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VA—79—2024

FACULTY OF SCIENCE/ARTS

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

NOVEMBER/DECEMBER, 2024

(CBCS/New Pattern)

MATHEMATICS

Paper—XIV

(Mechanics—I)

(Friday, 13-12-2024)

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 resultant of two forces when :

15

(i) If $\theta = 0$

(ii) If $\theta = \pi/2$

(iii) If $\theta = \pi$

P.T.O.

and if two forces whose magnitudes are P and $P\sqrt{2}$ act on a particle in directions inclined at an angle of 135° to each other, find the magnitude and direction of the resultant.

Or

- (a) State and prove polygon of forces. 8
- (b) If A and B are two smooth pegs in a horizontal line at a distance 5 m apart. Two light inextensible strings CA and CB of lengths 3 m and 4 m respectively attached to pegs. Find the tensions in the strings, when a weight of 10 kg is suspended from C. 7
2. 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-coplaner directions must separately vanish and if D, E, F are the middle points of the sides BC, CA and AB respectively of a $\triangle ABC$. Three forces represented by \overline{AD} , $\frac{2}{3}\overline{BE}$ and $\frac{1}{3}\overline{CF}$ act at a point inside the $\triangle ABC$. Prove that their resultant is represented by $\frac{1}{2}\overline{AC}$ and its line of action divides BC in the ratio 2 : 1. 15

Or

- (a) 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. 8
- (b) A force \overline{F} of magnitude 8 units acts at a point P(2, 3, 4) along with line 7

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

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

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

- (a) Find the magnitude and direction of the resultant of any number of coplanar forces acting at a point.
- (b) Prove that, if the three forces acting on a particle are in equilibrium, they can be represented both in magnitude and direction by the sides of any triangle, taken in order and drawn parallel to the given forces.
- (c) Prove that, the sum of the vector moment of a system of forces acting on a particle about any point equals to the vector moment of their resultant about the same point.
- (d) Find the vector moment of a force $\bar{F} = \bar{i} + 2\bar{j} + 3\bar{k}$ acting at a point $(-1, 2, 3)$ about the origin.