

Roll No.

(12/19-II)

5201

B. A./B. Sc. EXAMINATION

(Third Semester)

MATHEMATICS

BM-233

Statics

Time : Three Hours

Max. Marks : $\begin{cases} \text{B.Sc.: 40} \\ \text{B.A. : 27} \end{cases}$

Note : Attempt *Five* questions in all, selecting at least *one* question from each Section. Q. No. 1 is compulsory.

(Compulsory Question)

1. (a) Two forces F and $2F$ act on a particle. If the first be doubled and second be

increased by 10 kg.w.t., the direction of resultant is unaltered. Find the value of F.

2(1)

(b) State triangle law of forces. 2(1)

(c) To find the centre of gravity of a thin uniform rod. 1(1)

(d) Define null lines and null planes. 1(1)

(e) Define Poinsot's Central Axis. 1(1½)

(f) Define co-efficient of friction. 1(1½)

Section I

2. (a) If the greatest possible resultant of two forces P and Q is n times the least, show that angle between them when their resultant is half of their sum is :

$$\cos^{-1} \left(-\frac{n^2 + 2}{2(n^2 - 1)} \right) \quad 4(2\frac{1}{2})$$

(b) Two unlike parallel forces P and Q ($P > Q$), x metre apart act at two points of a rigid body. Show that if direction of P be reversed, the resultant is displaced through a distance $\frac{2PQ}{P^2 - Q^2}x$ metres.

4(3)

3. (a) Forces P , Q , R act along the sides BC , AC , BA respectively of an equilateral triangle. If their resultant is a force parallel to BC through the centroid of the triangle, prove that $Q = R = \frac{P}{2}$. 4(3)

(b) $ABCDEF$ is a regular hexagon. Forces P , $2P$, $3P$, $2P$, $5P$, $6P$ act along AB , BC , DC , ED , EF , AF respectively. Show that six forces are equivalent to a couple and find its moment. 4(3)

Section II

4. (a) One end of the uniform rod is attached to a hinge and other end is supported by a string attached to the extremity of the rod; the rod and the string are inclined at the same angle θ to horizontal. If W be the weight of the rod, show that the reaction at the hinge is $\frac{1}{4}W\sqrt{8 + \operatorname{cosec}^2\theta}$.

Also, find the tension of the string.

4(2½)

- (b) Find how high can be particle rest inside a hollow sphere of radius ' r ' if the coefficient friction be $\frac{1}{\sqrt{3}}$.

4(3)

5. (a) Find the limits between which a force must lie in order to keep a body in equilibrium on a rough inclined plane, when the force acts horizontally. 4(2½)
- (b) Find the centre of gravity of a right circular solid cone. 4(3)

Section III

6. Five equal uniform rods, freely jointed at their ends from a regular pentagon ABCDE and BE is jointed by a light rod. The system is suspended from A in a vertical plane. Prove that the thrust in BE is $W \cot\left(\frac{\pi}{10}\right)$, where W is the weight of each rod. 8(5½)

7. A force P acts along the axis of x and another force nP along a generator of the cylinder $x^2 + y^2 = a^2$. Show that the central axis lie on the cylinder $n^2(nx - z)^2 + (1 + n^2)^2 y^2 = n^4 a^2$. 8(5½)

Section IV

8. (a) If P and Q be two non-intersecting forces whose directions are perpendicular, show that the ratio of distance of the central axis from their lines of action are Q^2 and P^2 . 3(2)

- (b) Show that a given system of forces can be replaced by two forces, equivalent to the given system, in an infinite number of ways and that the tetrahedron formed by two forces is of constant volume.

5(3½)

9. (a) Find the null point of the plane $lx + my + nz = 1$ for the system of forces (X, Y, Z; L, M, N).

4(2½)

- (b) A heavy uniform cube balances on the highest point of a sphere whose radius is 'r'. If the sphere is rough enough to prevent sliding and if the side of cube be $\frac{\pi}{2}r$, show that the cube can rock through a right angle without falling.

4(3)