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Y—98—2019

FACULTY OF SCIENCE

B.Sc. (Third Year) (Fifth Semester) (Backlog) EXAMINATION

OCTOBER/NOVEMBER, 2019

(CGPA Pattern)

MATHEMATICS

Paper XV

[Mechanics-I : (Statics)]

(Tuesday, 19-11-2019) **Time : 10.00 a.m. to 12.00 noon**

Time— Two Hours *Maximum Marks*—40

N.B. :— (*i*) *All* questions are compulsory.

(*ii*) Figures to the right indicate full marks.

1. Attempt any *five* of the following : 2 each

(*a*) Define equilibrium.

(*b*) Define resultant of forces.

(*c*) State law of polygon of forces.

(*d*) State converse of the triangle law of forces.

(*e*) Define motion of rotation.

(*f*) Define couple.

2. Attempt any *two* of the following : 5 ecah

(*a*) Determine the magnitude and direction of the resultant $\vec{R}$ when the magnitudes of the *two* forces $\vec{P}$ and $\vec{Q}$ are equal.

(*b*) Find the magnitude and direction of the resultant of any number of coplanar forces acting at a point.

(*c*) Find the smaller force, when the forces act at an angle of 120°, the greater force is of 30 kg and resultant is perpendicular to smaller one.

P.T.O.

3. Attempt any *two* of the following : 5 each

(*a*) Prove that if three forces of magnitudes P, Q and R respectively acting on a particle are in equilibrium, each is proportional to the sine of the angle between the other two :

$$i.e.\ \frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$$

where $\measuredangle(\vec{Q}, \vec{R}) = \alpha, \measuredangle(\vec{R}, \vec{P}) = \beta$ and $\measuredangle(\vec{P}, \vec{Q}) = \gamma$

(*b*) Prove that the necessary and sufficient condition for a system of forces acting on a particle to be equilibrium is that the algebraic sum of resolved parts of the given forces along any three non-coplanar directions must separately vanish.

(*c*) A uniform plane lamina in the form of a rhombus, one of whose angle is 120°, is supported by two forces applied at the centre in the direction of the diagonals so that one side of the rhombus is horizontal. Prove that if P and Q be forces and P > Q, then :

$$P = \sqrt{3}Q$$

4. Attempt any *two* of the following : 5 each

(*a*) Prove that sum of the vector moments of two like parallel forces acting on a rigid body about any point equals to the vector moment of their resultant about the same point.

(*b*) Prove that the necessary and sufficient condition that a given system of forces acting upon a rigid body is in equilibrium is that the force-sum and moment-sum must separately vanish.

(*c*) Find the vector moment of force $\vec{F}$ of magnitude 10 units acting at a point (1, 2, 3) in the direction of the vector $2\vec{i} + \vec{j} + 2\vec{k}$ about the point (2, 3, 1)