MAMT-05/MSCMT-05/MAT-202

June - Examination 2026

M.A./M.Sc. (Previous) Examination

MATHEMATICS

Mechanics

Paper : MAMT-05/MSCMT-05/MAT-202

[*Time: **3** Hours*] [*Maximum Marks: **80***]

Note :- The question paper is divided into three Sections A, B and C. Write answers as per the given instructions in each section. Use of non-programmable scientific calculator is allowed in this paper.

Section-A **8×2=16**

(Very Short Answer Type Questions)

Note :- Answer **all** questions. As per the nature of the question delimit your answer in one word, one sentence or maximum up to **30** words. Each question carries **2** marks.

1. (i) Write formula for product of Inertia of rectangular plate of mass M and length of sides 2a, 2b about its sides.
   (ii) Define centre of percussion and line of percussion.
   (iii) Write expression for Kinetic Energy of a rigid body in a two-dimensional motion under finite forces.
   (iv) State Hamilton's Principle.
   (v) State principle of least action.
   (vi) Define viscosity.
   (vii) Define laminar flow.
   (viii) Define rotational and irrotational motion.

Section-B **4×8=32**

(Short Answer Type Questions)

Note :- Answer **any four** questions. You have to delimit your each answer maximum up to **200** words. Each question carries **8** marks.

2. Deduce the general equations of motion of a rigid body from D'Alembert's Principle when forces are finite.
3. A uniform solid cylinder is placed with its axis horizontal on a plane, whose inclination to the horizon is 'α', show that the least coefficient of friction between it and the plane, so that it may roll and not slide, is $\frac{1}{3}\tan\alpha$.
4. Show that for a body of revolution the maximum value of angle between axis of the impulsive couple acting on it and the instantaneous axis of initial motion set up by couple in the body is -

$$\sin^{-1}\left(\frac{C-A}{C+A}\right)$$

5. A top is executing steady motion with angular velocity *n* about its axis which is vertical, show that the motion is stable.

6. The velocity components for a two dimensional flow system can be given in the Eulerian system by $u = 2x + 2y + 3t$, $v = x + y + \frac{1}{2}t$. Find the displacement of a fluid particle in the Lagrangian system.

7. State and prove Bernoulli's Theorem.

8. Derive Euler's dynamical equations of motion in Cartesian coordinates.

9. Show that the velocity potential -

$$\phi = \frac{1}{2}\log\frac{(x+a)^2+y^2}{(x-a)^2+y^2}$$

gives a possible motion. Determine the stream lines.

Section-C

2×16=32

(Long Answer Type Questions)

Note :- Answer **any two** questions. You have to delimit your each answer maximum up to **500** words. Each question carries **16** marks.

10. Two uniform equal rods AB and AC are freely hinged at A and rest in a straight line on a smooth table. A blow is struck at it perpendicular to the rods. Show that the kinetic energy generated is $\frac{7}{4}$ times what it would be if the rods were rigidly fastened together at A.

11. Derive Lagrange's equations of motion in generalised coordinates for a holonomic dynamical system under finite forces.

12. A mass of liquid surrounds a solid sphere of radius a and its outer surface, which is a concentric spheres of radius b, is subject to a given constant pressure P, no other force being in action on the liquid. The solid sphere suddenly shrinks into a concentric sphere. Determine the subsequent motion and the impulsive action on the sphere.

13. A sphere of radius a is surrounded by infinite liquid of density ρ the pressure at infinity being π. The sphere is suddenly annihilated. Show that the pressure at a distance r from the centre immediately falls to $\pi\left(1-\frac{a}{r}\right)$. Show further that if the liquid is brought to rest by impinging on a concentric sphere of radius $\frac{a}{2}$, the impulsive pressure sustained by the surface of sphere is $\left(\frac{7\pi\rho^2}{6}\right)^{\frac{1}{2}}$.
