

Roll No. _____
[Total no. of questions: 09]

BS/2110

[Total no. of pages: 02]

~~COURSE: B. Sc./B. Ed. Medical (Non-Medical)~~

Semester: III
Paper III: Statics

5216/NH

Time: 3 Hours

Maximum Marks: 40

Instructions to Candidates:

Candidates are required to attempt five questions in all selecting two questions from each Section A and Section B and compulsory question of Section C.

Section-A

1. (a) State and prove Polygon Law of forces. 3
(b) Forces of magnitude $3Q$, $5Q$ and $7Q$ acting at a point are in equilibrium. Find the angle between the forces $3Q$ and $5Q$. 3
2. (a) Three forces of magnitude 5, 10 and 13 units act in a plane at a point, the angle between any two of their directions being 120° . Find the magnitude and direction of their resultant. 3
(b) Forces P , $3P$, $2P$, $5P$ act along the sides AB , BC , CD and DA of a square $ABCD$. Find the magnitude and direction of their resultant and prove that it meets AD produced at a point E such that $AE : ED = 5 : 4$. 3
3. (a) State and prove generalized theorem of moments. 3
(b) The constituent forces of a couple of moment G act at points A and B . If their lines of action are turned through a right angle, they form a couple of moment H . when they both act at right angles to AB , show that they form a couple of moment $\sqrt{G^2 + H^2}$. 3
4. One end of a uniform rod is attached to hinge and the 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 the horizontal. Show that the action of the hinge is $\frac{W}{4} \sqrt{8 + \operatorname{cosec}^2 \theta}$. 6

Section-B

5. (a) State and prove $\lambda - \mu$ Theorem. 3
(b) If AD is altitude of triangle ABC , show that the force AD acting along AD has components $\frac{a^2 + b^2 - c^2}{2a^2} AB$ and $\frac{c^2 + a^2 - b^2}{2a^2} AC$ along AB and AC respectively. 3
6. Equal weights W and W are attached to two ends of a string passing over a smooth peg at Q . The two portions of the string are separated by a heavy beam AB of weight W_1 , whose Centre of gravity is at a distance ' a ' from A and ' b ' from B . Show that AB is inclined to the horizontal at an angle $\tan^{-1} \left[\frac{a-b}{a+b} \tan \left(\sin^{-1} \frac{W_1}{2W} \right) \right]$. 6
7. (a) A uniform ladder rests with one end against a smooth vertical wall and the other end on the rough ground, the coefficient of friction being $\frac{3}{4}$. If the inclination of the

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- ladder to the ground be 45° , show that a man whose weight is equal to that of the ladder can just ascend to the top of the ladder without slipping. 3
- (b) If three non-concurrent forces acting on a rigid body are equivalent to a couple, then show that they must be proportional to the sides, taken in same order, of the triangle formed by their lines of action. 3
8. A square is described on the base of an isosceles triangle whose semi vertical angle is $\cos^{-1} \sqrt{\frac{12}{13}}$. Find the C.G. of the whole figure so obtained. 6

Section-C (2 X 8 = 16)

9. (a) The resultant of forces P and Q is R ; If Q be doubled, R is doubled; If Q be reversed, R is again doubled, show that $P^2 : Q^2 : R^2 :: 2 : 3 : 2$.
- (b) A uniform beam of length $2a$, rests against a smooth vertical plane over a smooth peg at a distance b from the plane. If θ be the inclination of the beam to the vertical, show that $\sin^3 \theta = \frac{b}{a}$.
- (c) Find a point O within a triangle ABC so that forces represented by OA , OB and OC in magnitude and direction and acting at O may be in equilibrium.
- (d) The weight of a triangular lamina ABC is 9 grams. What additional weight should be placed at A so that new C.G. divides the median through A in the ratio 3 : 4?
- (e) The ends of an inelastic string 0.17 m long are attached to two points A and B , 0.13 m apart in the same horizontal line. A weight 4 kg is attached to the point O of the string 0.05 m from end A . Find the tension in each portion of the string.
- (f) State laws of friction.
- (g) Find the necessary and sufficient conditions for the equilibrium of a number of coplanar concurrent forces.
- (h) Define moments with example.

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