

Total No. of printed pages = 8

43(1) STRU(1) 1'5

2011

STRUCTURE - I

Full Marks – 100

Pass Marks – 40

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No.1 and any *four* from the rest.

1. Choose the correct answer : $2 \times 10 = 20$

(a) Which one of the following is a fundamental quantity ?

(i) Velocity

(ii) Area

(iii) Mass

(iv) Force.

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(b) The resultant of two forces P and Q acting at an angle θ is equal to

(i) $\sqrt{P^2 + Q^2 + 2PQ \sin \theta}$

(ii) $\sqrt{P^2 + Q^2 + 2PQ \cos \theta}$

(iii) $\sqrt{P^2 + Q^2 - 2PQ \sin \theta}$

(iv) $\sqrt{P^2 + Q^2 - 2PQ \cos \theta}$

(c) The force of friction always acts in a direction opposite to that

(i) in which the body tends to move

(ii) in which the body is moving

(iii) both (i) and (ii)

(iv) None of the two.

(d) The centre of gravity of hemisphere lies at a distance of from its base measured along the vertical radius.

(i) $\frac{3r}{8}$ (ii) $\frac{3}{8r}$

(iii) $\frac{8r}{3}$ (iv) $\frac{8}{3r}$

(e) The force of friction between two bodies in contact

(i) depends upon the area of their contact

(ii) depends upon the relative velocity between them

(iii) is always normal to the surface of their contact

(iv) All of the above.

(f) According to Lami's theorem, the three forces

(i) must be equal

(ii) must be at 120° to each other

(iii) must be both of above

(iv) may not be any of the two.

(g) Which of the following statement is correct ?

(i) An irregular body can have more than one centre of gravity.

(ii) The C.G. of a triangle lies at a point where any two medians meet each other.

(iii) The C.G. of a triangle lies at a point where the bisectors of all the three angles meet.

(iv) All of the above.

(v) None of the above.

(h) The moment of inertia of a circular section of diameter 'd' is given by the relation :

(i) $\frac{\pi}{16}(d)^4$ (ii) $\frac{\pi}{32}(d)^4$

(iii) $\frac{\pi}{64}(d)^4$ (iv) $\frac{\pi}{96}(d)^4$

(i) The Lami's theorem is applicable only for

(i) coplanar forces

(ii) concurrent forces

(iii) coplanar and concurrent forces

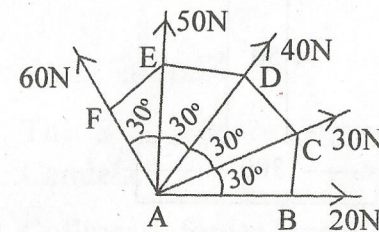
(iv) any type of forces.

(j) The moment of inertia of a triangular section of base 'b' and height 'h' about an axis through its base is given by

(i) $\frac{bh^3}{12}$ (ii) $\frac{bh^3}{18}$

(iii) $\frac{bh^3}{36}$ (iv) $\frac{bh^3}{64}$

2. Write down the characteristics of a force. The forces 20N, 30N, 40N, 50N and 60N are acting on one of the angular points of a regular hexagon towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force. 5+15=20



3. State the "Parallelogram law of forces." Find the magnitude of the two forces, such that if they act at right angles, their resultant is $\sqrt{10}$ N. But if they act at 60° , their resultant is $\sqrt{13}$ N.

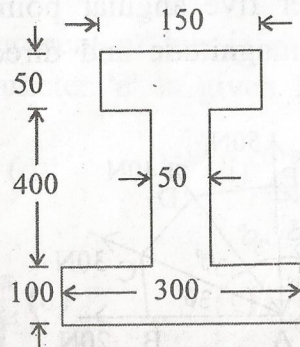
5+15=20

4. State the "Principle of Transmissibility of forces."

A ladder 5m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 70° with the horizontal. The weight of the ladder is 900N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750N stands on a rung 1.5m from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.

$$5+15=20$$

5. Differentiate between centre of gravity and centroid. 5+15=20



An I-section has the following dimension :

Bottom flange = 300 mm × 100 mm

Top flange = 150 mm × 50 mm

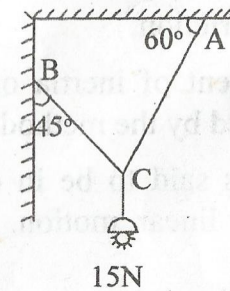
Web = 400 mm × 50 mm.

Determine the position of centre of gravity.

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6. State Lami's theorem.

An electric light fixture weighing 15N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal and BC at 45° to the vertical as shown below :



Using Lami's theorem or otherwise, determine the forces in the strings AC and BC. 5+15=20

7. (a) State true or false : 1×10=10

(i) The S.I. units of luminous intensity is Candela.

(ii) Collinear forces mean the forces are having the same plane.

(iii) The C.G. of a body always lies within the body.

(iv) The C.G. of a body depends upon the shape of the body.

(v) Co-efficient of friction has no units.

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- (vi) Moment of inertia is also called second moment of area.
- (vii) The force of friction between two bodies in contact depends upon the area of their contact.
- (viii) The static friction is more than the limiting friction.
- (ix) The moment of inertia of an area may be obtained by the method of integration.
- (x) A body is said to be in equilibrium, if it has no linear motion.

(b) Define the following : $2 \times 5 = 10$

- (i) Kinematics
- (ii) Fundamental units
- (iii) Dynamic friction
- (iv) Moment of a force
- (v) Force.

8. Write short notes on the following : $4 \times 5 = 20$

- (i) Limiting friction
- (ii) Effects of force
- (iii) Moment of inertia
- (iv) Equilibrium of forces
- (v) Normal reaction.