DEPARTMENT OF MECHANICAL ENGINEERING, IIT PATNA

ME102 **Engineering Mechanics** **End-Semester Examination**

Instructions:

1. This is a closed book closed notes examination. Students are allowed to bring pen, pencil, geometry box and a calculator ONLY. Sharing of calculators is not allowed.
2. Carefully read the problems and in case of any missing data or confusion, please make suitable assumptions and solve the problem.
3. Draw clear FBD as appropriate.
4. All answers should be boxed, units be mentioned, and rules of numerical accuracy be followed.
5. All parts of a problem should be **solved at one location together**.

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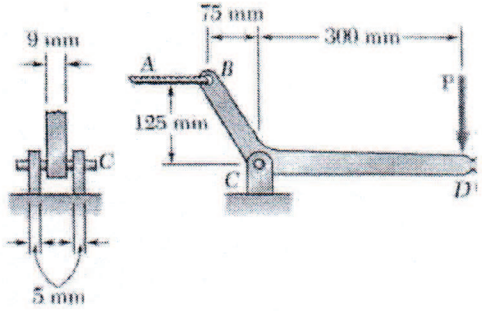
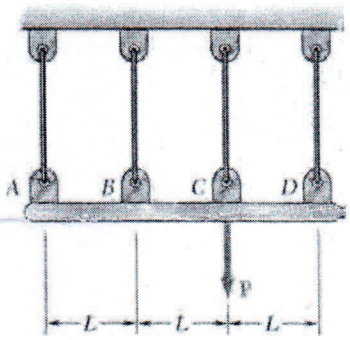
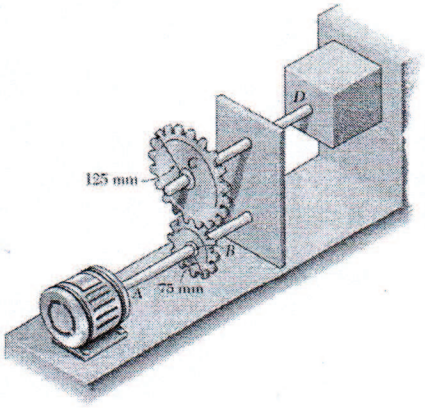
1. Knowing that a force P of magnitude 750 N is applied to the pedal shown, determine (a) the diameter of the pin at C for which the average shearing stress in the pin is 40 MPa, (b) the corresponding bearing stress in the pedal at C, (c) the corresponding bearing stress in each support bracket at C. **[10]**



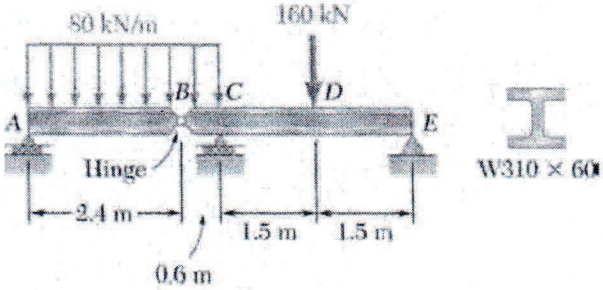
2. The rigid bar ABCD is suspended from four identical wires. Determine the tension in each wire caused by the load P shown. Note that the wires can deform. **[10]**



3. The two solid shafts and gears shown are used to transmit 12 kW from the motor at A operating at a speed of 1260 rpm, to a machine tool at D. Knowing that each shaft has a diameter of 25 mm, determine the maximum shearing stress (a) in shaft AB, (b) in shaft CD. **[8]**



4. Draw the shear and bending-moment diagrams for the beam and loading shown and determine the maximum normal stress due to bending. The section modulus of the W310x60 is 844×10^{-6} m^3. **[12]**

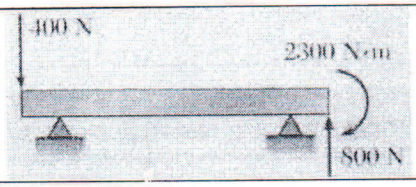
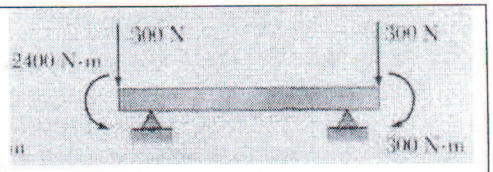
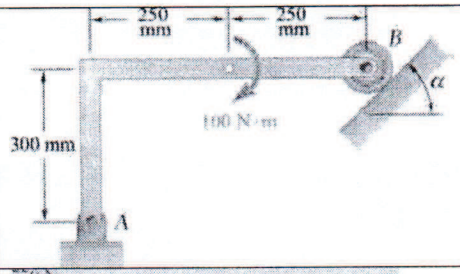
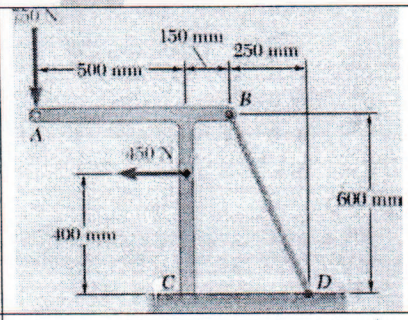
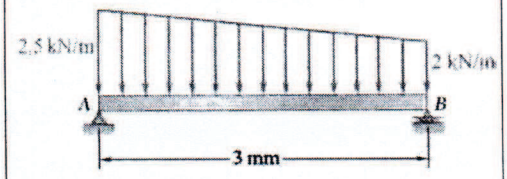
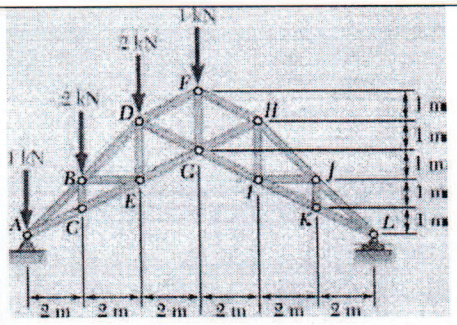
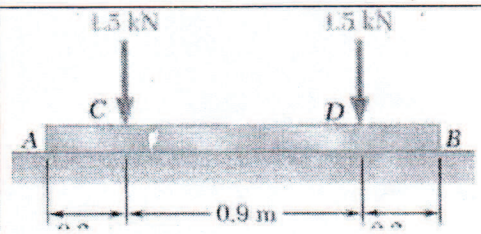


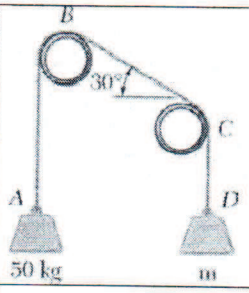
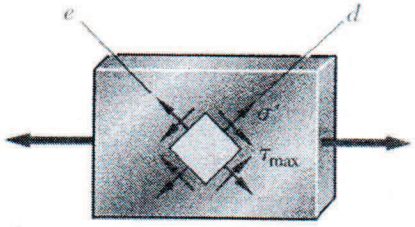
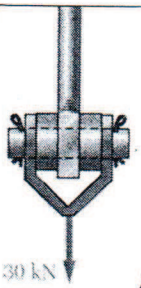
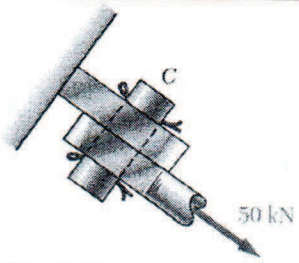
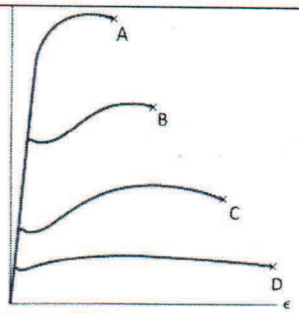
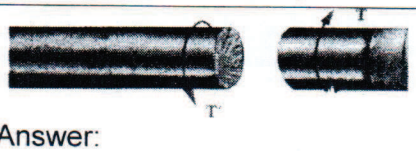
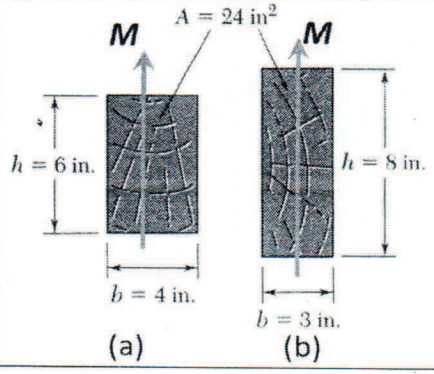
DEPARTMENT OF MECHANICAL ENGINEERING, IIT PATNA

ME102 **End-Semester Examination** **Part 1 - 30 Marks**

Name: **Roll No:**

A. **Answer all questions in the space provided on this sheet ONLY.**
B. **DO NOT perform rough work on this sheet. Each question carries TWO (2) marks.**
C. **SUBMIT either by 1 hour or when finished, whichever earlier.**
D. **Question paper for PART 2 will be provided after this sheet has been submitted.**

1.	A 4-m-long beam is subjected to a variety of loadings. Replace each loading below with an equivalent force couple system at the left end of the beam. Indicate the direction and magnitude of the force and couple in the answer itself.	 Answer:	 Answer:
2.	Determine the reactions at A and B when (a) $\alpha = 0°$, and (b) $\alpha = 30°$.		Answer for part (a): Answer for part (b):
3.	Draw the CORRECT free body diagram of the T-link ABC shown on the right. Please follow the procedure discussed in the class accurately.		FBD:
4.	For the beam and loading shown, determine the magnitude and the location of the resultant of the distributed load.		Answer:
5.	Identify the zero-force members in the scissor roof truss shown on the right.		Answer:
6.	Assuming that the reaction of the ground is uniformly distributed, draw the bending-moment diagram for the beam AB. Mark the critical coordinate points.		Bending Moment Diagram:

7.	Knowing that the μ_s is 0.25, determine the smallest value of the mass m for equilibrium.		Answer for question 7:
8.	The corresponding tension in portion BC of the rope.		Answer for question 8:
9.	Draw the Mohr's circle for the plane stress condition shown on the right. $\sigma_x = \sigma_y = \tau_{xy}$ Identify normal and shear stress corresponding to planes "e" and "d".		
10.	Identify the cases as either "single shear" or as "double shear" for the pin joints shown on the right.	 Answer:	 Answer:
11.	Arrange the different grades of steel (A/B/C/D) in order of increasing stiffness.		Answer for question 11:
12.	Arrange the different grades of steel (A/B/C/D) in order of increasing strength.		Answer for question 12:
13.	Identify as "brittle" or "ductile".	 Answer:	 Answer:
14.	Under what conditions does the neutral plane of a beam undergoing bending not pass through the geometric centroid?	Answer:	
15.	For the beam cross sections shown on the right, which will fail first and why? The direction of bending moment is shown through the arrow.		Answer: