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W—81—2018

FACULTY OF ARTS/SCIENCE

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

OCTOBER/NOVEMBER, 2018

(CBCS Pattern)

MATHEMATICS

Paper XIV

(Mechanics-I)

(Friday, 19-10-2018) **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. Attempt any *four* of the following : 8

(*a*) What is the difference between like parallel forces and unlike parallel forces ?

(*b*) Find the resultant of two forces $\vec{P}$ and $\vec{Q}$, when $K(P, Q) = \pi/2$.

(*c*) State Triangle law of forces.

(*d*) State Lami's theorem.

(*e*) Define arms of the couple.

(*f*) If $F = 3\vec{i} + 4\vec{j} + 5\vec{k}$, then find the moment of force about *y*-axis.

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

(*a*) State and prove Law of parallelogram of forces.

(*b*) Find the magnitude and direction of the resultant of any number of coplanar forces acting at a point.

(*c*) Find the resultant of two forces whose magnitudes are 8 kg and 7 kg respectively at an angle of 60°.

P.T.O.

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

(*a*) (*i*) State and prove polygon of forces.

(*ii*) A uniform plane lamina in the form of a rhombus, one of whose angles is 120°, is supported by two forces applied at the centre in the direction of the diagonals so that one side of the rhombus is horizontal. Prove that, if P and Q be forces and P > Q, then $P = \sqrt{3}.Q$.

(*b*) (*i*) 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.

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

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

(*a*) 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.

(*b*) Show that a system of forces acting upon a rigid body is equivalent to a force at any arbitrary point together with a couple.

(*c*) Find the vector moment of a 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).

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

(*a*) Define resultant of the forces and if greatest and least magnitude of the resultant R of two forces P and Q are G and L respectively, then show that :

$$R^2 = G^2 \cos^2 \theta + L^2 \sin^2 \theta$$

where 2θ is the inclination between the two forces P and Q.

(*b*) (*i*) If the three forces acting on a particle are in equilibrium, then 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 inextensible strings CA and CB of length 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.

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