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X—33—2019

FACULTY OF ARTS/SCIENCE

B.A./B.Sc. (Third Year) (Fifth Semester) (Regular) EXAMINATION

OCTOBER/NOVEMBER, 2019

(CBCS Pattern)

MATHEMATICS

Paper-XIV

[Mechanics-I (Statics)]

(Thursday, 17-10-2019) **Time : 10.00 a.m. to 12.00 noon**

Time—2 *Hours* *Maximum Marks*—40

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

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

(*iii*) Use of non-scientific/non-programmable calculator is allowed.

1. Find the magnitude and direction of the resultant of any number of coplanar forces acting at a point and hence find the smaller force, when two forces act at an angle of 120º, the greater force is of 30 kg and resultant is perpendicular to smaller one. 15

Or

(*a*) Define like parallel forces and find the resultant of two like parallel forces.

(*b*) A particle is acted upon by three forces in one plane equal to 2, $2\sqrt{2}$ and 1 kg respectively. The first force is horizontal, the second acts at 45° to the horizontal and third is vertical. Find the magnitude and direction of resultant.

2. State and prove converse of the triangle law of forces, and prove that $P = \sqrt{3}\,Q$ when a uniform plane lamina in the form of rhombus, one of whose angle is 120°, is supported by two forces P and Q applied at the centre in the direction of diagonals so that one side of rhombus is horizontal, where $P > Q$. 15

P.T.O.

Or

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

(*b*) A particle is placed at centre O of circle inscribed in Δ ABC, forces $\vec{P}, \vec{Q}, \vec{R}$ acting along $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$ respectively are in equilibrium.

Prove that $P : Q : R = \cos \frac{A}{2} : \cos \frac{B}{2} : \cos \frac{C}{2}$.

3. Attempt any *two* of the following : 10

(*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*) 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).

(*c*) Write the conditions of equilibrium of forces acting on a rigid body in Cartesian form.

(*d*) ABCD is a square whose side is 2 units in length. Forces of magnitudes *a, b, c, d* act along the sides AB, BC, CD and DA taken in order and forces of magnitudes $p\sqrt{2}, q\sqrt{2}$ act along the diagonals AC and DB respectively. Prove that if :

$$p + q = c - a \text{ and } p - q = d - b.$$

The forces are equivalent to a couple of moment $a + b + c + d$.