

**BACHELOR OF SCIENCE EXAMINATION, 2019**

(1st Year, 2nd Semester, Old Syllabus)

**MATHEMATICS (HONOURS)**

**Mechanics - I**

**Paper : 2.1**

Time : Two hours

Full Marks : 50

Answer *q.no. 6* and any *three* from the rest.

1. (a) If three co-planar forces acting on a rigid body be in equilibrium, then prove that the forces must meet at a point or else all must be parallel to one another. 7
- (b) A heavy uniform rod of length  $a$  rests with one end against a smooth vertical wall, the other end being tied to a point of the wall by a string of length  $l$ . Prove that the rod may remain in equilibrium at an angle  $\theta$  to the wall, given by

$$\cos^2 \theta = \frac{l^2 - a^2}{3a^2} \quad 8$$

2. (a) State the laws of statical friction. 6
- (b) A uniform ladder is in equilibrium with one end resting on the ground and the other end against a vertical wall. If the ground and wall both be rough and the co-efficients of friction be  $\mu$  and  $\mu'$  respectively and if the ladder is on the point of slipping

(Turn Over)

(2)

at both ends, show that the inclination of the ladder to

the horizon is given by  $\tan \theta = \frac{1 - \mu \mu'}{2\mu}$ . 9

3. (a) Find the centre of gravity of the homogeneous area bounded by the parabola  $y^2 = 4ax$ , the x-axis and the ordinate  $x = h$ . 8

(b) Find the centre of gravity of a uniform solid hemisphere. 7

4. (a) A uniform chain of length  $2l$  is tightly stretched between two points in the same horizontal line at a distance  $2a$  apart. Show that the sag of the chain at its lowest point is  $\frac{1}{2}\sqrt{6a(\ell - a)}$  approximately. 10

(b) Obtain the intrinsic equation of common catenary. 5

5. (a) A body consisting of a cone and a hemisphere on the same base rests on a rough horizontal table, the hemisphere being in contact with the table. Show that the greatest height of the cone, for the stable equilibrium, is  $\sqrt{3}$  times the radius of the hemisphere. 8

(3)

(b) A hemisphere rests in equilibrium on a sphere of equal radius. Discuss the stable and unstable equilibrium of the system. 7

6. Obtain the equation of the central axis of a system of forces acting on a rigid body. 5

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