TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

Department of Mechanical &Automotive Engineering

UNIVERSITY EXAMINATION FOR 2015/2016

Bachelor of Science in Mechanical Engineering

EMG 2303: SOLID &STRUCTURAL MECHANICS I.

END OF SEMESTER EXAMINATION

SERIES: MAY 2015/2016

TIME: 2 HOURS

DATE: MAY 2016

Instructions to Candidates

1. You should have the following for this examination
   - *Answer Booklet,*
   - *Examination pass and student ID*
   - *Non –programmable calculator*
   - *Drawing Instruments*
2. This paper consists of **FIVE** questions.
3. Answer Question one is **COMPULSORY** and any other **TWO** Questions
4. All symbols have their usual meanings.
5. This paper consist of **THREE** printed pages
6. **Do not write on the question paper.**

Question ONE (30mks)

a) A bar 20mm diameter is tested in tension .It is observed that when a load of 40KN is applied ,the extension measured over a gauge length of 180mm is 0.12mm and contraction in diameter is 0.0036mm .Find poisons ratio and elastic constants E (5mks)

b) A load of 270KN is carried by a short concrete column 250mmX250mm in size. The column is reinforced with 8 bars of 16mm diameter .Find the stresses in concrete and steel ,if the modulus of elasticity for the steel is 18 times that of concrete.(8mks)

c) State atleast **THREE** basic assumptions made in derivation of simple torsion theory equations (3mks)

d) Show that volumetric strain in a thin cylinder with internal pressure P, thickness t, diameter d, volume V and young's modulus of material given as E ,is given by

$$\frac{pd}{4tE}(5-4\upsilon) \qquad \text{(5mks)}$$

e) A railway is laid so that there is no stress in the rails at 20°C. The rail are 27m long.

   a. Calculate the stress in the rails at -6 °C if all contraction is prevented(3mks)

   b. if however there is 6mm allowance for contraction per rail,what is stress at -6 °C.(6mks)

(Take E=206Gpa and α=12X10-6/ °C.)

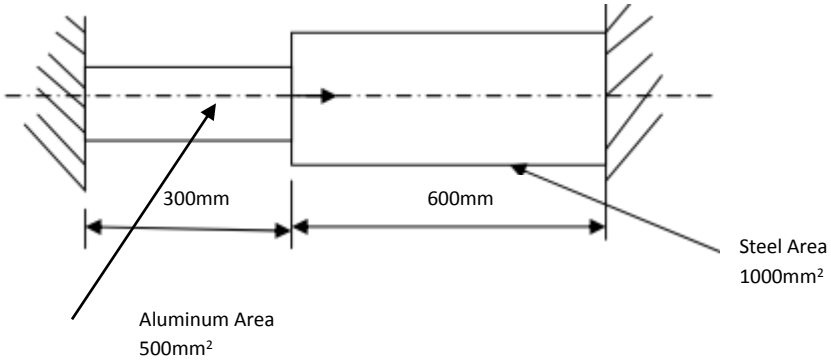
Question TWO (20mks)

a) The figure shows a composite bar made of aluminium and steel .The composite is stress free at 38°C .What will be stresses in the two bar when the temperature is 21°C.If

   i. The support is unyielding

   ii. The support come neearer to each other by 0.1mm

Assume that change of temperature is uniform all along the length of the bar (12mks)



b) A cylinder has an internal diameter of 230mm and wall thickness 5mmthick and is 1m long. It is found to change in internal volume by $12.0X10^{-6}m^3$when filled with a liquid at a pressure P. Determine

   i. The values of hoop and longitudinal stresses

   ii. The modification to these values if joint efficiencies of 45% (hoop)and 85% (longitudinal) are assumed

   iii. The necessary change in pressure (p) to produce a further increase in internal volume of 15%.The liquid may be assumed incompressible.

(Take E=200Gpa υ=0.25 and assuming rigid ends plates) (8mks)

Question THREE (20mks)

Determine the diameter of a hollow shaft with a diameter ratio 3:4 which is to transmit 60Kw at 200rev/min. .The maximum shear stress in the shaft is limited to 70Mpa and angle of twist to 3.8 degree in a length of 4m. For the shaft material G=80Gpa

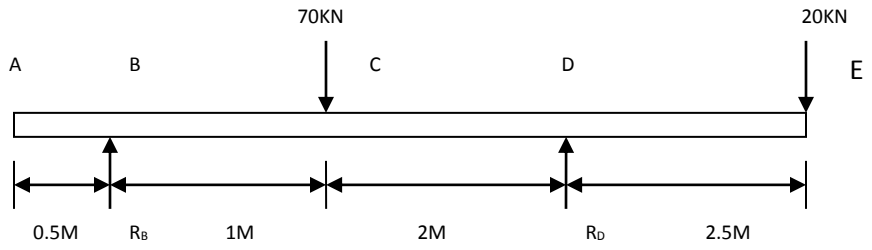
Question FOUR (20mks)

A 12 mm diameter steel rod passes centrally through a copper tube 48mm external and 36mm internal diameter and 2.5 m long. The tube is closed at each end by 25mm thick steel plates which are secured by nuts .The nuts are tightened until the copper tube is reduced in length to 2.4995m and the whole assembly is then raised in temperature by 60 ^{o}C .Calculate the stresses in the copper and steel before and after the rise in temperature assuming the thickness of the plates to remain unchanged (Take α Copper=$17.5X10^{-6}$/K and α steel=$12X10^{-6}$/K E Steel =200GPa; E Copper=100Gpa)(20mks)

Question FIVE

Consider a beam ABCDE 6m long and simply supported at B and D as shown below. It carries appoint load of 70KN and 20KN at C and E respectively. AB =0.5m BC =1m CD=2m and DE=2.5m

i. Determine the reactions at B and D
ii. For the beam given ,calculate the shearing force and bending moment at each points PQ and R which are respectively 1m ,2.25m and 4.5m from A .
iii. Draw the shearing force and bending moment diagram for the beam



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