BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: IMSc **SEMESTER : III**
BRANCH: PHYSICS **SESSION : MO/2025**

SUBJECT: PH24201 - MECHANICS

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	Define Inertial frame of reference. Give example of inertial frame of reference	[2]	1	2
Q.1(b)	A projectile is launched with initial speed v_0 towards a slope that slopes down at an angle of $30°$ w.r.t. horizontal direction. Determine that launch angle that will give maximum range.	[3]	1	3
Q.2(a)	Find the centre of mass of a cone of diameter of base, $d = 10\ \text{cm}$ and height, $h = 20\ \text{cm}$. Assume the density of the cone to be uniform.	[2]	1	3
Q.2(b)	State principle of conservation of angular momentum. Using this principle, obtain the equation of motion of a rocket in free space.	[3]	1	3
Q.3(a)	State and explain work-energy theorem.	[2]	1	2
Q.3(b)	The potential energy of a one-dimensional system is given by $U(x) = k\left(\sqrt{x_0{}^2 + x^2} - l_0\right)^2$ where $l_0 > x_0$. Find the equilibrium points of the system and identify the stable and unstable points.	[3]	1	3
Q.4(a)	Differentiate between elastic and inelastic collisions.	[2]	2	1
Q.4(b)	A particle of mass m_1 undergoes an elastic collision with a particle of mass m_2, initially at rest. The scattering angles observed in laboratory frame and in centre of mass frame are $30°$ and $60°$, respectively. Find the ratio m_1/m_2	[3]	2	3
Q.5(a)	Find the moment of inertia of a rectangular plate about an axis perpendicular to its plane and passing through the centre of mass.	[2]	2	3
Q.5(b)	Define streamline flow. Write the formula for volumetric flow rate of a fluid through a capillary tube of circular cross-section, assuming the flow to be streamline, and explain all the terms.	[3]	2	3

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