

Name:

Enrolment No:



## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

Programme Name: B.Sc. (H) Physics

Course Name : Mechanics

Course Code : PHYS1012

Nos. of page(s) : 2

Semester : I

Time : 03 hrs

Max. Marks : 100

**Instructions:** Read the instructions carefully and follow them strictly.

- i) Mention roll no. at the top of the question paper.
- ii) Attempt all the parts of a question at one place only.

### SECTION A (Attempt all the questions) (5QX4M=20 Marks)

S. No.		Marks	CO
Q 1	Write the Lorentz transformation equations.	4	CO1
Q 2	Interpret Poisson's ratio. What are its theoretical limits?	4	CO2
Q 3	If the centre of mass of three particles of masses 1, 2 and 3 gram be at a point (1,1,2), then where should a the forth particle of mass 5 gram be placed so that the combined centre of mass may be at the point (0,0,0).	4	CO2
Q 4	Prove that the curl of a conservative force is zero.	4	CO3
Q 5	Discuss moment of inertia. On what factors does it depend?	4	CO3

### SECTION B (Attempt all the questions. Question 9 has internal choice) (4QX10M=40 Marks)

Q 6	Express the relation between the kinetic, potential, total energy, and angular momentum $\mathbf{J}$ of a satellite of mass $\mathbf{m}$ moving in a circular orbit of radius $\mathbf{r}$ .	10	CO1
Q 7	Calculate the moment of inertia of a hollow cylinder about its own axis.	10	CO1
Q 8	With suitable diagram, state Kepler's law of planetary motion. Show that the time period of revolution of the planet in an elliptical orbit is; $T = \sqrt{\frac{4\pi^2 m^2 l a^3}{J^2}}$ Where $a$ is the semi-major axis and $l$ is the semi-latus rectum of ellipse.	10	CO3
Q 9	A fly wheel, whose mass is $500\text{ kg}$ and diameter $2\text{ meters}$ , makes $500$ revolutions in one minute. Assuming that the whole mass is concentrated on its rim, determine the angular velocity, energy, and moment of inertia of the flywheel. <b>Or</b>	10	CO4

	A steel rod of length 2 meters and of diameter 0.52 mm is suspended from a rigid support and loaded with 5 kg. An elongation of 2.3 mm is observed. Calculate the coefficient of longitudinal elasticity of steel.		
<b>SECTION-C (Attempt all the questions. Question 11 has internal choice)</b> <b>(2QX20M=40 Marks)</b>			
Q 10	(a) Deduce an expression for the gravitational potential and field due to a spherical shell at a point inside the shell.  (b) A solid sphere of mass 4 kg and diameter 0.10 meter is suspended on a wire. Find the period of angular oscillations for small displacement if the torque required to twist the wire is $4 \times 10^{-3} N - m/rad$ .	10  10	CO2
Q 11	(a) A body moving with velocity $v$ has a mass $m$ . Show that $m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$ Where $m_0$ is the rest mass of the body and $c$ , the speed of light.  (b) Calculate the speed of electrons which has kinetic energy 2 MeV. Rest mass of an electron = $9.1 \times 10^{-31} kg$  <b>Or</b>  (a) Explain Lorentz Fitzgerald contraction and time dilation. Find out the necessary expressions.  (b) With what velocity should a rod move (parallel to the length) so that its length appears half of its original length?	15  5  15  5	CO3