16/12/2015

DOON UNIVERSITY, DEHRADUN

End Semester Examination, First Semester, 2015

School of Physical Sciences

Generic Elective test paper of 5 Years (Integrated) MSc Programmes

Course: PHG-101: Mechanics Elective

Time Allowed: 3 Hours ***Maximum Marks: 30***

Note: Attempt All Questions from Sections A,B,C.

SECTION: A *(Marks: 1 X 6=6)*

1. Write the relation between total angular momentum and the moment of inertia.
2. Define the work energy theorem.
3. Define modulus of rigidity.
4. A particle executed simple harmonic motion of period 10 sec and amplitude 5 cm. Calculate the maximum amplitude of velocity.
5. A vector $\vec{c}$ is given by the following: $\vec{c} = m * (\vec{a} X \vec{b})$ (where m is an scalar and $\vec{a}$ and $\vec{b}$ are vectors). What will be the projection of $\vec{c}$ on the vector $\vec{b}$?
6. Express the vector product of the following: $\vec{a} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} + \hat{j} + 3\hat{k}$

SECTION: B *Attempt any four questions. (Marks: 3 X 4=12)*

1. Write down the Kepler's laws. Derive the orbital velocity of a planet.
2. Show that whereas distance and acceleration are invariant to Galilean transformation, velocity is not invariant.
3. Define Poisson's ratio. Derive a relationship between Young's Modulus, Bulk Modulus and Poisson's ratio.
4. What is simple harmonic motion? Show that a simple pendulum executes simple harmonic motion. Find its period.
5. Solve the following differential equation: $\frac{dy}{dx} = \frac{x^2 + y^2}{xy}$
6. Solve the following differential equation: $\frac{dy}{dx} = \frac{y + x - 2}{y + x - 4}$

SECTION: C *(Marks: 4X 3=12)*

1. (a) Show that the dynamics of two particles of masses m_1 and m_2 can be reduced to a one-particle problem with mass $\mu = \frac{m_1 m_2}{m_1 + m_2}$ if only central forces act between the particles.

(b) A circular loop of radius R starts rolling down a smooth inclined plane without slipping. Show that its acceleration down the plane is $\frac{1}{2} g \sin\theta$.

2. (a) A particle of mass 10 gm lies in a potential field $U = 32x^2 + 200$ ergs/gm. Find the frequency.

(b) What is Elasticity. Does Hook's law lies in elastic limit or elastic region? Explain.

3. Solve the following second order differential equations:

(a) $\frac{d^2x}{dt^2} = -10t$ with the boundary conditions, velocity = 10 at t = 0 and x = 5 at t = 0.

(b) $\frac{d^2y}{dx^2} = -2\sin x$ with boundary conditions, at x = 0, y = 0 and at $x = \pi$, $y = \pi$.