Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

Course: Mechanics **Semester: I**

Program: BSc Physics Research **Time : 03 hrs.**

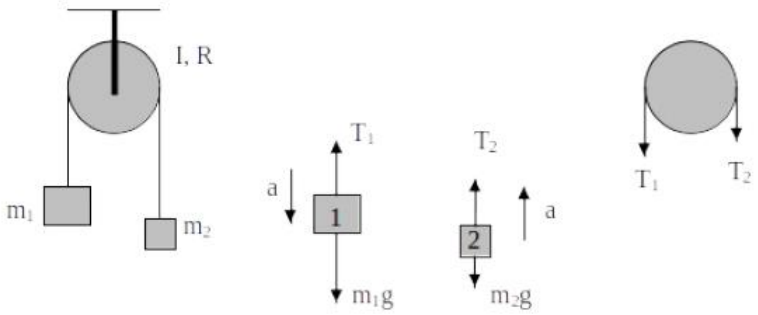
Course Code: MECH 1014 **Max. Marks: 100**

Instructions: All questions are compulsory and question numbers 9 and 11 have internal choices

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Torque of 1Nm is applied to a wheel of mass 10kg and radius of gyration 50 cm. Determine the resulting acceleration.	**4**	**CO1**
Q 2	Define inertial and gravitational mass. State the principle of equivalence.	**4**	**CO3**
Q 3	A meter rod is moving in a direction along its length with a velocity of 0.8c. Determine the percentage contraction in the length of rod.	**4**	**CO4**
Q 4	A particle executes simple harmonic motion of period 10 sec and amplitude 5 cm. Determine the maximum amplitude of velocity.	**4**	**CO4**
Q.5	Force in a region is expressed as $F = (x + 2y + az)\hat{\imath} + (bx - 3y - z)\hat{\jmath} + (4x + cy + 2z)\hat{k}$. Calculate the values of a.b.c for it to be conservative	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	An Atwood machine comprises of two masses hanging by a string over a pully as shown  Determine an expression for the acceleration of the masses, assuming that friction can be neglected. The pulley has inertia **I** and radius R.	**10**	**CO1**
Q 7	Obtain an expression for gravitational potential of a solid sphere. having mass '**M**' and radius '**R**' at an internal point of the sphere.	**8+2**	**CO3**

	Show that the gravitational potential at the center of a solid sphere is 1.5 times the gravitational potential at its surface.		
Q 8	A rod of length L_0 moves with a velocity of 0.8c in a direction making angle 30 degree with the axis of the rod. Determine the percentage contraction in the length of the rod.	**10**	**CO4**
Q 9	Obtain an expression for the fractional decrease in the kinetic energy of a neutron of mass m_1 when it makes a head on collision with an atomic nucleus of mass m_2. OR Explain the concept of reduced mass. For a system of two particles of masses m_1 and m_2 under force of mutual interaction only. Obtain the equation of motion for equivalent one body using the concept of reduced mass.	**10** **10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	a) Define rotational kinetic energy and hence explain the concept of moment of inertia. b) Obtain the moment of inertia of a solid sphere about one of the diameters.	**10** **10**	**CO1**
Q 11	a) Describe the Michelson Morley experiment and explain the negative results obtained. b) Obtain expression for velocity transformation. OR a) Define the concept of proper time and proper length and hence, obtain expression for Length contraction and Time dilation. b) In context of constancy of speed of light Show that the Galilean transformation equations changes to Lorentz transformation equations. Also obtain the value of relativistic constant γ..	**10** **10** **10** **10**	**CO4**