

*This question paper contains 8 printed pages.*

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Your Roll No. ....

**B. Tech. (C) / I**                      **J**

**PAPER ECE-106**

**ENGINEERING MECHANICS**

**Time : 3 hours**

**Maximum Marks : 70**

*(Write your Roll No. on the top immediately  
on receipt of this question paper.)*

*Attempt four questions in all. Question Number 1  
is compulsory. Answer any three from remaining.*

1. (a) Define Product of Inertia. Mention its salient properties.                      2
- (b) Consider a semi-circular area of diameter 4 cm as shown in Fig (1). Determine its moment of inertia about a tangent parallel to the diameter. 6

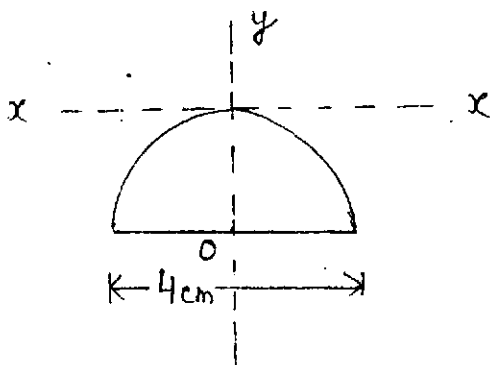


Fig. 1

P.T.O.

- (c) State and explain the concepts of principal axis and principal moment of inertia. 2

2. (a) A uniform wheel of 50 cm diameter and 1 kN weight rests against a rigid rectangular block of thickness 20 cm shown in Fig (2). Considering surfaces smooth, determine:

- (i) least pull to be applied through the centre of wheel to just turn it over the corner of the block,  
(ii) Reaction of the block. 10

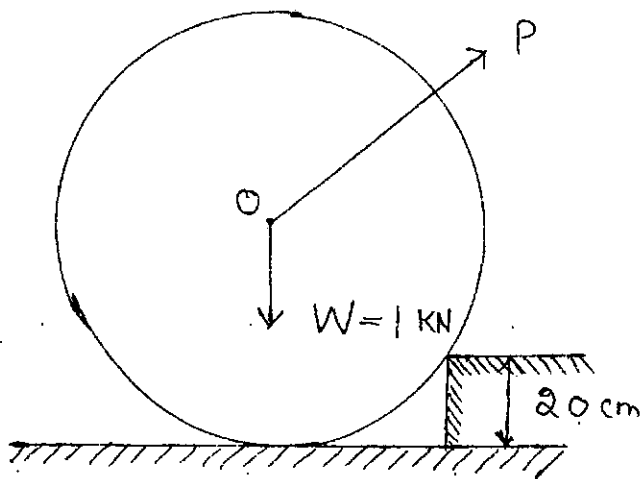


Fig. 2

- (b) A beam has been loaded and supported as shown in Fig (3). Determine the reactions at A and B. 10

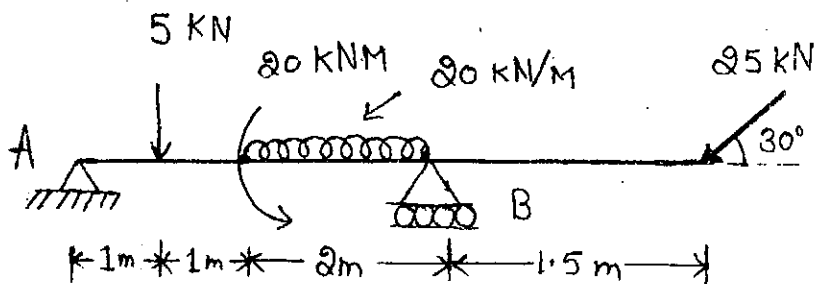


Fig. 3

3. (a) What is reversibility of a machine? Explain. Show for reversible machine efficiency should be greater than 50%. 5
- (b) Show by graph variation of mechanical advantage with load as well as variation of efficiency with load. 5
- (c) In a lifting machine an effort of 150 N raised a load of 7700 N. What is the mechanical advantage? Find velocity ratio if the efficiency at this load is 60%. If by same machine, a load of 13,200 N is raised by an effort of 250 N, what is the efficiency? Calculate the maximum mechanical advantage and the maximum efficiency. 10

P. T. O.

4. (a) Determine the resultant of the system of forces and a couple acting on a lamina shown in Fig (4). Also locate the points of intersection of the resultant with arms AB, BC and CD of the lamina.

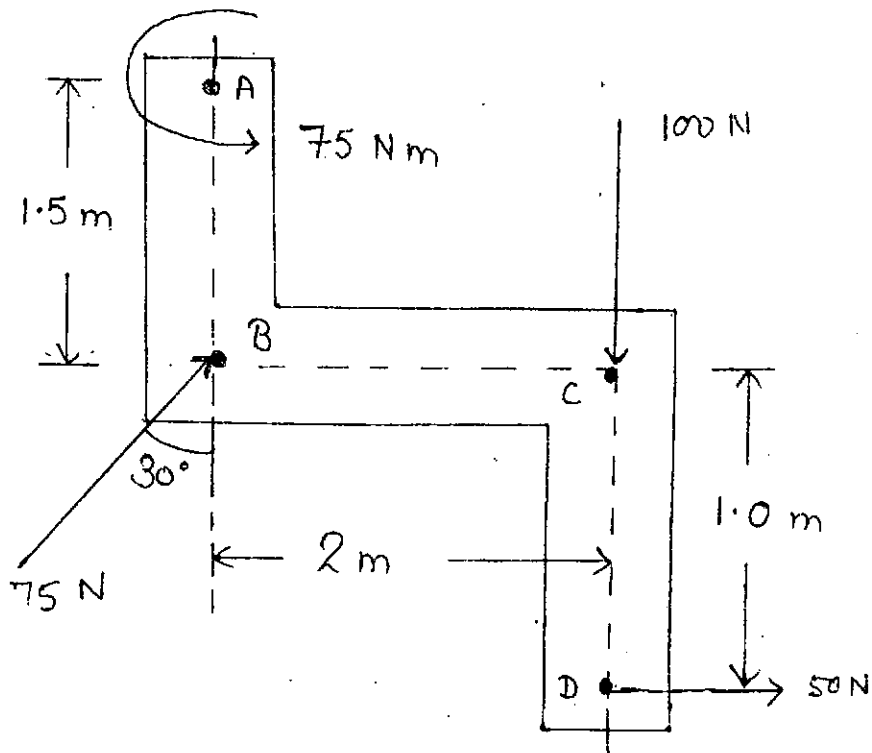


Fig. 4

- (b) A force  $\vec{F} = 3\mathbf{i} - 4\mathbf{j} + 12\mathbf{k}$  acts at a point A whose coordinates are  $(1, -2, 3)$  m. Compute:
- (i) moment of force about origin. 3

(ii) moment of force about the point B (2, 1, 2) m. 3

(iii) vector component of force F along line AB and the moment of this force about the origin. 4

5. (a) Using any method find forces in members ED, DF and FC for loaded and supported truss as shown in Fig (5). 10

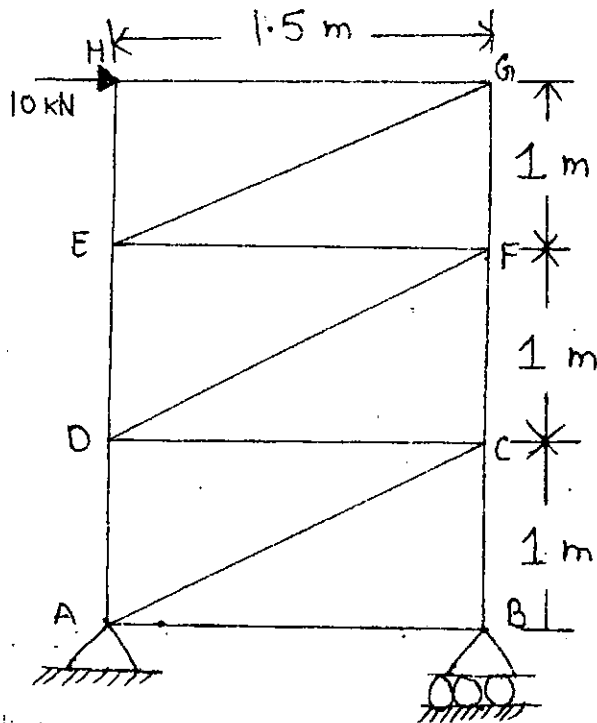


Fig. 5

- (b) In Fig (6) the coefficient of friction is 0.20 between the rope and the fixed drum, and between other surfaces of contact  $\mu=0.3$ . Determine the minimum weight  $W$  to prevent downward motion of the 1000 N body. 10

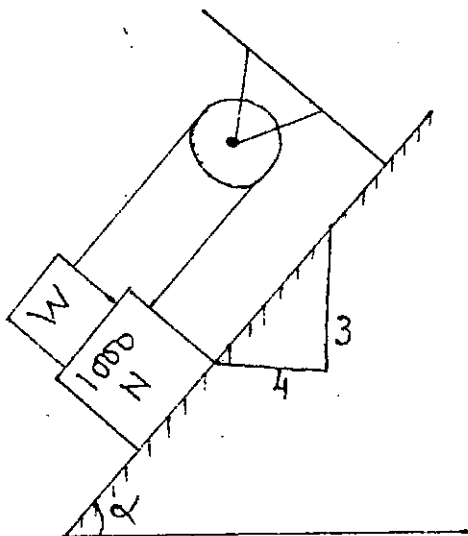


Fig. 6

6. (a) A 3000 N block starting from rest as shown in Fig (7) slides down a  $50^\circ$  inclined plane. After moving 2 m it strikes a spring whose modulus is 20 N/mm. If the coefficient of friction between the block and the inclined plane is 0.2, determine the

maximum deformation of the spring and the maximum velocity of the block. 10

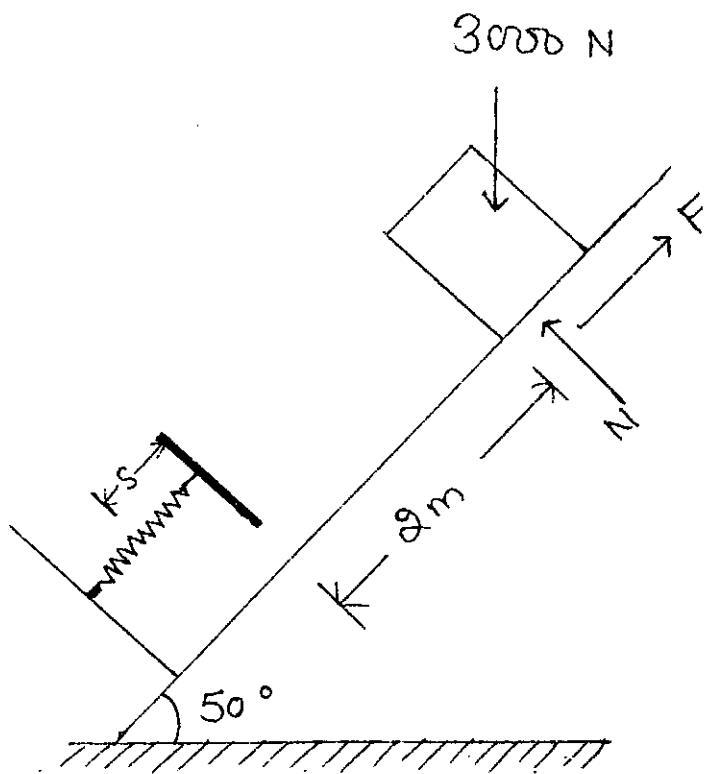


Fig. 7

(b) Determine the tension in the strings and the velocity of  $1500\text{ N}$  block shown in Fig (8), 5 seconds after starting—

(i) From rest

P.T.O.

(ii) With a downward velocity of 3 m/sec.

Assume pulleys as weightless and frictionless. 10

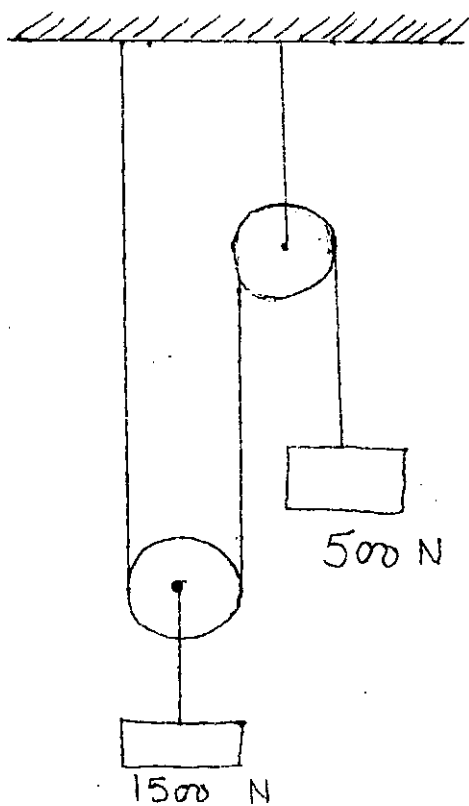


Fig. 8