Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2019

Programme Name: B.Sc. (H) Physics | **Semester** : I
Course Name : Mechanics | **Time** : 03 hrs
Course Code : PHYS1012 | **Max. Marks** : 100
Nos. of page(s) : 2

SECTION A (Attempt all the questions)

S. No.		Marks	CO
Q 1	State the fundamental postulates of special theory of relativity.	4	CO1
Q 2	Define Poisson's ratio. What are its theoretical limits?	4	CO2
Q 3	A bullet of mass *10 gm* is fired with a speed of *1000 m/s* from a freely hanging gun of mass *2 kg*. Calculate the recoil velocity of the gun.	4	CO2
Q 4	Show that the curl of a conservative force is zero.	4	CO3
Q 5	Explain moment of inertia. On what factors does it depend?	4	CO3

SECTION B (Attempt all the questions. Question 9 has internal choice)

Q 6	Define torque and angular momentum of a particle. Show that for a system of particles; $\boldsymbol{\tau}^{ext} = \frac{d\boldsymbol{J}}{dt}$ where symbols have their usual meanings.	10	CO1
Q 7	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	CO1
Q 8	State and prove the theorem of parallel axes for moment of inertia.	10	CO3
Q 9	Find the maximum length of a wire that can be suspended without breaking. Its breaking stress and density are equal to $7.2 \times 10^8 N/m^2$ and $7.8 \times 10^3 kg/m^3$ respectively.	10	CO4
	Or		
	A fly wheel, whose mass is *500 kg* and diameter *2 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.		

SECTION-C (Attempt all the questions. Question 11 has internal choice)			
Q 10 (a)	Describe the working principle of a rocket. Establish the following relation for a rocket; $$v = v_0 + u\, log_e \frac{M_0}{M}$$ where, v_0 is the initial velocity of the rocket, u is the exhaust velocity of the gases relative to the rocket and M_0 is the initial mass.	**10**	**CO2**
Q 10 (b)	A particle executes S.H.M. along a straight line and its velocity when passing through point *3 cm* and *4 cm* from the centre of its path is *16 cm/s* and *12 cm/s* respectively. Find the amplitude and time period of the motion.	**10**	**CO2**
Q 11 (a)	Write down Lorentz transformation equations and hence explain time dilation.	**10**	**CO3**
Q 11 (b)	Explain Lorentz Fitzgerald contraction. How fast would a rocket have to go relative to an observer for its length to be contracted to *99%* of its length at rest?	**10**	**CO3**
	Or		
Q 11 (a)	Describe the Michelson-Morley experiment and discuss the importance of negative results obtained from it.	**10**	**CO3**
Q 11 (b)	Calculate the fringe shift in Michelson-Morley experiment. Given $l = 10\ m$, $v = 3 \times 10^4\ m/s$ and $\lambda = 6.0 \times 10^{-7}\ m$. Where, l is the separation between two mirrors and v is the speed of apparatus.	**10**	**CO3**