

B.Sc. Semester I (Honours) Examination, 2018-19**PHYSICS****Course ID : 12412****Course Code : SHPHS-102C-2(T)**

Course Title : Mechanics

Time: 1 Hour 15 Minutes**Full Marks: 25***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.***Section – I**

1. Answer *any five* questions: 1×5=5
- What is meant by stable equilibrium?
 - State the work-kinetic energy theorem.
 - Which force is responsible for keeping an artificial satellite in its specified orbit?
 - How does the co-efficient of viscosity of liquid depend upon the temperature?
 - How does the length of the year of a planet depend upon its distance from the sun?
 - Write down the expression of the acceleration of a particle moving in a central force field.
 - What is Galilean invariance?
 - Write down the perpendicular axis theorem for a plane lamina body.

Section – IIAnswer *any two* questions. 5×2=10

2. A sphere of mass M and radius r is rolling down freely, without slipping, along a plane inclined at an angle θ with the horizon. Show that the acceleration of the sphere is given by the equation.

$$f = \frac{g \sin \theta}{\left(1 + \frac{k^2}{r^2}\right)}$$

when g = acceleration due to gravityand k = radius of gyration 5

3. A force is given by $\vec{F} = (2xy + z^2)\hat{i} + x^2\hat{j} + 2xz\hat{k}$ Newton. Show that it is a conservative force field. Calculate the amount of work done by the force in moving a particle from (0, 1, 2) to (5, 2, 7). 3+2=5
4. A particle of unit mass moves according to the equation $\vec{r} = \hat{i}(2 + 3t^2) + \hat{j}5t^2 + \hat{k}t$. Find the force acting on it, torque (\vec{N}) and angular momentum (\vec{L}) about the origin. Hence verify $\vec{N} = \frac{d\vec{L}}{dt}$

5. (a) Write down the general differential equation of motion under central force field.
 (b) The motion of a particle under the influence of a central force is described by $r = a \sin \theta$.
 Find the expression for force. 1+4=5

Section – III

Answer *any one* question. 10×1=10

6. (a) Deduce Poiseuille's equation for the rate of steady flow of liquid through a narrow tube clearly mentioning the conditions to be satisfied for the deduction of the equation.
 (b) What are the limitations of the equation?
 (c) A large bottle is fitted with a siphon made of capillary glass tube. Compare the times taken to empty the bottle, when it is filled with water and petrol of specific gravity 0.8. The co-efficient of viscosity of water and petrol are 0.01 and 0.02 poise respectively at the given temperature. 5+2+3=10
7. (a) Prove that the total angular momentum of a system of particles about any point 'O' equals the angular momentum of the total mass assumed to be located at the centre of mass plus the angular momentum about the centre of mass.
 (b) State the postulates of the special theory of relativity.
 (c) If V_0 is the rest volume of a cube of side l_0 , then show that $V_0 \sqrt{1 - \beta^2}$ is the volume viewed from a reference frame moving with uniform velocity v in a direction parallel to an edge of the cube. Here $\beta = \frac{v}{c}$, c is the speed of light. 5+2+3=10
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