

Ex/Math/12/2.1/54/2018(Old)

BACHELOR OF SCIENCE EXAMINATION, 2018

(1st Year, 2nd Semester)

MATHEMATICS (Honours)

Paper - 2.1

(Mechanics - 1)

[Old Syllabus]

Full Marks : 50

Time : Two Hours

The figures in the margin indicate full marks.

Symbols and Notations have their usual meanings.

Answer any *five* questions.

1. (a) Find a necessary and sufficient condition for the equilibrium of a system of co-planar forces acting on a rigid body. 5
- (b) Three forces P , Q , R act along the sides of a triangle formed by the lines $x + y = 1$, $y - x = 1$, $y = 2$. Find the equation of the line of action of the resultant. 5
2. (a) If a system of co-planar forces acting at different points of a rigid body be in equilibrium and if the body be

[Turn over]

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given a small virtual displacement consistent with the geometrical conditions of the system, then prove that the algebraic sum of the virtual work done by the forces is zero. 5

(b) A regular hexagon $ABCDEF$ is formed of six equal uniform rods, each of weight w , freely jointed together. The hexagon rests in a vertical plane and the side AB is in contact with a horizontal table. If C and F be connected by a light string, prove that its tension is $w\sqrt{3}$. 5

3. (a) Obtain the intrinsic equation of common catenary. 5

(b) A uniform chain of length l , which can just bear a tension of n times its weight, is stretched between two points in the same horizontal line. Show that the least possible

sag in the middle is $l \left[n - \sqrt{n^2 - \frac{1}{4}} \right]$. 5

4. (a) State the laws of statical friction. 2

(b) Define the co-efficient of friction, angle of friction and cone of friction. 3

[Turn over]

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- (c) A body is placed on a rough plane inclined to the horizon at an angle greater than the angle of friction and is supported by a force, acting in a vertical plane through the line of greatest slope. Find the limits of the force in order to keep the body at rest on the inclined plane. 5
5. (a) Find the centre of gravity of a plane lamina of uniform density in the form of a quadrant of an ellipse. 5
- (b) Find the centre of gravity of the area bounded by the parabola $y^2 = 4ax$, the axis of x and the latus rectum. 5
6. (a) A hemisphere rests in equilibrium on a sphere of equal radius. Show that the equilibrium is
- (i) unstable when the curved surface rests on the sphere,
- (ii) stable when the flat surface of the hemisphere rests on the sphere. 5
- (b) 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, so that the equilibrium may be stable, is $\sqrt{3}$ times the radius of the hemisphere.

[Turn over]

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7. (a) Show that a system of forces acting at given points of a rigid body can be reduced to a single force acting through an arbitrary chosen point O and a couple whose axis passes through O. 5
- (b) Find the equation of the central axis of a system of forces acting on a rigid body. 5
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