



RE-3465-66

M. Sc. (Part - I) Examination

April / May - 2010

Physics : Paper - I

(Classical Mechanics & Electrodynamics)

Time : 3 Hours]

[Total Marks : 70

RE-3465

Instructions :

(1)

नीचे दशांश के निशानों वाली विगतो उत्तरवही पर अवश्य लिखनी. Fillup strictly the details of signs on your answer book.		Seat No. :	
Name of the Examination :		<input type="text"/>	
M. SC. - 1		<input type="text"/>	
Name of the Subject :		<input type="text"/>	
PHYSICS - 1		<input type="text"/>	
Subject Code No. : <input type="text"/> 3 <input type="text"/> 4 <input type="text"/> 6 <input type="text"/> 5		Section No. (1, 2,.....) : <input type="text"/> 1	
		Student's Signature	

- (2) Answer to the two section must be written in separate answer books.
- (3) Symbols used have their usual meaning.
- (4) Figures to the right indicate full marks.

- 1 (a) What are inertial and non-inertial frame of reference? Why centrifugal and coriolis forces are called Pseudo forces? 2
- (b) Explain the meaning of holonomic constraints giving two examples. 2
- (c) What are the properties of orthogonal transformations representing rigid-body transformations? 2
- (d) The semi-major axis of the orbit of Jupiter is 5.2 times that of the Earth. Find its orbital period in years. 3
- (e) Using the Jacobi identity show that if u and v are two constants then $[u, v]$ is also a constant of motion. 2
- 2 (a) Show that for a system of particles the total angular momentum about an origin is the sum of the angular momentum of the centre of mass about an axis passing through the origin and the angular momentum of the system about an axis passing through the centre of mass. 4
- (b) Explain how a two-body problem can be reduced to an equivalent one-body problem for central forces. 3

- (c) A mass $2m$ is suspended from a fixed support by a spring with spring constant $2k$, a second mass m is suspended from the first mass with a spring of spring constant k . Write the Lagrangian for this system and find the equation of motion. 5

OR

- 2 (a) What is meant by cyclic coordinates? Show that the generalized momentum conjugate to such a coordinate is a constant of motion. Show how this leads to conservation of total linear momentum. 4
- (b) What is Foucault's pendulum? How it is related to the rotation of the Earth? 3
- (c) A central force field allows a particle to move in a logarithmic spiral orbit given by $r = R \exp(b\theta)$ where R and b are constants. 5
- (i) find the force law
- (ii) determine $\theta(t)$ and $r(t)$ as a function of time
- (iii) What is the total energy of the orbit?
- 3 (a) Write expressions for the total kinetic energy and angular momentum of a rigid-body under principal axes transformation. 2
- (b) What are the conditions under which the Hamiltonian of a system is equal to the total energy of the system? Should it always be constant? 2
- (c) Define Hamiltonian function and find Hamilton's equations of motion. 3
- (d) Set up the Lagrangian for a one-dimensional tri-atomic molecule and using the theory of small oscillations. Find the frequencies of normal modes of vibration. 5

OR

- 3 (a) For a function $u(q, p, t)$ show that $\frac{du}{dt} = [u, H] + \frac{\partial u}{\partial t}$ and hence find the condition for conservation of u . 3
- (b) What is the difference between Hamilton's principal function and Hamilton's characteristic function and their respective Hamilton-Jacobi equations. 3
- (c) What is meant by equation state for fluid motion. 1
- (d) If the generating function of a canonical transformation is given by : 5

$$F = \frac{m}{2} w q^2 \cot Q$$

where m and w are constants, then show that

$$q = \left(\frac{2P}{mw} \right)^{1/2} \sin Q \quad \text{and} \quad p = (2m w P)^{1/2} \cos Q$$

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(1)

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Name of the Examination :	<input type="text"/>
<input type="text" value="M. SC. - 1"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="PHYSICS - 1"/>	<input type="text"/>
Subject Code No. : <input type="text" value="3"/> <input type="text" value="4"/> <input type="text" value="6"/> <input type="text" value="6"/>	Section No. (1, 2,.....) : <input type="text" value="2"/>
Student's Signature	

- (2) Answer to the two section must be written in separate answer books.
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- 1 (a) Show that Gauss's law is a direct consequences of Coulomb's inverse square of force. 2
- (b) State Biot-Savart's law. 2
- (c) Write Maxwell's equation for vacuum and macroscopic media. 2
- (d) Define waveguide. Give its applications in various forms. 2
- (e) What do you mean by gauge transformation? Give expressions for two most used gauges. 2
- (f) What are plasma oscillations? 1
- 2 (a) Derive Poisson's and Laplace's equation and discuss the use of this equation. 4
- (b) Two infinite grounded metal plates lie parallel to the XZ plane, one at $y=0$ the other at $y=a$. The end, at $x = 0$, is closed off with an infinite strip insulated from the two plates and maintained at a specific potential $V_0(y)$. Find the potential inside the slot. 4
- (c) Derive Gauss's law in presence of dielectrics. 4

OR

- 2 (a) Derive the Ampere's law in integral form in magnetized materials. 4
- (b) Compare electrostatics and magnetostatics. 4
- (c) The constitutive parameters of copper are given by 4

$$\mu = \mu_0 = 4\pi \times 10^{-7} \text{ N/A}^2, \quad \epsilon = \epsilon_0 = 10^{-9} / (36 \pi) \text{ F/m} \quad \text{and}$$

$$\sigma = 5.8 \times 10^7 \text{ mhos/m}.$$

Find the intrinsic impedance of copper at frequency 3 GHz.

- 3 (a) Derive the propagation coefficients and intrinsic impedance of good dielectrics and conductors. 4
- (b) What is skin depth? Where does it occur, in non conducting or conducting medium? Why not in the other? 4
- (c) Find the skin depth δ at a frequency of 1.6 MHz in aluminium, where $\sigma = 38.2 \text{ Ms/m}$ and $\mu_r = 1$. Also find the propagation constant and wave velocity. 4

OR

- 3 (a) Explain Lorentz gauge. Show that it is possible to find a Lorentz Gauge. Show how it helps to uncouple the Maxwells equation for A and ϕ . 4
- (b) Derive magnetic field of oscillating Hertzian dipole. 4
- (c) Discuss the plasma behaviour in magnetic fields. 4
