24U314 (Pages: 2) Name : .....

Reg. No : .....

THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(FYUGP)

CC24UPHY3CJ201 - MECHANICS – I

(B.Sc. Physics / Physics & Computer Science Double Major - Major Course)

(2024 Admission - Regular)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. State the law of conservation of momentum. [Level:1] [CO1]
2. Give an real-life example of an elastic collision. [Level:1] [CO3]
3. A solid sphere and a hollow sphere of the same mass and radius rotate about the same diameter. Which one has the larger moment of inertia? Analyse how mass distribution affects inertia. [Level:4] [CO1]
4. A person is sitting on a rotating swivel chair holding dumbbells in both hands. When the person pulls the dumbbells closer to the chest, the chair rotates faster. Justify your answer. [Level:4] [CO1]
5. State the expression for the total kinetic energy of a rigid body undergoing combined translation and rotation. [Level:1] [CO3]
6. Define the term couple and explain how it produces rotation without translation. [Level:2] [CO3]
7. Derive the expression for the moment of inertia of a thin rod about its center. [Level:1] [CO2]
8. State the key features of equipotential surface. [Level:1] [CO5]
9. Define Gauss Divergence theorem. [Level:1] [CO5]
10. Define a completely in elastic collision. [Level:1] [CO3]

(Ceiling: 24 Marks)

Part B (Paragraph questions/Problem)

Answer ***all*** questions. Each question carries 6 marks.

11. A space vehicle of initial mass 50,000 kg (including fuel) ejects gases at 3500 m/s. If it consumes 40,000 kg of fuel, find the velocity attained. [Level:1] [CO1]

12. You are winding a fishing reel and the spool is slowing to a stop. The angular velocity of the spool at t=0 is 50.0rad/s, and its angular acceleration is a constant −15.0rad/s^2. A line on the surface of the spool lies along the +x-axis at t=0. (a) What is the spool's angular velocity at t=0.500s? (b) What angle does the line on the spool make with the +x-axis at this time? [Level:4] [CO1]

13. A satellite is in a circular orbit around a planet with a radius of 6.8×106m. At a certain point in its orbit, its angular speed is 7.5×10−4rad/s and its angular speed is increasing at a rate of 2.0×10−7rad/s^2. At this instant, find the tangential and centripetal components of the satellite's acceleration, and the magnitude of the total acceleration. [Level:4] [CO1]

14. A disk starts from rest and accelerates such that its angular velocity is given by ω(t)=100sin(2t), where ω is in rad/s and t in seconds. If the moment of inertia of the disk is 1.2 kg·m2, find: (a) The angular momentum at t=1.0 s. (b) The torque acting at t=1.0s. [Level:2] [CO2]

15. Derive an expression for the angular velocity of precession of a symmetric gyroscope of mass M, spinning with angular speed ω, in terms of torque and angular momentum. [Level:2] [CO2]

16. A long thin rod of length L lies along the x-axis. The end points of the rod are at x'=0 and x'=L. Assume the rod can be represented as a continous mass distribution with linear density λ mass per unit length. Determine the gravitational field at the point x=4L. [Level:3] [CO5]

17. A particle of mass m is located at (2,2), a particle of mass 3m is located at (3,4). Determine the gravitational force acting on the particles of masses m and 3m in vector form. [Level:3] [CO5]

18. Two particles in plane: m1=2 kg at (1,2), m2=3 kg at (4,6). Find (xcm,ycm) [Level:1] [CO1]

(Ceiling: 36 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19. Discuss Practical applications of angular acceleration. Analyze how controlling angular acceleration is important in machines like washing machines, turbines, or vehicles. [Level:4] [CO1]

20. Define gravitational field with equation. A point mass M is located at the origin. Another point mass M is located at (0,4). Determine the gravitational field at (0,3) and (3,0) [Level:3] [CO5]

(1 × 10 = 10 Marks)

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