



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

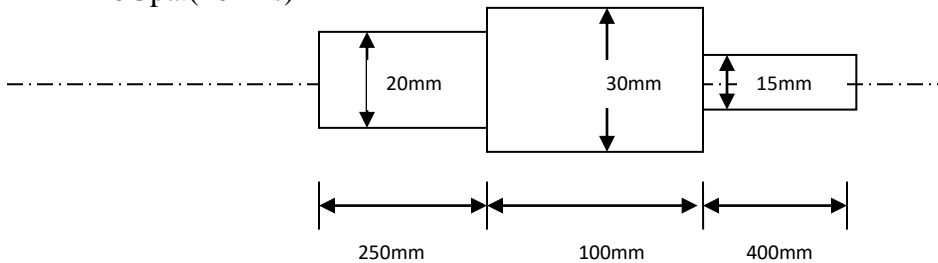
Instructions to Candidates

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 **FOUR** printed pages
6. **Do not write on the question paper.**

Question ONE (30mks)

- a) Define the following terms
 - i. Stress
 - ii. strain
 - iii. Bulk modulus
 - iv. Toughness
 - v. Hooke's law
 - vi. Coefficient of thermal expansion/contraction (6mks)
- b) Give two differences between a brittle and ductile material giving examples in each case(4mks)

- c) A cylindrical shell of 500mm diameter is required to withstand internal pressure of 4 Mpa. Find minimum thickness of shell, if maximum tensile strength in the plate material is 400Mpa and efficiency of joints is 65%. Take a factor of safety as 5. (4MKS)
- d) Determine the stress in each section of the bar below when subjected to an axial tensile load of 20KN. The central section is 30mm square and cross section of other portions are of circular section, their diameter are being indicated. What will be the total extension of the bar. For the material take E as 210Gpa. (10mks)



- e) A steel transmission shaft is 510mm long and 50mm external diameter. For part of its length it is bored to a diameter of 25mm and for the rest to 38mm diameter. Find the maximum power that may be transmitted at a speed of 210rev/min if the shear stress is not to exceed 70Mpa. (6mks)

Question TWO (20mks)

- a) Show that volumetric strain of a rectangular body subject to axial load P is given by $\epsilon (1-2\nu)$. (10mks)
- b) Given that a steel bar 2m long, 20mm wide and 15mm thick is subjected to a tensile load of 30KN. Find the increase in volume if Poisson's ratio is 0.25 and young modulus is 200Gpa. (5mks)
- c) 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 Poisson's ratio and elastic constants E. (5mks)

Question THREE (20mks)

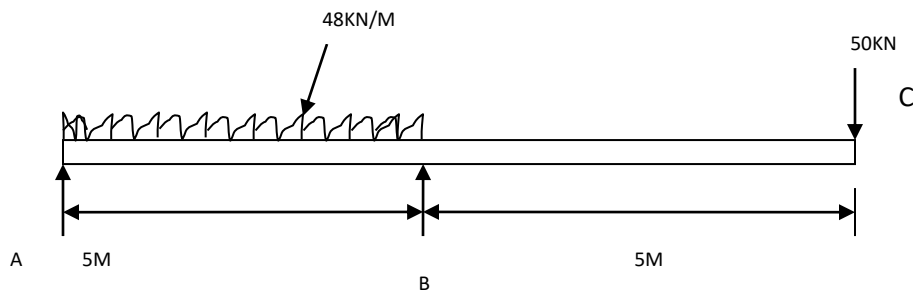
- a) For a cylindrical vessel with hemispherical ends show that the ratio of the cylindrical section thickness (t_c) to spherical thickness (t_s) is 2.4 in order to avoid distortion.(8MKS)
- b) A boiler shell 2m diameter is made up of mild steel plate of 20mm thick. The efficiency of the longitudinal and circumferential joints is 70% and 60% respectively. Determine the safe pressure in the boiler if the permissible tensile stress in the plate section through the rivets is 100Mpa. Also determine the circumferential stress in the plate and longitudinal stress through the rivets(6MKS)
- c) 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.(6MKS)

Question FOUR (20mks)

- a) A solid shaft 100mm diameter transmit 75kw at 150rev/min .
 - i. Determine the value of the maximum shear stress set up in the shaft and angle of twist per metre of the shaft length if $G=80\text{Gpa}$
 - ii. If the shaft were now bored in order to reduce weight to produce a tube of 100mm outside diameter and 60mm inside diameter, what torque could be carried if the same maximum shear stress is not to be exceeded. What is the percentage increase in power/weight ratio effected by this modification
- b) A close coiled helical spring is required to carry a load of 150N.If the mean coil diameter is to be 8times that of wire ,calculate these diameter .Take maximum shear stress as 100Mpa

Question FIVE

- a) A beam 10m long is simply supported at the left hand end and at its midpoint. It carries a uniformly distributed load of 48kN/m between the support and a point load of 50kN at the right hand end
- Draw the shearing force and the bending moment diagrams for the beam
 - State the greatest positive and negative values of these quantities and
 - Calculate the position of the point of contra-flexure



THE END