

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5972

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Unique Paper Code : 2222551203

Name of the Paper : Mechanics

Name of the Course : B.Sc. Prog. – Physical Sciences with Industrial Chemistry_NEP: UGCF-2022

Semester : II

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **FOUR** questions in all.
3. Question No. 1 is compulsory.
4. **All** questions carry equal marks.

1. Answer any **five** questions. Each question carries **3** marks.

(a) If the vectors $\vec{P} = 3\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{Q} = 2\hat{i} + 6\hat{j} + m\hat{k}$ are perpendicular to each other, find the value of m.

(b) Solve the differential equation : $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$.

(c) Show that Newton's first law of motion is the special case of the Newton's second law of motion.

(d) Show that the rate of change of angular momentum of a rotational body is equal to the torque acting on it.

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- (e) State Kepler's law?
- (f) What is poisson's ratio? Write down its limiting values.
2. (a) What are conservative and non-conservative forces? Show that the conservative force can be expressed as the negative gradient of potential energy i.e. $\vec{F} = -\vec{\nabla}U$. (2+3)
- (b) Is the force $\vec{F} = (2xy + z^2)\hat{i} + x^2\hat{j} + 2xz\hat{k}$ conservative? Calculate the amount of work done by this force in moving the particle from (0, 1, 2) to (5, 2, 7). (3+2)
- (c) State and prove work-energy theorem. (5)
3. (a) What are the characteristics of simple harmonic motion? Find out the differential equation of simple harmonic motion and solve it. (2+3+3)
- (b) Prove that the average kinetic energy of a particle performing simple harmonic motion is equal its average potential energy and each is equal to half the average total energy. (7)
4. (a) What is central force? Prove that central forces are conservative in nature. (2+4)
- (b) What is geostationary orbit? Find out the height of geostationary orbit from the surface of the earth. (3+6)
5. (a) What are the postulates of special theory of relativity? (3)
- (b) Write down Lorentz Transformation. Prove that the time observed in moving system is longer than the clock's rest system (Time dilation). (2+6)
- (c) The length of a rod is 10 meters in system S. What is its length as seen by an observer in system S', when S' has velocity of $0.8c\hat{i}$ relative to S. (4)