(101PH24)

M.SC DEGREE EXAMINATION, Model QP

Physics - First Semester

CLASSICAL MECHANICS

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

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5 X 14 = 70 M

1. (a) What is the principle of virtual work? Write a note on compound pendulum. What is Hamilton's principle?

   (b) Write a note on one dimensional harmonic oscillator. Write the canonical equation in terms of Poisson-Bracket notation.

   (or)

   (c) What is the generating function and its applications? What are the conditions for closed orbits?

   (d) What are action-angle variables? Write the expression for fast precision and velocity transformations.

2. (a) What is meant by motion in a central force field? Write about motion in the magnetic field.

   (b) Discuss Larmour precision. Define degrees of freedom.

   (or)

   (c) Write a note on aberration of light from stars. Write about motion in electric field.

   (d) Derive the expressions for Lorentz space time transformation. What are Lorentz transformations, and why are they essential in relativity?

3. (a) What is time dilation, and how does it impact the perception of time for moving observers? State the energy-mass relation and explain its importance in modern physics

   (b) Write a note on the Transformation of force from one inertial system to another.Discuss the covariance of the physical laws.

   (or)

   (c) How does the principle of relativity lead the constancy of speed of light in all inertial frames. Why is the speed of light significant in the context of the Principle of Relativity?

   (d) What is Galilean or Newtonian principle of relativity? Write about the Principal axes and principal moments of inertia.

4. (a) Derive the Rotational kinetic energy of a rigid body. What is Torque-free motion of a rigid body?

   (b) What is Angular momentum and Inertia tensor? Derive Hamilton-Jacobi equation for Hamilton's characteristic function.

   (or)

   (c) Write Action angle variables. Show Harmonic oscillator problem as an example of Hamilton-Jacobi method.

   (d) State and prove Hamilton-Jacobi Equation of Hamilton's principal function. Explain the fundamentals and the angular momentum in Poisson notation.

5. (a) Write Jacobi identity. What are equations of motion in Poisson bracket ?

   (b) What are canonical transformation equations? Discuss how transformation equations can be obtained from generating functions F_1 and F_2.

   (or)

   (c) State the condition for canonical transformation and show that the transformation $q = \sqrt{2P}\sin Q \ \ and\ p = \sqrt{2P}\cos Q$ is canonical

   (d) Write the Principle of Least Action. Lagrange's Equation for Non-Conservative, Non-Holonomic Systems.

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M.SC DEGREE EXAMINATION, Model QP

Physics - First Semester

INTRODUCTORY QUANTUM MECHANICS

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

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5 X 14 = 70 M

1. (a)Explain about the Ehrenfest theorem.
   (b)Explain about Harmonic oscillator by using Schrodinger equation.

   or

   (c)Write about the application to Wave mechanics in one dimension.
   (d)Explain about the Inadequacy of classical mechanics
2. (a)Explain about the Orthogonalization procedure.
   (b)Briefly write about the projection operators.

   or

   (c)Describe the Vectors and operators briefly.
   (d)Explain about the continuous spectrum.
3. (a)Explain about the Eigen values and Eigen functions of rigid rotator and hydrogen atom.
   (b)Explain about the Eigen value problem for L_+ and L_- operators.

   or

   (c)Explain about the Angular momentum in spherical polar coordinates
   (d)Explain about the Eigen value for L^2 and L_z.
4. (a)Briefly explain about the Time-independent perturbation theory for degenerate system.
   (b)Application to ground state of Helium atom.

   or

   (c)Briefly explain about the WKB method.
   (d)Write about the Stark effect in Hydrogen atom.
5. (a)Briefly explain about general perturbation theory.
   (b)Explain about the transition into closely spaced levels.

   or

   (c)Explain about the variation of constants in time dependent perturbation theory.
   (d)Explain about the Einstein transition probabilities.

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M.SC DEGREE EXAMINATION, Model QP

Physics - First Semester

MATHEMATICAL PHYSICS

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

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5 X 14 = 70 M

1. (a) Show that $\int_0^1 \frac{d}{\sqrt{(1-x^n)}} = \frac{\Gamma\left(\frac{1}{n}\right)}{\Gamma\left(\frac{1}{2}+\frac{1}{n}\right)} \cdot \frac{\sqrt{\pi}}{n}$.

   (b)Explain the Orthogonal properties of Legendre's differential equation.

   Or

   (c)Explain about the Associated Legendre equation.

   (d)Explain the power series solution of Bessel's differential equation.

2. (a)Explain the Rodrigues formula of Hermite differential equation.

   (b)Explain the Orthogonal properties of Laguerre differential equation.

   Or

   (c)Explain the Laplace transform of derivatives.

   (d)Explain the solution of ordinary differential equation by using Laplace transformation of method.

3. (a) Find the finite Fourier sine and cosine transforms of f(x) = x in (0, l).

   (b) Determine the analytic function f(z) = u + iv when u + v = $x^2 - y^2 + 2xy$.

   Or

   (c) Evaluate $\int_c \frac{z^2}{(z-5)} dz$, where "c" is the circle such that |z| = 2.

   (d) Find the first four terms of Taylor series of expansion of a complex variable function $f(z) = \frac{1}{(z-1)(z-3)}$ about the point z = 4 find the origin of convergence.

4. (a) Evaluate real integral $\int_0^{2\pi} \frac{1}{2+\cos(\theta)} dx$.

   Or

   (b) A contravariant vector Ai in a 3-dimensional Cartesian coordinate system (x^1, x^2, x^3) has components: $A^1 = x^1 + 2x^2$, $A^2 = x^3$, $A^3 = (x^1)^2 - x^3$. The coordinate system is transformed to a new system $(\bar{x}^1, \bar{x}^2, \bar{x}^3)$ according to the following transformation: $\bar{x}^1 = x^1 - x^2 + x^3$, $\bar{x}^2 = 2x^2 - x^3$, $\bar{x}^3 = x^1 + x^3$. Determine the components of the transformed contravariant vector $\bar{A}^i$ in the new coordinate system. Express your answer in terms of the original coordinates (x^1, x^2, x^3).

5. (a) Explain the difference between symmetric and anti-symmetric tensors, and give a mathematical expression for each.

   Or

   (b) State the quotient law and explain its significance in determining tensor character.

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M.SC DEGREE EXAMINATION, Model QP

Physics - First Semester

ANALOG AND DIGITAL ELECTRONICS

Time : Three hours **Maximum : 70 marks**

Answer ALL Questions.

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5 X 14 = 70 M

1. (a) Explain the construction and working of a photo diode.
   (b) What are the advantages and applications of CMOS technology?

Or

   (c) Discuss the addressing modes of the 8085 microprocessors with examples.
   (d) Write an 8085-assembly language program to find the largest number in an array.

2. (a) What is Common Mode Rejection Ratio (CMRR)? How does it affect operational amplifier performance?
   (b) Explain the concept of negative feedback in operational amplifiers and its effect on gain.

Or

   (c) Describe the working of a Wein Bridge oscillator with a neat circuit diagram.
   (d) What is a comparator? Explain its role in waveform generation circuits.

3. (a) What is demodulation? Explain the process of AM wave demodulation.
   (b) Compare double sideband suppressed carrier (DSBSC) and single sideband (SSB) modulation.

Or

   (c) Explain the concept of vestigial sideband modulation (VSB) and its applications.
   (d) What is the role of Frequency Division Multiplexing (FDM) in communication systems?

4. (a) What are EX-OR and EX-NOR gates? Write their truth tables and applications.
   (b) Explain the function and applications of a multiplexer (MUX) with an example.

Or

   (c) Describe the working of a T flip-flop with circuit diagrams.
   (d) What is an Analog-to-Digital (A/D) converter? Explain its working principle.

5. (a) Explain the control signal generation process in the 8085 microprocessors.
   (b) How is interrupted handling performed in the 8085 microprocessors?

Or

   (c)Describe the architecture and pin configuration of the 8051 microcontrollers.
   (d) Explain the concepts of precision, accuracy, and error propagation in data analysis.