

3567

[This question paper contains 2 printed pages]

Roll No.....

Name of the Course: B.A./B.Sc./B.Com.

Semester: I

Name of the Paper: Mechanics_GE

Unique Paper Code: 2224001003

Duration: 3 Hours

Maximum Marks: 90

Instructions for Candidates:

1. Attempt any five questions in all.
2. Q 1 is compulsory
2. All questions carry Equal Marks.

Q1. Answer any six parts

6x3=18

- a. State the Newton's law of gravitation.
- b. A vector field is given by $\vec{u} = x^2\hat{i} + 3xy\hat{j} - 3z^2\hat{k}$. Determine divergence of $\vec{u}$ at the point (1,2,3).
- c. Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at (2,-1, 2) in the direction $2\hat{i} - 3\hat{j} + 6\hat{k}$
- d. Solve the following differential equation: $(\sin x)y' + (\cos x)y = x^2$
- e. State Kepler's laws of planetary motion.
- f. A vector B is given as $B = x\hat{i} + 4y\hat{j} + 7y\hat{k}$. Find the dot and cross product of B with itself.
- g. What is a geosynchronous orbit?
- h. Differentiate between a simple pendulum and a compound pendulum.

Q2.

- a. If three points masses m_1, m_2, m_3 are situated at the vertices of an equilateral triangle of side 'a' then what will be the coordinate of Centre of Mass of the system?
- b. What are conservative and non-conservative forces? Show that in case of conservative force the work done around a closed path is zero? (8+10)

Q3.

- a. Under a central force show that angular momentum is conserved and the particle moves in a fixed plane. Show it explicitly in case of gravitational interaction between two massive object.
- b. Consider the simple harmonic motion of a simpler pendulum of length 'L' and mass 'm'. Derive an expression for its displacement from mean position if it was at its maximum displacement A (say) at time $t=0$. Also find its time period. (8+10)

Q4.

- a. What do you understand by moment of inertia? What is its analogous term for the case of linear motion?

- b. What is satellite? What characteristics separate a geosynchronous satellite from other satellites?
- c. A feather and a Javelin will touch the earth surface at the same time if they are allowed to free-fall from a height of 1km inside a vacuum tower. Explain why. What will happen if air is let in to the tower? (5+5+8)

Q5.

- a. Determine the moment of inertia of a circular disc of radius R and mass M about an axis through its diameter.
- b. Show that the Young's modulus Y , modulus of rigidity η and Poisson's ratio σ are related by equation $Y = 2\eta(1 + \sigma)$. (9+9)

Q6.

- a. Derive the expressions for Lorentz transformation of coordinates and time if a frame of reference is moving with a uniform velocity ' v ' with respect to the other.
- b. Obtain the expression for time dilation. (12+6)