

Total No. of printed pages = 6

ME 181104

Roll No. of candidate

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2024

B.Tech. 2nd Semester End-Term Examination

(All Branch)

ENGINEERING MECHANICS

New Regulation (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19)

Full Marks – 70

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. Answer the following (MCQ/ Fill in the blanks) :

(10 × 1 = 10)

(i) Which of the following forces do not cause the rotation?

(a) Non-Parallel

~~(b) Non-concurrent~~

(c) Parallel

~~(d) Concurrent~~

(ii) If two equal forces of magnitude P act at an angle θ degree, their resultant will be

(a) $P/2 \cos \theta/2$

(b) $2P \sin \theta/2$

(c) $2P \tan \theta/2$

~~(d) $2P \cos \theta/2$~~

(iii) When trying to turn a key into a lock, following is applied

(a) Coplanar force

~~(b) Couple~~

(c) Lever

(d) Moment

[Turn over

(iv) Distance of centre of gravity of a hollow cone from the base is

(a) $h/4$

☒ (b) $h/3$

(c) $3h/2$

(d) $4h/1$

(v) The moment of inertia of a rectangular section 3 cm wide and 4 cm deep about X-X axis is

(a) 9 cm^4

Never mind

(b) 12 cm^4

(c) 6 cm^4

(d) 20 cm^4

(vi) In ideal machine mechanical advantage is _____ velocity ratio.

☒ (a) equal to

(b) less than

(c) greater than

(d) none of the above

(vii) If the number of pulleys in a system is equal to its velocity ratio then it is a _____ system of pulleys.

(a) first

☒ (b) second

(c) third

(d) none of the above

(viii) Which of the following is not a form of potential energy?

(a) gravitational energy friction

(b) electrical energy

(c) elastic energy

☒ (d) energy of friction

(ix) What is the coefficient of restitution (e) for elastic impact?

(a) $e = 0$

☒ (b) $e = 1$

(c) $e < 0$

(d) $e > 1$

☒ (x) Uniformly distributed load of 5 kN acts on a simply supported beam of length 10 m. What are the reactions at end points of the beam?

(a) 12.5 kN

☒ (b) 25 kN

(c) 50 kN

(d) None of the above

- (a) State and prove parallelogram law of forces. (7)
- (b) Two cylinders P and Q rest in a channel as shown in Fig. 1. The cylinder P has diameter of 100 mm and weighs 200 N, whereas the cylinder Q has diameter of 180 mm and weighs 500 N. If the bottom width of the box is 180 mm, with one side vertical and the other inclined at 60° , determine the pressures at all the four points of contact. (8)

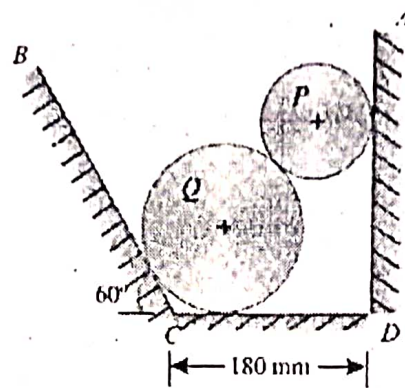


Fig. 1

- (a) How would you distinguish between a deficient frame and a redundant frame? (2)
- (b) A beam AB of 6 m span is loaded as shown in Fig 2. Determine the reactions at A and B. (5)

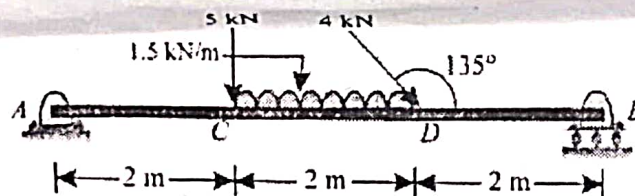


Fig. 2

- (c) A truss of span 10 meters is loaded as shown in Fig.3. Calculate the magnitude and nature of forces in all the members of the truss. (8)

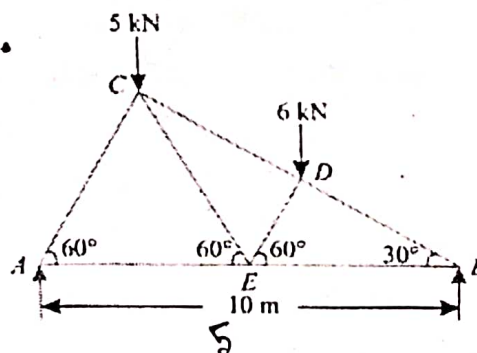


Fig. 3

$$P_y = \frac{W_x}{h}$$

$$60 = \frac{MA \cdot W_x}{Y_B \cdot P_y}$$

- a) Define coefficient of friction. (2)
- b) An I-section has the following dimensions as shown in the Fig. 4 in mm units: (5)

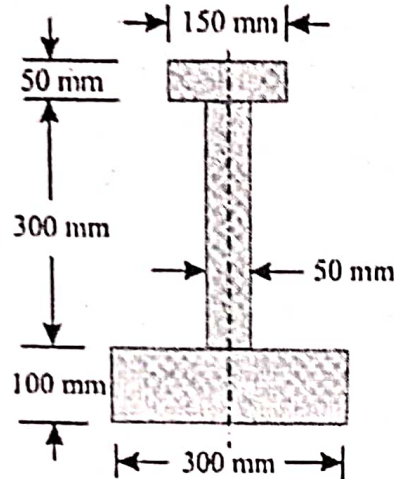


Fig. 4

Determine mathematically the position of centre of gravity of the section.

- (c) The block A in Fig. 5 supports a load $W = 100 \text{ kN}$ and is to be raised by forcing the wedge B under it. The angle of friction for all surfaces in contact is $f = 15^\circ$. If the wedge had a weight of 40 kN , what value of P would be required (i) to start the wedge under the block and (ii) to pull the wedge out from under the block? (8)

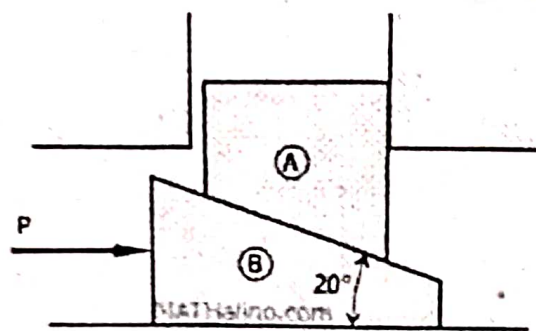


Fig. 5

5. (a) Distinguish between centre of gravity and centroid. (2)
- (b) A screw jack has a mean diameter 80 mm and pitch 15 mm . The coefficient of friction between screw and nut is 0.075 . Calculate the effort required to be normally applied at the end of its operating lever 800 mm long to raise a load of 2 kN . (5)

- (c) Find the moment of inertia of the lamina with a circular hole of 30 mm diameter about the axis AB as shown in Fig.6. (8)

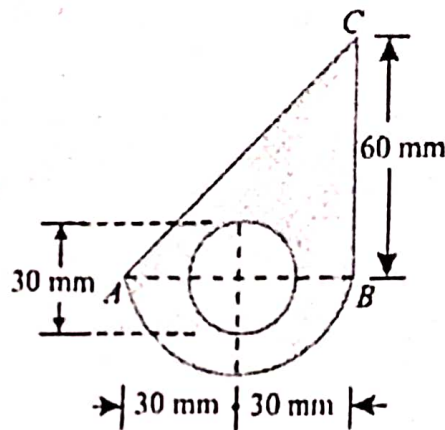


Fig. 6

6. (a) What do you mean by Ideal load and Ideal effort? (2)
- (b) Explain the followings :
- Law of conservation of Energy
 - Perpendicular axis theorem. (5)
- (c) In a lifting machine, the efforts required to lift loads of 200 N and 300 N are 50 N and 60 N respectively. If the velocity ratio of the machine is 20 Calculate the followings :
- Law of machine
 - Efficiencies corresponding to loads of 200 N and 300 N
 - Effort lost in friction in both cases
- The maximum efficiency which can be expected from this machine. (8)

7. (a) A block of mass 5 kg is released from rest on an inclined plane as shown in Fig. 7 Find the maximum compression of the spring, if the spring constant is 1 N/mm and the coefficient of friction between the block and the inclined plane is 0.2. (7)

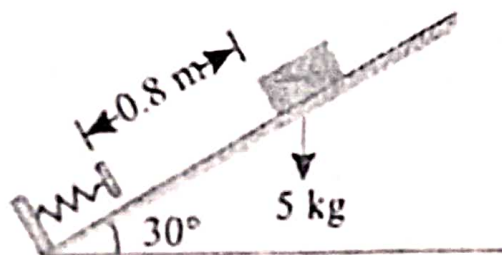


Fig. 7

- (b) A simply supported beam AB of span 5 m is loaded as shown in Fig. 8. Using the principle of virtual work, find the reactions at A and B. (8)

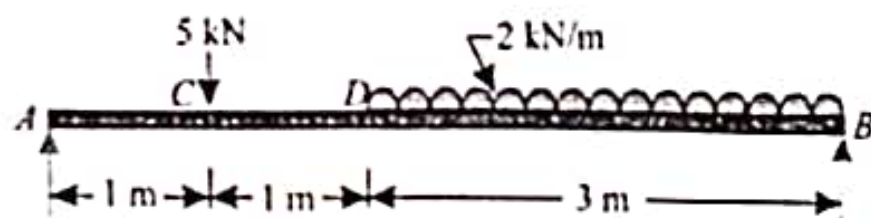


Fig. 8