This question paper contains **3** printed pages]

NA—79—2023

FACULTY OF SCIENCE/ARTS

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

NOVEMBER/DECEMBER, 2023

(CBCS/New Pattern)

MATHEMATICS

Paper XIV

(Mechanics–I)

(Saturday, 16-12-2023) **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.

(*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 if 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 the third is vertical. Find the magnitude and direction of the resultant. 15

Or

(*a*) State and prove polygone of forces. 8

(*b*) Prove that if three like or unlike parallel forces be in equilibrium, the magnitude of each force varies as the distance between the other two. 7

P.T.O.

2. 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 and if a Force $\vec{F}$ of magnitude 8 units act at a point P(2, 3, 4) along the line : 15

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

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

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 separately vanish. 8

(*b*) D, E, F are the middle points of the sides BC, CA and AB respectively of a Δ ABC. Three forces represented by $\overrightarrow{AD}$, $\frac{2}{3}\overrightarrow{BE}$ and $\frac{1}{3}\overrightarrow{CF}$ act at a point inside the Δ ABC, then prove that their resultant is represented by $\frac{1}{2}\overrightarrow{AC}$ and its line of action divides BC in the ratio 2 : 1. 7

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

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

(*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 triangle, taken in order, and drawn parallel to the given forces.

(*c*) If A and B are two smooth pegs in a horizontal line at a distance 5 m apart, two light enextensible string 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.

(*d*) Find the vector moment of a Force $\vec{F}$ of magnitudes 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).