

17350

16117

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All Questions are *compulsory*.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Use of Non-programmable Electronic Pocket Calculator is permissible.
(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any TEN :

20

- (a) Define self-locking machine.
- (b) Define max. M.A. & max. efficiency.
- (c) What is the law of machine ? State it's importance.
- (d) Define :
 - (i) Fatigue
 - (ii) Creep
- (e) A circle hole of 20 mm. dia. is to be punched in a mild steel plate of 3 mm thickness. If the shearing stress developed in the metal is 180 mPa. Find the required force to punch the hole.
- (f) State Hooke's law.

- (g) State the principle of transmissibility of forces.
- (h) State the conditions of equilibrium.
- (i) State law of parallelogram of forces.
- (j) State Lami's theorem.
- (k) Define free body diagram with example.
- (l) Define angle of repose.
- (m) Indicate the position of centroid for equilateral triangle & semi circle.
- (n) A hemisphere of dia 800 mm. rests on the ground with dia. at top & parallel to ground. Locate the C.G. of the section from ground.

2. Attempt any FOUR of the following :

16

- (a) Find the resultant in magnitude & direction of the following forces acting at & away from the point.
 - (i) 300 N. force acting 30° North of East.
 - (ii) 150 N. force acting 45° North of West.
 - (iii) 200 N force towards west.
 - (iv) 400 N force acting 30° west of south.
- (b) Five forces P, 2P, 3P, 4P & 5P are acting at 0° , 20° , 90° , 140° & 240° respectively measured from positive direction of x-axis. Calculate their resultant.
- (c) If two forces of 60 kN each are required to be equivalent to a single force of 60 kN. What is the angle between the two forces.

- (d) Find the magnitude of two forces such that if they act at right angles, their resultant is $\sqrt{85}$ N but if they act at 60° , their resultant is $\sqrt{127}$ N.
- (e) The sum of two forces is 9N. Their resultant perpendicular to the smaller force is of 6N. Find magnitude of the forces.
- (f) A steel bar $40 \text{ mm} \times 40 \text{ mm}$ in section & 3m. Long is subjected to an axial pull of 128 kN. If change in length is 1.2 mm. (increase) & change in width & thickness is 0.00048 mm. (decreases), calculate modulus of elasticity & Poisson's ratio.

3. Attempt any FOUR of the following :

16

- (a) Differentiate between equilibrant & resultant.
- (b) A sphere of 400 N. is resting between surfaces of A & B as shown in Fig. 1. Find the reactions.

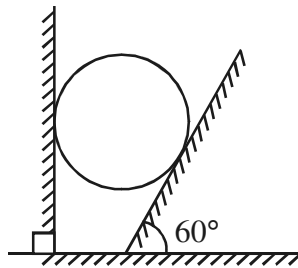


Fig. 1

- (c) A string ABCD is fixed at A & D. Two weights 400 N. & WN. are attached at B & C. The string AB, BC & CD are making angles of 60° , 10° & 45° with horizontal respectively. Find the weight W & tension in the string.

P.T.O.

- (d) Find the support reactions of the simply supported beam as shown in Fig. 2.

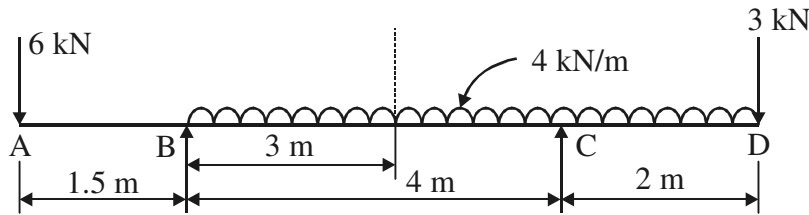


Fig. 2

- (e) Draw stress-strain curve for mild steel & explain the terms.
- (f) Find analytically the reactions as shown in Fig. 3.

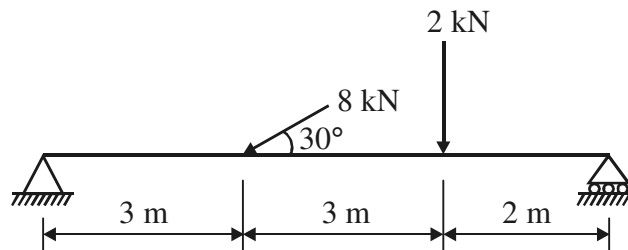


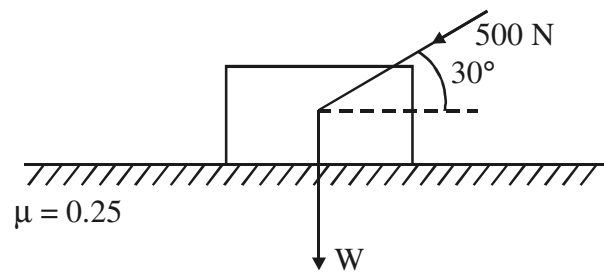
Fig. 3

4. Attempt any FOUR of the following :

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- (a) A body weighing 1500 N is resting on a rough horizontal plane. A pull of 300 N applied at 30° up with respect to horizontal just move the body. Find coefficient of friction.
- (b) Find a push at 20° to horizontal required to just move a block of 400 N on rough horizontal surface. It was observed that if the given plane is at 25° then the block just slides down due to self weight only.
- (c) A block of 1000 N is kept on horizontal surface. A horizontal force of 300 N. is required to just move it. Find.
- (i) Normal reaction

- (ii) Frictional resistance
 - (iii) Resultant reaction
 - (iv) Case of friction.
- (d) A 200 N block on inclined plane requires a force of 150 N applied along the plane to move it up the plane Similarly a force of 20 N down the plane is require to move it down. Find angle of inclined plane & coefficient of friction.
- (e) A body of weight 100 N rest on rough horizontal plane. It was found that a pull of 30 N inclined at 60° to the horizontal is required to just move the body. Find coefficient of friction between body & plane.
- (f) Find the value of 'W' if the body is in the limiting equilibrium for Fig. 4.

**Fig. 4****5. Attempt any FOUR of the following :****16**

- (a) Find centre of gravity of the dam wall having top 2.1 m. bottom 5.0 m. height 6.0 m & face of the wall on upstream side is vertical.
- (b) From a circular lamina 300 mm dia., a square hole is drilled such that diagonal of the square is the radius of circle. Find centroid of remaining.

P.T.O.

- (c) Locate the centroid of a composite section in fig No.5.

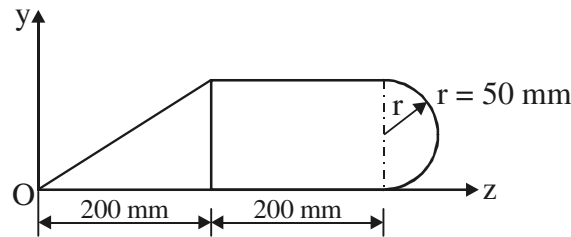


Fig. No. 5

- (d) A solid form with a cone of base 100 mm & height 200 mm joins a base with cylinder of base 100 mm & height 200 mm. compute the position of C.G.
- (e) A cone has base 120 mm & height 200 mm. In to it a hole of diameter 60 mm is drilled upto a depth of 50 mm. Find C.G. of remaining volume of cone.
- (f) A certain lifting machine has V.R.=150. A load of 2.4 kN is just lifted by effort of 50 N. While an effort of 65 N is required to lift 4.2 kN. Find the efficiency of machine when the load to be lifted is 3 kW.

6. Attempt any FOUR of the following :

16

- (a) A single purchase crab has following details.

- (i) Length of handle = 40 cm.
- (ii) Dia. of load drum = 20 cm.
- (iii) No. of teeth in the pinion = 16
- (iv) No. of teeth in the spur = 80

Find

- (1) V.R.
- (2) Effort req. to raise load of 2000 N with an efficiency of 75%.

- (b) A Weston's differential pulley block has 8 cogs on the bigger pulley & 7 on the smaller pulley on this machine an effort of 70 N is required to lift a load of 300 N & an effort of 90 N is required to lift a load of 400 N. Find the law of machine & the efficiency at the load of 600 N.
- (c) A screw jack lifts a load of 30 kN with an effort of 400 N at the end of handle of 60 cm. If the pitch of the screw is 15 mm. Calculate the V.R, M.A. & efficiency of machine.
- (d) A worm & worm wheel has 30 cm. as dia. Of effort wheel 60 cm. as dia. of load drum & number of teeth on worm wheel are 50. Calculate the load this machine can lift using an effort of 30 N & ideal effort if the efficiency is 40%.
- (e) A bar of 30 mm. dia. Is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm. is 0.09 mm & change in diameter is 0.0039. Calculate the Poisson's ratio & modulus of elasticity.
- (f) Define Torsion. State any four assumptions in the theory of torsion in solid circular shaft.
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