

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH
BRANCH: ECE/CSE/AIML/EEE

SEMESTER : I/ADD
SESSION : MO/2024

SUBJECT: ME24101 BASICS OF MECHANICAL ENGINEERING

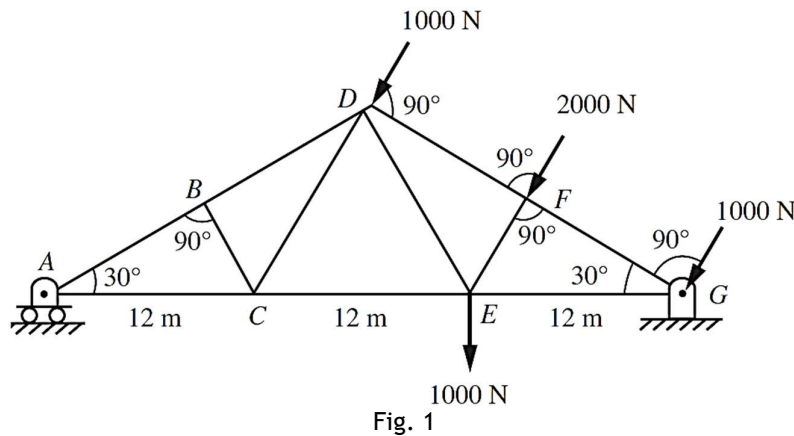
TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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|--------|---|-----|-------------------|-----------|
| Q.1(a) | Using vector analysis, prove that the moment of a force F in 3D space, with respect to an arbitrary axis defined in the Cartesian coordinate system, remains constant regardless of the point chosen on the arbitrary axis. The arbitrary axis in the question is not aligned with the x , y , z axes of the Cartesian coordinate system. Use the properties of cross-products and projections to justify your proof. | [5] | CO
CO2,
CO3 | BL
III |
| Q.1(b) | Determine the forces in members BD , CD , and CE of the Fink truss shown in Fig. 1 | [5] | CO2,
CO3 | III |



- | | | | | |
|--------|---|-----|-------------|-----|
| Q.2(a) | In the linkage shown in Fig. 2, bar AB is constrained to move horizontally, and bar CD rotates about point D . If bar AB has a velocity of 0.6 m/s to the left, Find the angular velocity of CD ? | [5] | CO2,
CO3 | III |
|--------|---|-----|-------------|-----|

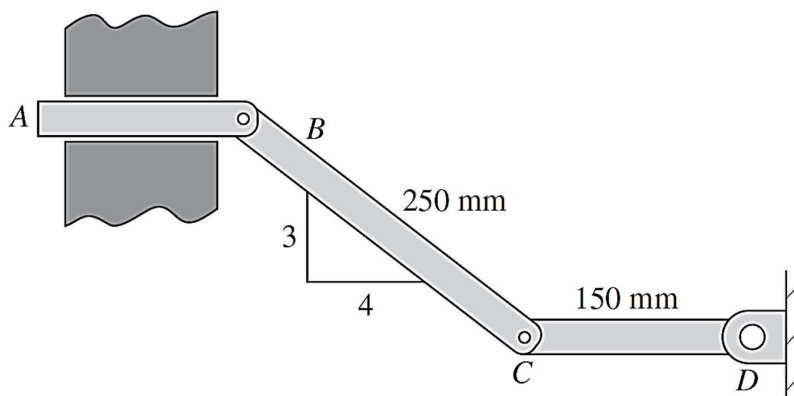


Fig. 2

PTO

- Q.2(b) Refer to Fig. 3(a). Stand A is accelerated to the left at 2.5 m/s^2 . But B is pinned at P, and its top rests against the smooth vertical surface at H. Both A and B have masses of 30 kg and 7 kg, respectively. Determine the horizontal force F and the horizontal push F_H on the top of the bar. The dimensions are shown in Fig. 2(b). [5] CO2, III
CO3

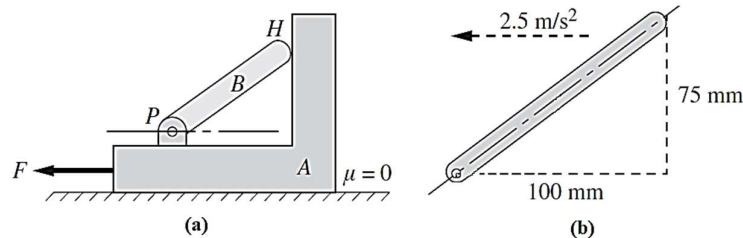


Fig. 3

- Q.3(a) In analysing the self-locking criteria of a screw jack, its operation is simplified to a block on an inclined plane. How does this analogy capture the mechanics of the screw jack, which involves both rotational and axial motion? Analyse and draw proper free-body diagrams for three cases: (i). Raising the load, (ii). Lowering the load, (iii). Resisting auto-sliding. Explain how the self-locking condition depends on the inclined plane angle. [5] CO2, II,
CO3, III
CO4
- Q.3(b) Refer to Fig. 4. The wedge B is used to raise the load of 1960 N resting on block A. What horizontal force P is required to do this if the coefficient of friction for all surfaces is 0.2? Neglect the weights of the blocks. [5] CO2, III
CO3

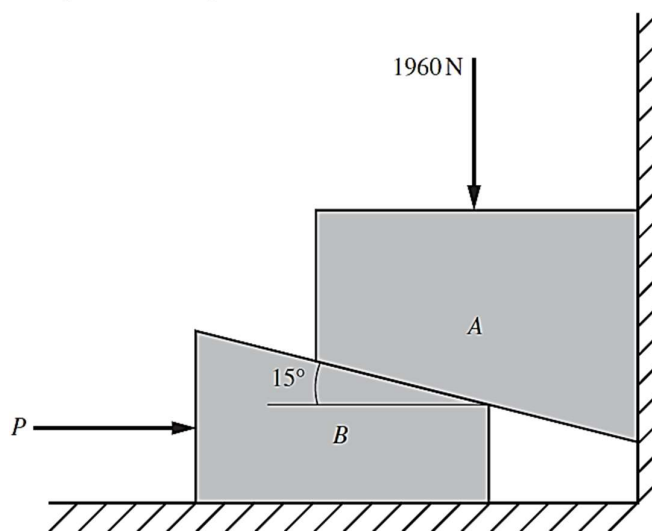


Fig. 4

- Q.4(a) A fire tube boiler and a water tube boiler are standard boilers used in various industries. Analyse and discuss the differences between these two boilers, considering their applications, maintenance, and safety aspects, and explain why one type might be preferred in specific industrial settings. [5] CO1, II
CO4
- Q.4(b) A cam is often called a mechanical timer because it controls timing in mechanical systems. Relate the rotation of a cam in an internal combustion (IC) engine to the engine's cycles, specifically the strokes. A neat and clean schematic diagram of a 4-stroke petrol engine should be drawn, clearly explaining each stroke and labelling the corresponding machine parts for each engine stroke. [5] CO1, II,
CO2 III
- Q.5(a) Describe three renewable energy sources and compare their advantages and disadvantages over each other. [5] CO1, II
CO4
- Q.5(b) Explain the factors that make a site suitable for solar power, focusing on the impact of seasonal and weather conditions on system performance, while also addressing other important elements that affect the overall efficiency and operation of the system. [5] CO4 II