THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering and Technology

Department of Mechanical and Automotive Engineering

Bachelor of Engineering in Mechanical Engineering

YEAR II SEMESTER II
OCTOBER 2011 SERIES

EME 4309 SOLID AND STRUCTURAL MECHANICS I

TIME: 2 HOURS

INSTRUCTIONS:

1. Attempt any THREE questions.
2. All questions have equal marks.

Question 1 is compulsory and carries 30marks.Choose any other two questions from the paper.

1) a) A beam AB, 3m long is simply supported at A and B. It carries a 26KN concentrated load at
C, 1.2m from A and a uniformly distributed load of 8kN/m over the remainder of the beam.
Draw the Shear Force and Bending Moment diagrams and determine the value of the maximum bending moment.
20marks

b) If the beam is made of a T-section of total depth 560mm, a flange 300mm wide by 30mm
thick and a web 30mm thick, calculate the maximum bending stress in the beam.10marks

10marks

2) a) Show that the maximum torsional stress in a close- coiled helical spring subjected to an axial load W, is given by

$$\frac{2WR}{\pi r^3}$$

Where r = radius of wire
R = mean radius of spring coils. 5marks

b) A helical spring is made from a wire of 6mm diameter and has outside diameter of 75mm. If the permissible shear stress is 350mPa and Modulus of rigidity is 84 KN/mm^2, find the axial load which the spring can carry and the deflection per active turn.

i) Neglecting the effect of curvature
ii) Considering the effect of curvature
10marks

3) a) Derive the expression for pure torsion theory.
5marks

b) A solid steel shaft transmits 20kW at 300 r.p.m. The ultimate shear stress for the steel is 360mPa and a factor of safety is 5.

i) Determine the diameter of the shaft

ii) If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5
15marks

4. When a thin walled cylinder is subjected to internal pressure, mutually perpendicular principal stresses will be set up in the cylinder material. The result will be changes in the length, diameter and internal volume of the vessel. Demonstrate that the change in volume will be given by

$$\frac{pd}{4tE}[5-4v]V$$

Where V = Original vessel volume
P = Internal pressure
t = wall thickness
ϑ = poissons ratio
E = Modulus of Elasticity

5. a) A cast iron link shown in fig Q5 is required to transmit a steady tensile load of 55KN.

Find the tensile stress induced in the link materials at sections A-A and B-B.

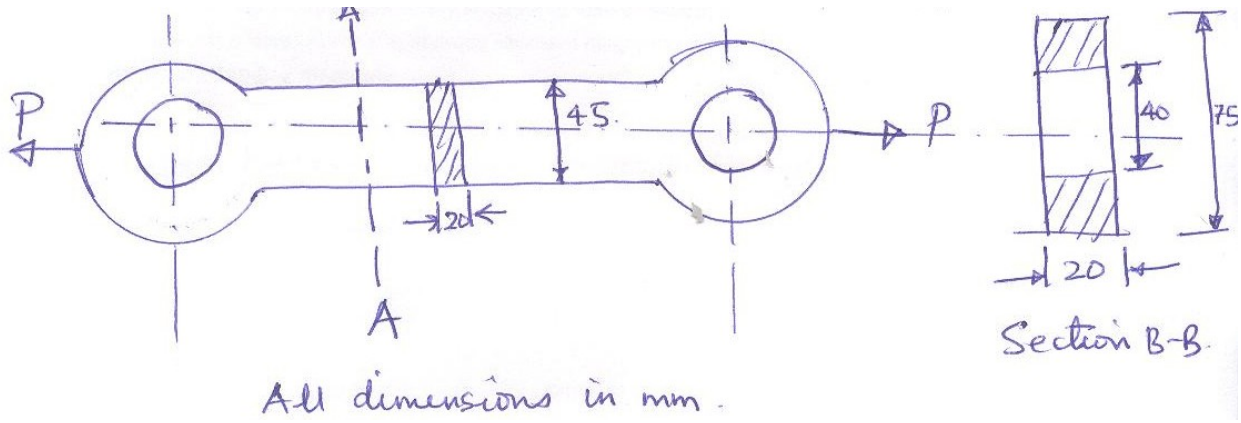

Fig Q5

b) A hydraulic press exerts a total load of 4.0MN. This load is carried by two steel rods,

supporting the upper head of the press. If the safe stress is 95MPa and $E = 210KN/m^2$

Determine:

i) Diameter of the rods
ii) Extension in each rod in a length of 2.5mm