*Department of Civil Engineering*
NATIONAL INSTITUTE OF TECHNOLOGY CALICUT
End-Semester Exam, 20 Dec 2023

Name:_____
Roll. No:_____
Sl. No:_____ CE1/CE2/CE3/CE4

**CE1001E Engineering Mechanics**

Duration: 3 hours | Maximum Marks: [50]

*Note: Answer all questions; Provide neat sketches; Assume missing data; Read questions carefully*

1. A cantilever beam *AB* is *pinned* at *B* to a simply supported beam *BC* as shown in Fig. 1. For the loads given, find the supporting force system at *A*. Determine the force components that are normal and tangential to the cross-section of beam *AB*. Neglect the weight of the beams. [10]

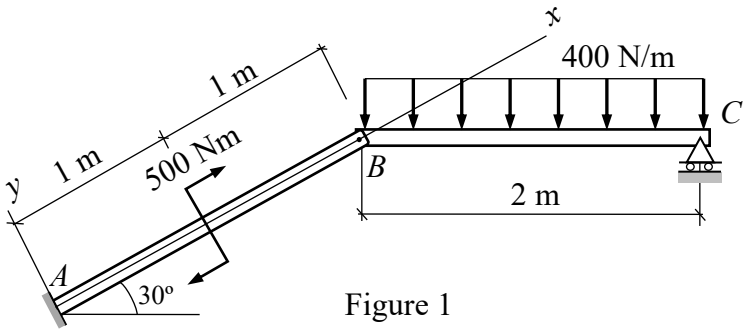


Figure 1

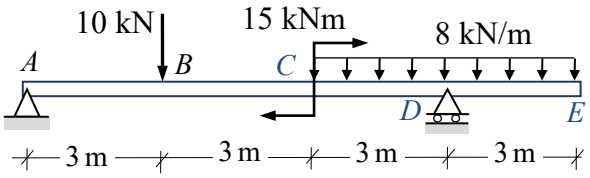


Figure 2

2. For the beam in Fig. 2, calculate the support reactions, write the shear force and bending moment equations for each segment, and neatly sketch the shear force and bending moment diagrams indicating all salient points. [10]
3. (a) Find the forces in members AB, AF, BC, BF, FC and FG of the truss in Fig. 3 by the *method of joints*.
   (b) Determine the forces in the members CD, CH and GH of the truss by *method of sections*. [6+4]

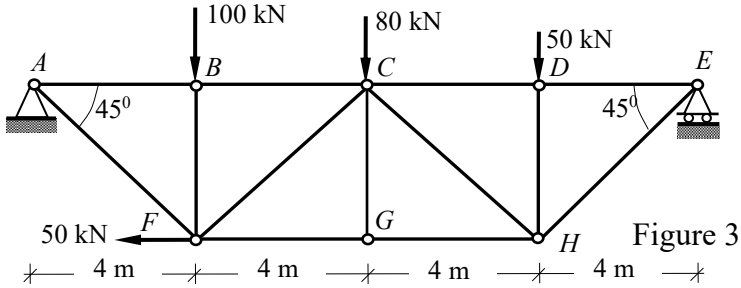


Figure 3

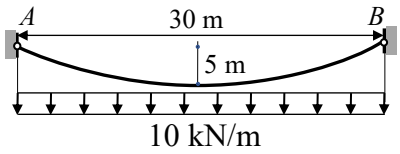


Figure 4

4. Neglect the self-weight of the cable in Fig. 4, determine the deflection curve of the cable, and the maximum force in the cable. The maximum sag is 5m from the supports. [6]
5. (a) What is the value of the force *F*, inclined at 30º to the horizontal, needed to get the block just started up the incline? What is the force $F_1$ needed to keep it just moving up at a constant speed? The coefficient of static and dynamic frictions are 0.30 and 0.275 respectively. [4]

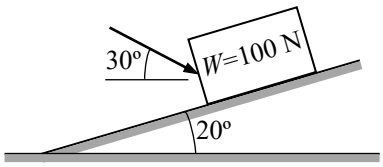


Figure 5a

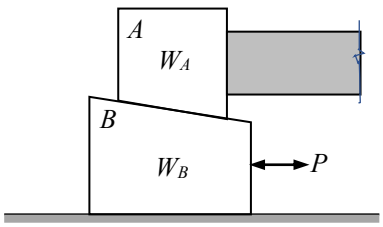
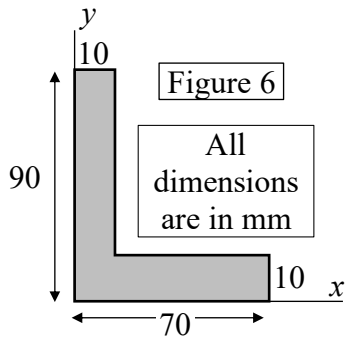


Figure 5b




(b) Draw neat free-body diagrams showing all possible forces for the cases: (i) impending motion of block *B* to the left; and (ii) impending motion of block *B* to the right. [2]

6. (a) Find the centroid of the area shown in Fig. 6.
   (b) Find $I_{xx}$, $I_{yy}$ and $I_{xy}$ of the section shown in Fig. 6 (about the *x* and *y* axes marked).
   (c) If the second moments and products of a particular area are: $I_{xx} = 3\times10^7$ mm$^4$, $I_{yy} = 2\times10^7$ mm$^4$ and $I_{xy} = -1.5\times10^6$ mm$^4$, determine the principal axes and the principal moments of areas. [10]

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