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

B—95—2019

FACULTY OF ARTS/SCIENCE

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

MARCH/APRIL, 2019

(CBCS PATTERN)

MATHEMATICS

Paper XIV

(Mechanics–I)

(Friday, 29-3-2019) **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.

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

1. Attempt any *four* of the following : 8

(*a*) Write the principle of transmissibility of force.

(*b*) Find the resultant of two forces $\vec{P}$ and $\vec{Q}$ when $\measuredangle(P, Q) = \pi$.

(*c*) State polygon of forces.

(*d*) Define equilibrium of forces.

(*e*) When we say two couples are equivalent couples ?

(*f*) If

$$\vec{F} = 3\vec{i} + 4\vec{j} + 5\vec{k},$$

then find the moment of force about z-axis.

2. Attempt any *two* of the following : 8

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

P.T.O.

(*b*) Show 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.

(*c*) 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.

3. Attempt any *one* of the following : 8

(*a*) (*i*) State and prove Lami's theorem.

(*ii*) D, E, F are the middle points of the sides BC, CA and AB respectively of a Δ ABC. Three forces represented by $\vec{AD}$, $\frac{2}{3}\vec{BE}$ and $\frac{1}{3}\vec{CF}$ act at a point inside the Δ ABC.

Prove that their resultant is represented by $\frac{1}{2}\vec{AC}$ and its line of action divides BC in the ratio 2 : 1.

(*b*) (*i*) Show 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.

(*ii*) A and B are two smooth pegs in a horizontal line at a distance 5 m apart. Two light enextensible strings CA and CB of lengths 3m and 4m respectively attached to pegs. Find the tensions in the strings, when a weight of 10 kg is suspended from C.

4. Attempt any *two* of the following : 8

(*a*) Show 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.

EFBE71C5E45A42A132CB9246F4CED5A0

(*b*) Three forces of magnitudes P, Q, R act along the sides BC, CA, AB of a Δ ABC, taken in order.

Prove that if the resultant passes through the circumcentre of ΔABC, then :

$$P\cos A + Q\cos B + R\cos C = 0.$$

(*c*) 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.

5. Attempt any *one* of the following : 8

(*a*) Define like parallel forces and if two like parallel forces of magnitudes P and Q act on a rigid body at A and B respectively, then 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 along AB.

(*b*) 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.

(*c*) Prove that, when two couples, acting in one plane upon a rigid body whose moments are equal and opposite, balance each other.

EFBE71C5E45A42A132CB9246F4CED5A0