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Total No. of Questions : 07

B.Sc.(CS) (2013 & Onwards) (Sem.–4)

FUNDAMENTALS OF STATICS

Subject Code : BCS-402

M.Code : 72318

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains SIX questions carrying TEN marks each and students have to attempt any FOUR questions.**

SECTION-A

1. Answer briefly :

a) Define Moment of a force about a point.

b) Discuss Moment of a couple.

c) State condition of equilibrium.

d) State Parallelogram Law of forces.

e) Forces equal to 3Q, 5Q and 7Q acting at a point are in equilibrium. Find the angle between the forces 3Q and 5Q.

f) What are laws of friction ?

g) Find the height at which a particle can rest inside a hollow sphere of radius r if the coefficient of friction is $\frac{1}{\sqrt{3}}$.

h) Define Centre of Gravity.

i) Define Wrenches.

j) Define Null Planes.

SECTION-B

2. a) A force F acts at a point (3, 4) of the XY-plane. The force is directed away from the origin and inclined at 60° to the X-axis. The horizontal component of F is 5 kg wt. Determine the force F and find the perpendicular distance of the origin from the line of action of F.

   b) ABCD is a square whose side is 2m. Along AB, BC, CD and DA act forces equal to 1, 2, 8 and 5 kg wt. and along AC and DB act forces equal to $5\sqrt{2}$ and $2\sqrt{2}$ kg wt. Show that they are equivalent to a couple whose moment is equal to 16 metre kg.wt.

3. a) Two uniform rods AB, BC of lengths $2a$, $2b$ respectively are rigidly united at B and are suspended freely from A. If they rest inclined at angles θ, ϕ respectively to the vertical show that

$$\frac{\sin\theta}{\sin\phi}=\frac{b^2}{a(a+2b)}$$

   b) State and prove converse of Lami's theorem.

4. a) Forces P, Q, R act along the sides BC, CA, AB respectively of triangle ABC. If the resultant passes through the orthocenter, Show that P sec A + Q sec B + R sec C = 0.

   b) ABC is a triangle. D, E, F are the middle points of the sides BC, CA and AB respectively. Show that the forces acting on a particle and represented by AD, BE, CF will maintain equilibrium.

5. a) A body of weight W can just be sustained on a rough inclined plane by a force P and just dragged up the plane by a force Q, P and Q both acting up the line of the greatest slope. Show that the coefficient of friction is $\frac{Q-P}{[4W^2-(P+Q)^2]^{\frac{1}{2}}}$.

   b) Particles of weights 3, 4, 5 and 6 kgs. are placed at corners A, B, C and D respectively of a rectangle ABCD. If AB = 0.6m and BC = 1.2 m. Find the perpendicular distances of C.G. from AB and BC.

6. a) A heavy uniform rod rests with its extremities on a rough circular hoop fixed in a vertical plane, the rod subtends an angle of 120° at the centre and in limiting position of equilibrium is inclined to horizon at angle θ. If $\sqrt{3}\mu = \tan\alpha$ show that $\tan\theta : \tan 2\alpha = 2 : \sqrt{3}$.

   b) If two non-intersecting forces P and Q are perpendicular, their distances from the central axis are in the ratio as $Q^2 : P^2$

7. a) If a piece of wire is bent into the shape of an isosceles triangle whose sides are a, a and b, show that the distance of the C.G. from the base is $\frac{a}{2}\sqrt{\frac{2a-b}{2a+b}}$.

b) A uniform ladder of length *l* and weight W, rests with its foot on rough ground and its upper end against a smooth wall, the inclination to the vertical being α, A force P is applied horizontally to the ladder at a point distance *c* from the foot so as to make the foot approach wall.

Prove that P must exceed $\frac{lW}{l-c}\left(\mu+\frac{1}{2}\tan\alpha\right)$,

where μ is the coefficient of friction at the foot.

NOTE : Disclosure of identity by writing mobile number or making passing request on any page of Answer sheet will lead to UMC against the Student.