2022

MATHEMATICS

[HONOURS]

(B.Sc. Sixth Semester End Examination-2022)

PAPER-MTMH DSE 601

[MECHANICS]

Full Marks: 60 ***Time: 03Hrs***

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer any ten questions: **2x10= 20**

i) State Verignon's theorem of moments.

ii) Prove that if three coplanar forces acting on a rigid body are in equilibrium then they must either be concurrent or parallel to one another.

iii) Discuss: angle of friction, cone of friction.

iv) Mention the forces which may be omitted in the equation of virtual work.

v) Define: wrench, pitch

vi) State the theorem of pappus.

vii) Determine the moment of a force about an axis.

viii) What is meant by momental ellipsoid at a point?

ix) Find the moment of inertia of a solid right circular cone about its axis.

x) Define D'Alembert's principle.

xi) What is the principle of conservation of momentum?

xii) The resultant of two forces P and 2P, acting at a point, is perpendicular to P. Find the angle between the forces

xiii) A uniform cubical box of edge a is placed on the top of a fixed sphere. Show that the least radius of the sphere for which the equilibrium will be stable is $\frac{a}{2}$

xiv) Find the moment of inertia of the arc of a circle about the diameter bisecting the arc.

xv) Find the length of the simple equivalent pendulums of a circular disc, axis being the tangent to it (Axis being horizontal).

2. Answer any four questions: 4x5 = 20

i) A semicircular disc rests in a vertical plane with its curved edge on a horizontal plane and an equally rough vertical plane and coefficient of friction being μ. Find the greatest angle that the bounding diameter can make with the horizontal plane.

ii) Drive the equation of the central axis when a system of non-coplanar forces acting on a rigid body at different points .

iii) Find the position of the c.g. of the surface generated by revolution of a loop of the leminiscate $r^2 = a^2 \cos 2\theta$ about the initial line

iv) Show that the momental ellipsoid at a point on the rim of a hemisphere is $2x^2 + 7\left(y^2 + z^2\right) - \frac{15}{4}zx = Constant$

v) ABC is a triangular area and AD is perpendicular to BC and AE is a median O, is the middle point of DE. Show that BC is a principal axis of the triangle at O.

vi) A uniform rod OA of length $2a$, free to turn about its end O, revolves with uniform angular velocity w about the vertical OZ through O, and is inclined at a constant angle α to OZ; show that the value of α is either zero or $\cos\left(\frac{3g}{4aw^2}\right)$.

3. Answer any two questions: 2x10 = 20

i) a) Prove the principle of virtual works for a system of coplanar forces acting at different points on a rigid body.

b) Find the moment of inertia of a rectangular lamina about a line through the centre and parallel to its length.

ii) a) A square frame ABCD of four equal joined rods hangs from A, the shape being maintained by a string joining mid-points of AB, BC. Find the ratio of the tension of the sting to the reaction at C.

b) A force P acts along the axis of x and another force nP acts along a generators of the cylinder $x^2+y^2=a^2$. Show that the central axis lies on the cylinder

$n^2(nx-z)^2+(1+n^2)^2y^2=a^2n^4$

vi) a) A uniform rod AB is freely movable on a rough inclined plane, whose inclination to the horizon is i and whose coefficient of friction is μ about a smooth pin fixed through the end A; the bar is held in the horizontal position in the plane and allowed to fall from this position . If θ be the angle through which it falls from rest show that $\frac{\sin\theta}{\theta} = \mu\cot i.$

b) Find the kinetic energy of a rigid body rotating about a fixed axis.
