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SB—131—2022

FACULTY OF SCIENCE/ARTS

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

JUNE/JULY, 2022

(CBCS/Old Pattern)

MATHEMATICS

Paper XIV

Mechanics—I

(Monday, 20-6-2022)

Time : 10.00 a.m. to 12.30 p.m.

Time—2½ 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. Prove that the algebraic sum of the resolved parts of two forces in a given direction is equal to the resolved part of their resultant along the same direction and the resultant of two forces P and Q is R. If the force Q be doubled, the new resultant is perpendicular to the force P. Prove that the force Q equals to the resultant R. 15

Or

(a) Determine magnitude and direction of the resultant \vec{R} of two forces \vec{P} and \vec{Q} acting at an angle θ .

(b) Two like parallel forces of magnitudes P and Q act on a rigid body at A and B respectively. Show that if they interchange position, the point of application of the resultant is displaced through a distance

$$\left(\frac{P - Q}{P + Q} \right) AB \text{ along AB.}$$

P.T.O.

2. State and prove Lami's theorem and if three forces of magnitudes P, Q, R acting on a particle are in equilibrium and the angle between P and Q is double the angle between P and R, then show that : 15

$$R^2 = Q(Q - P).$$

Or

- (a) State and prove triangle law of forces.
- (b) D, E, F are the middle points of the sides BC, CA and AB respectively of a ΔABC . Three forces represented by \vec{AD} , $\frac{2}{3}\vec{BE}$ and $\frac{1}{3}\vec{CF}$ act at a point inside the ΔABC . Prove that their resultant is represented by $\frac{1}{2}\vec{AC}$ and its line of action divides BC in the ratio 2 : 1.
3. Attempt any *two* of the following : 10

- (a) Prove that, a system of forces acting upon a rigid body is equivalent to a force at any arbitrary point together with a couple.
- (b) Find the vector moment of a force $\vec{F} = i + 2j + 3k$ acting at a point $(-1, 2, 3)$ about the origin.
- (c) Prove that the vector moment of the resultant couple of two couples acting upon a rigid body is the sum of the vector moments of the given couples.
- (d) A force \vec{F} of magnitude 8 units acts at a point P(2, 3, 4) along the line

$$\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$$

Find the moment of the force \vec{F} about x-axis.