TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

ECE 2204 : STRENGTH OF MATERIALS I

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2017

TIME: 2 HOURS

DATE: 19 Sep 2017

Instructions to Candidates

You should have the following for this examination

-*Answer Booklet, examination pass and student ID*

-*Drawing instruments.*

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper

QUESTION 1 (COMPULSORY)

a) Define the following terms as used in strength of materials

i. Brittle materials

ii. Elastic action of a material

iii. Proof stress

iv. Modulus of resilience **(2 marks)**

b) Given the same stress element (shown below), find the stress components when it is inclined at 30°clockwise. Draw the corresponding stress elements **(10 marks)**

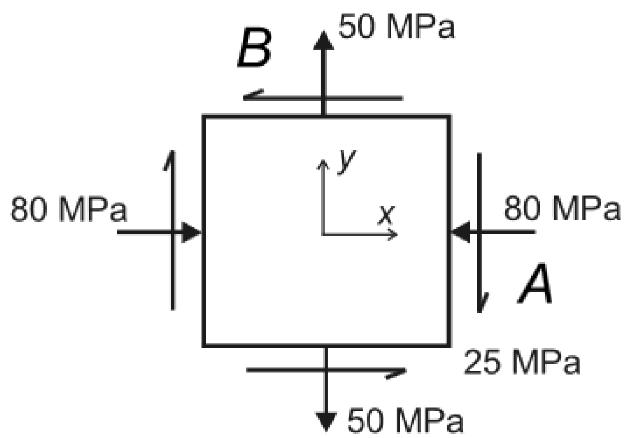

Figure Q1 (b)

c) A pin is used to attach a clevis to a rope. The force in the rope will be a maximum of 60 kN. The maximum shear stress allowed in the pin is 40 MPa. Calculate the diameter of a suitable pin. **5 marks)**

d) A timber beam of rectangular section is to support a load of 12kNuniformly distributed load over a span of 3.6m. if the depth of the section is to be twice the breadth and the stress in timber is not to exceed 70kN/mm^2

   i. Find the dimension of the cross section
   ii. How would you modify the cross section of the beam if it were a concentrated load placed placed2m from the right support with the same ratio of breadth and depth. **(8Marks)**

e) From the first principles of deformed bodies, show that the deformation of the barunder its own weight is given by $\frac{\mathbf{WL}}{\mathbf{2E}}$ **(5 marks)**

QUESTION 2

a) From the first principles of moment of inertia, show that the moment of inertia of a rectangular section is given by $\mathrm{I}_{yy} = \boldsymbol{db^3/_{12}}$

. **(5 marks)**

b) A timber beam of rectangular section is to support a load of 12kNuniformly distributed load over a span of 3.6m. if the depth of the section is to be twice the breadth and the stress in timber is not to exceed $70kN/mm^2$

i. Find the dimension of the cross section

ii. How would you modify the cross section of the beam if it were a concentrated load placed placed2m from the right support with the same ratio of breadth and depth.

. **(8 Marks)**

c) Two bars, one of aluminum and one of steel are subjected to tensile forces that produce normal stresses of $\sigma = 50MPa$ in both bars. What are the lateral strains ε_a and ε_s in the aluminum and steel bars, respectively, if E = 70GPa and $\nu = 0.33$ for aluminum and E = 210GPa and $\nu = 0.3$ for steel. **(7 Marks)**

QUESTION 3

a) A moment of 3KNm acting on the beam section in Fig. Q3 causes compression to occur at the top. Determine the maximum tensile and compressive stresses in the beam. .

.. **(10marks)**

NB. The section is symmetrical about the centroidal axis.

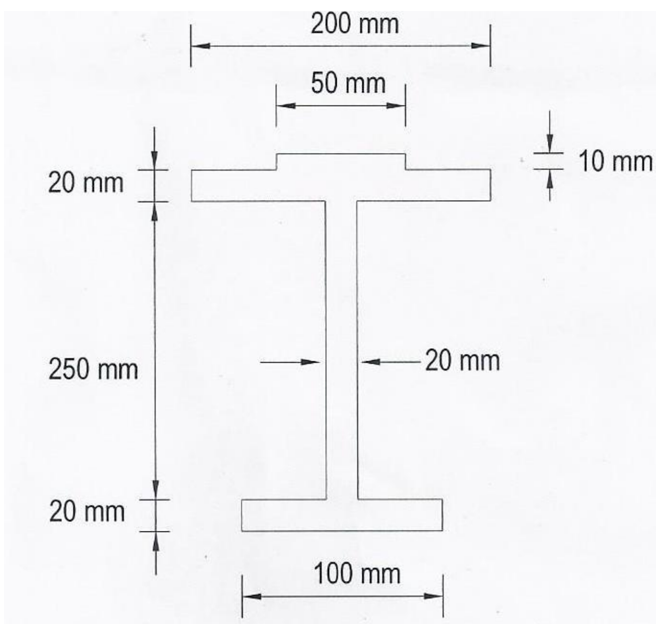

Fig Q3

b) The beam shown in figure 3 is subjected to a shear force of 100KN. Calculate the maximum and minimum shear stresses τ_{max} and τ_{min} in the web. Plot the shear stress variation in the web. **(10 marks)**

QUESTION 4

The beam loaded is loaded as shown in Fig 4(a). If the beam has the cross section shown in figure 4(b) determine the maximum bending stress and maximum shearing stress in the beam. **(20 marks)**

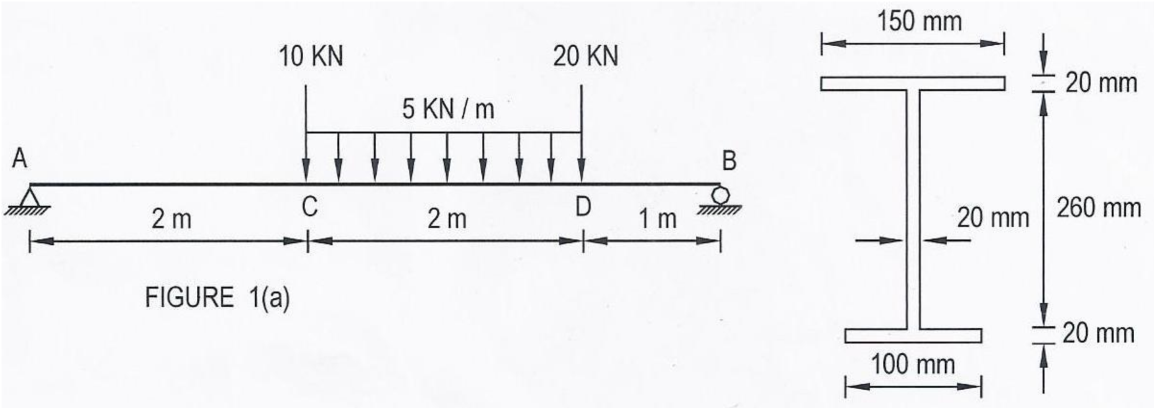

Figure Q4

QUESTION 5

A tensile test has been carried out on a mild steel specimen 10mm thick and 50mm wide rectangular cross section. An extensometer was attached over a 100mm gauge length and load extension readings obtained as follows

Load (KN)	16	32	64	96	128	136	144	152	158
Extension (mm)	0.016	0.032	0.064	0.096	0.128	0.137	0.147	0.173	0.605
Load (KN)	154	168	208	222	226	216	192	185.4	
Extension (mm)	1.181	2.42	7.25	12.0	16.8	22.0	24.0	Fracture	

Plot the stress starn curves and determine values for (i) young's modulus (ii) proportional limit stress (iii) yield point stress (iv) the ultimate tensile stress (v) percentage elongation (vi) 0.2% proof stress