NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

INDUSTRIAL AND MANUFACTURING ENGINEERING DEPARTMENT

B-Eng. Hons Industrial and Manufacturing Engineering

<u>Main Examination 2012/3 Academic Year</u>

SOLID MECHANICS I		**COURSE CODE: TIE 2103**
DATE	**:**	**JANUARY 2013**
DURATION	**:**	**3 HOURS**

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any FOUR questions out of SIX.
2. Each question carries 25 marks.
3. Show all working
4. There are four (4) printed pages.

REQUIREMENTS

1. Scientific calculator

QUESTION ONE

(a) A bar ABCD consists of three sections: AB is 25 mm square and 50 mm long, BC is of 20 mm diameter and 40 mm long and CD is of 12 mm diameter and 50 mm long. For the bar material, E = 210GN/m^2

(i) Determine the stress set up in each section of the bar when it is subjected to an axial tensile load of 20 kN at the ends of the bar. **[8]**

(ii) What will be the total extension of the bar under this load? **[4]**

(b) A steel bar ABCD consists of three sections as shown in Fig 1b : AB is of 20mm diameter and 200 mm long, BC is 25 mm square and 400 mm long, and CD is of 12 mm diameter and 200mm long. The bar is subjected to an axial compressive load which induces a stress of 30 MN/m^2 on the largest cross-section. Determine the total decrease in the length of the bar when the load is applied. For steel E = 210GN/m^2**.** **[13]**

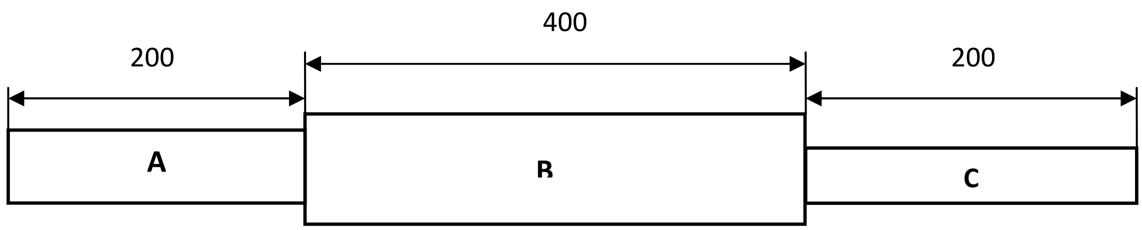

Fig QU 1b: 3 Section Bar

QUESTION TWO

A hollow rolling reservoir gate drive shaft is 225 mm outside diameter and 150 mm inside diameter. Calculate;

a. The maximum power this shaft can transmit at a speed of 150 rpm if the maximum shear force is not to exceed 70 MN/m^2. **[12]**
b. The diameter of a solid shaft of the same material which would transmit the same maximum power at the same speed with the same stress. **[13]**

QUESTION THREE

A beam of symmetrical I-section has the following dimensions: flange 0.15 m wide, 0.03 m thick and web 0.03 m thick, total depth of beam 200 mm.

a. Calculate the second moment of area of the beam section about an axis through the centroid parallel to the flange face. **[12]**
b. If the beam is simply supported over a length of 2000 mm and carries uniformly distributed load of 6000 kg/m, calculate the maximum bending stress in the beam. **[13]**

QUESTION FOUR

a. What are the assumptions made in the theory of pure Torsion? **[5]**
b. Determine the diameter of a solid shaft which will transmit 90 KW at 160 rpm, if the shear stress in the shaft is limited to 60 N/mm^2. **[10]**
c. Find also the lentgh of the shaft, if the angle of twist must not exceed one degree over the entire length.Take modulus of rigidity $=8x10^4$ N/mm^2. **[10]**

QUESTION FIVE

A uniform T-section beam is 100 mm wide and 150 mm deep with a flange thickness of 25 mm and a web thickness of 12 mm. If the limiting bending stresses for the material of the beam are 80 MN/m^2 in compression and 160 MN/m^2 in tension, find the maximum Uniformly Distributed Load that the beam can carry over a simply supported span of 5 m. **[25]**

QUESTION SIX

Figure QU6 shows an overhanging beam carrying loads at three points. Determine, for the set-up shown:

(a) The reaction supports **[10]**

(b) The shear force diagram **[7]**

(c) The bending moment diagram **[8]**

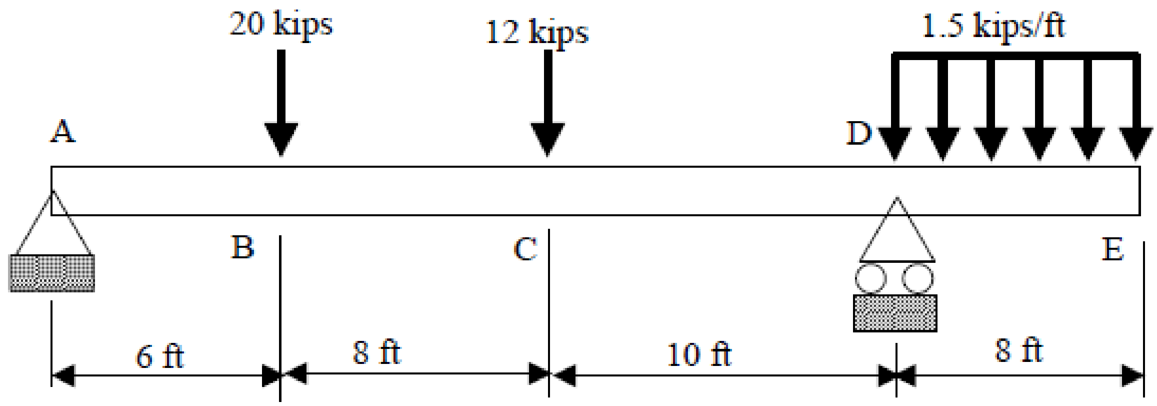

Figure QU6: Overhanging Beam

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