born approximation

b) Given $\frac{d\sigma}{d\Omega} = (a + b\cos\theta)$; *where* $0 \le \theta \le \pi$ find the total cross section **(12+3)**

Or

8. a) Using the WKB method, deduce the quantization rule for the phase Integral and hence obtain the energy levels of a bound system.

b) Explain the term 'exchange degeneracy' **(12+3)**

9. State & explain Ehren fest's theorem . **(10)**

10. Find the discrete energy levels & the normalized eigen functions of a particle in one - dimensional infinite square - well potential. **(10)**

11. Obtain the equation of motion in schrodinger representation **(10)**

12. A linear harmonic oscillator in perturbed by a potential $H^1 = \frac{1}{2}bx^2$. Using the perturbation technique, final the first order energy corrections **(10)**
