[This question paper contains 2 printed pages.]

Sr. No. of Question Paper : 1289   E   Your Roll No................

Unique Paper Code   : 222281

Name of the Course   : **B.Sc. (Hons.) Mathematics/B.Sc. Mathematical Science**

Name of the Paper   : Physics – I

Semester   : II

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt **five** questions in all including Question No. **1** which is compulsory.

1. Answer any **five** of the following questions:

    (a) Determine whether the force $\vec{F} = 3xy\hat{i} - y\hat{j}$ is conservative or not.

    (b) Prove: $\vec{A} \times (\vec{B} \times \vec{C}) + \vec{B} \times (\vec{C} \times \vec{A}) + \vec{C} \times (\vec{A} \times \vec{B}) = 0$.

    (c) State and prove the law of conservation of angular momentum.

    (d) If the plane of vibration of the incident beam makes an angle of 30° with the optic axis, compare the intensities of extraordinary and ordinary light.

    (e) Give the physical interpretation of

       (i) Divergence of a vector field and

       (ii) Curl of a vector field.

    (f) Define scalar and vector fields. Give examples.

    (g) Explain how light can be polarized using reflection method?   (3×5=15)

2. (a) State and prove work-energy theorem.   (7)

    (b) What are conservative and non-conservative forces? Give an example for each.   (4)

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(c) Define the terms torque and angular momentum. Derive a mathematical relation between them. (4)

3. (a) Derive an expression for the moment of inertia of a solid sphere about an axis passing through its centre. (8)

(b) What is centre of mass? Show that in the absence of external forces the velocity of the centre of mass remains constant. (7)

4. (a) What are forced oscillations? Write a differential equation for a forced oscillator and discuss the significance of each of the terms appearing in the equation. (7)

(b) A simple harmonic motion has amplitude of 5 cm and a frequency of 12 Hz. At time $t = 0$ the particle has a displacement equal to its amplitude. Write an expression for the displacement, velocity and acceleration of the particle. Also plot the displacement versus time curve. (8)

5. (a) Explain the phenomenon of interference in a thin film. Show that the intensity distribution pattern for reflected and transmitted light are complementary to each other. (10)

(b) A thin film of plastic of refractive index 1.45 for light of wavelength 589 nm is inserted normally in path of one of the interfering beams. The central bright band shifts through 10 fringes. Find the thickness of the film. (5)

6. (a) What is Rayleigh's criterion of resolution? Find the expression for the resolving power of a telescope. (5)

(b) What is a plane transmission grating? Discuss its theory. How it can be used to determine the wavelength of light? (10)

7. (a) What is polarization of light? Discuss the production and analysis of circularly and elliptically polarized light. 10

(b) Calculate the thickness of a half wave plate of quartz when a light of wavelength of 5000 Å being used, has $\mu_0 = 1.553$ and $\mu_e = 1.544$. (5)

(500)