UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec 2022

Course: Classical Dynamics

Program: B.Sc [Physics]

Course Code: PHYS3010D

Semester: V

Time   : 03 hrs.

Max. Marks: 100

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Determine the number of degrees of freedom in the following cases [i] A rigid body moving in a space with one point fixed [II]A rigid body rotating about a fixed axis in space	4	CO1
Q 2	Write their significance of generalized coordinates in classical dynamics and give two examples of it.	4	CO1
Q 3	Define the retarded time. Write the expression of it.	4	CO1
Q 4	Derive Newton's second law of motion from Lagrange's equations.	4	CO1
Q 5	In the following cases, discuss whether the constraints are holonomic or non-holonomic. I. A pendulum with variable length II. The motion of a body on an inclined plane under gravity	4	CO1
SECTION B **(4Qx10M= 40 Marks)**			
Q 6	What is Atwood machine. Derive its equation of motion by using Langrange,s equation	10	CO1
Q 7	What is retarded potential. Derive an expression of Lienard-Wiechert potential.	10	CO3
Q 8	Define the power radiation. Find the expression of the power radiation of accelerated charge.	10	CO3
Q 9	A cylinder of radius a and mass m rolls down on an inclined plane making an angle θ with the horizontal. Set up the Lagrangian and find the equation of motion	10	CO3

	OR Show that the transformation $Q = \frac{1}{p}$ and $P = qp^2$ is canonical		
	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	[a] Explain the space and time like in four-vectors. [b] The rest mass of a proton is 1.6725×10^{-27} kg. Find its mass and momentum, when it is with 2.7×10^8 m/s velocity. If it is collides with a stationary nucleus of mass 2.7×10^{26} kg and coalesces, find the velocity of the combined particle. **OR** [a] Explain the space and time like intervals with its conditions. [b] What is the Doppler effect? Derive an expression for the relativistic longitudinal Doppler effect.	**20**	**CO2**
Q. 11	In frame S, two events have the space-time coordinates $(0,0,0,0)$ and $(5c, 0,0,4)$, where time coordinates in seconds. Calculate the space-time interval between them. Also calculate the velocity of a frame in which the first event occurs 1 sec earlier than the second.	**20**	**CO4**