

QP CODE: D3BPH2401	(Pages: 2)	Reg. No	:
		Name	:

THIRD SEMESTER FYUGP EXAMINATION, NOVEMBER 2025

Discipline Specific Core (DSC) Courses - Major

PHY3CJ201 : Mechanics - I

(Credits: 4)

Time: 2 Hours

Maximum Marks: 70

Section A

Answer the following questions. Each carries 3 marks (Ceiling: 24 marks)

1.	How does an external force affect the total momentum of a system?	BL2 CO2
2.	Show that kinetic energy always decreases after an inelastic collision.	BL3 CO3
3.	Define angular acceleration. Compare the direction of angular acceleration vector with that of angular velocity vector.	BL2 CO1
4.	Explain how the centripetal acceleration of a point on a rotating rigid body is related to a) linear speed of that point and b) angular speed of the rigid body	BL2 CO1
5.	What is meant by precession?	BL1 CO4
6.	Explain vector nature of angular momentum.	BL2 CO1, CO2
7.	Distinguish between gravitation potential and potential energy.	BL1 CO6
8.	Define gravitational field. What is its unit?	BL3 CO6
9.	What is the thrust exerted on a rocket?	BL3 CO4
10.	What is meant by the torque produced by a force?	BL1 CO1, CO2

Section B

Answer the following questions. Each carries 6 marks (Ceiling: 36 Marks)

11.	Three particles of masses 1 kg, 2 kg and 3 kg are placed at the corners of an equilateral triangle of side 1 m. Locate the centre of mass.	BL4 CO2, CO3
12.	Discuss the physical principles involved in the working of airbags. Explain why a longer time interval for stopping reduces force, and why this is important in vehicle safety design?	BL3 CO1
13.	A uniform sphere with mass M and radius R is rotating with angular speed ω_1 about a frictionless axle along a diameter of the sphere. The sphere has rotational kinetic energy K_1 . A thin-walled hollow sphere has the same mass and radius as the uniform sphere. It is also rotating about a fixed axis along its diameter. In terms of ω_1 , What angular speed must the hollow sphere have if its kinetic energy is also K_1 , the same as for the uniform sphere?	BL4 CO1, CO5

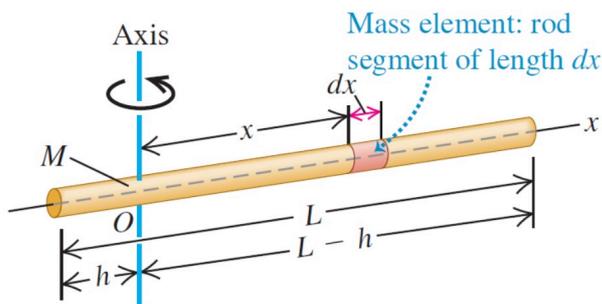
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14.	A disk rotates around an axis through its center that is perpendicular to the plane of the disk. The disk has a line drawn on it that extends from the axis of the disk to the rim. At $t = 0$ this line lies along the x-axis and the disk is rotating with positive angular velocity ω_{0z} . The disk has constant positive angular acceleration α_z . At what time after $t = 0$ has the line on the disk rotated through an angle θ ?	BL4	CO1, CO5
15.	For a wheel undergoing rolling without slipping, obtain the kinetic energy of the wheel using the parallel-axis theorem.	BL4	CO1, CO2
16.	Derive the expression for Power due to a torque acting on a rigid body.	BL2	CO1, CO2
17.	Use Gauss's law to obtain the gravitational field outside of an infinitely long cylinder of radius a with constant linear mass density λ .	BL3	CO6
18.	Discuss the significance of Poisson's equation in gravitational theory. Explain how this differential equation relates the distribution of mass to gravitational potential, and describe the situations where it reduces to Laplace equation.	BL3	CO6

Section C

Answer any one question. Each carries 10 marks (1 x 10 = 10 Marks)

19.	Discuss the different ways to represent gravitational field. Compare their merits and demerits.	BL2	CO6
20.	A slender uniform rod with mass M and length L . It might be a baton held by a twirler in a marching band (without the rubber end caps). (a) Use integration to compute its moment of inertia about an axis through O , at an arbitrary distance h from one end. (b) verify the result - moment of inertia obtained by integration - using parallel-axis theorem. (c) Initially the rod is at rest. It is given a constant angular acceleration of magnitude a around the axis through O . Find how much work is done on the rod in a time t . (d) At time t , what is the linear acceleration of the point on the rod farthest from the axis?	BL2	CO1



CO : Course Outcome

BL : Bloom's Taxonomy Levels (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)