Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2023

Course: Mechanics **Semester: I st**
Program: B.Sc. (H) Physics **Time : 03 hrs.**
Course Code: PHYS1012 **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=20Marks)

S. No.		Marks	CO
Q 1	Define the theorems of parallel and perpendicular axes regarding moment of inertia.	**4**	**CO1**
Q 2	Summarize the fundamental postulates of special theory of relativity.	**4**	**CO2**
Q 3	Interpret the reduced mass? Explain its physical significance?	**4**	**CO2**
Q 4	Relate that, the conservative force can be expressed as the negative gradient of potential energy.	**4**	**CO3**
Q 5	A 4 kg block extends a spring 0.16 meter from its unstretched position. The block is removed, and a 0.50 kg body is hung from the same spring. If the spring is, then stretched and released, what is its period of motion?	**4**	**CO4**

SECTION B (Attempt all the questions. Question 9 has internal choice)
(4Qx10M= 40 Marks)

Q 6	Relate the kinetic, potential, total energy, and angular momentum **J** of a satellite of mass **m** moving in a circular orbit of radius **r.**	**10**	**CO1**
Q 7	Describe the moment of inertia of a solid cylinder about its own axis.	**10**	**CO1**
Q 8	Sketch 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	Three interacting particles of masses *10, 20* and *40 g* have each a velocity of *20 cm/s* magnitude along the *+ve* direction *x-axis, y-axis* and *z-axis* respectively. Find the velocity of first particle, when due to forces of interaction the third	**10**	**CO4**

	particle stops moving and the velocity of the second particle is $(10\,\hat{j} + 5\,\hat{k})\ cm/s$. **Or** Calculate the reduced mass in case of hydrogen atom and positronium.		
	SECTION-C (Attempt all the questions. Question 11 has internal choice) **(2Qx20M=40 Marks)**		
Q 10	(a) Deduce an expression for the gravitational field and potential at a point outside of thin uniform spherical shell. (b) Explain multi-stage rocket? Discuss its motion when the rocket is moving in a free space field with no frictional forces present and also when it is moving in a region where gravitational forces are present.	**10** **10**	**CO2**
Q 11	(a) Discuss the experiment of Michelson-Morley to show that the velocity of light is independent of the direction relative to all inertial frames of reference. (b) Illustrate the damped harmonic oscillator. **Or** (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) Illustrate the galvanometer with small damping.	**15** **5**	**CO3** **CO4**