ELIZADE UNIVERSITY, ILARA-MOKIN
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
COURSE CODE: ONE 216 SESSION/SEMESTER: SECOND SEMESTER/ 2018/2019
COURSE TITLE: STRENGTH OF MATERIALS LEVEL: 200L
TIME ALLOWED: 3 HOURS
INSTRUCTION: ATTEMPT ANY FOUR QUESTIONS

QUESTION 1 (15 marks)

(1a) Two parallel walls 6m apart are stayed together by a steel rod 25 mm diameter passing through metal plates and nuts at each end. The nuts are tightened well when the rod is at a temperature of 100°C. Determine the stress and strain in the rod when the temperature falls down to 60°C if;

i. the ends do not yield
ii. the ends yield by 1 mm. Take E = 200 GPa and $\alpha = 12 \times 10^{-6}/K$.

(8 marks)

(b) Considering a bar of Length (L), Cross-sectional area (A), Young modulus (E) and specific weight (W) is as shown in Figure Q1. Show that the change in length (δl) = WL/2AE. (7 marks)

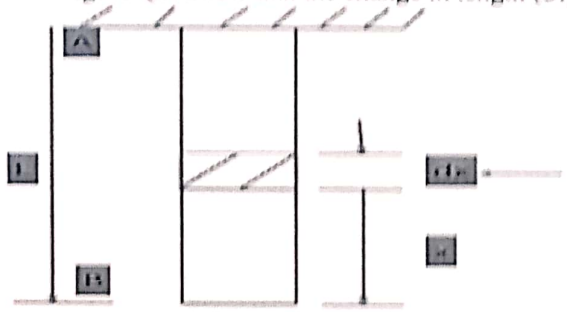

Figure Q1: Bar under loading

QUESTION 2 (15 Marks)

(a) A flat steel bar 200 mm × 20 mm × 8 mm is placed between two aluminum bars 200 mm x 20 mm x 6 mm so as to form a composite bar as shown in Figure Q2. All the three bars are fastened together at room temperature. Find the stresses in each bar where the temperature of the whole assembly is raised through 50 ° C. Assume E_s = 200GPa; E_{al} = 80 GPa; expansion (α_s) = 12 * 10^{-6}°C; Coefficient of linear expansion (α_A) = 24 * 10^{-6}° C.

(9 Marks)

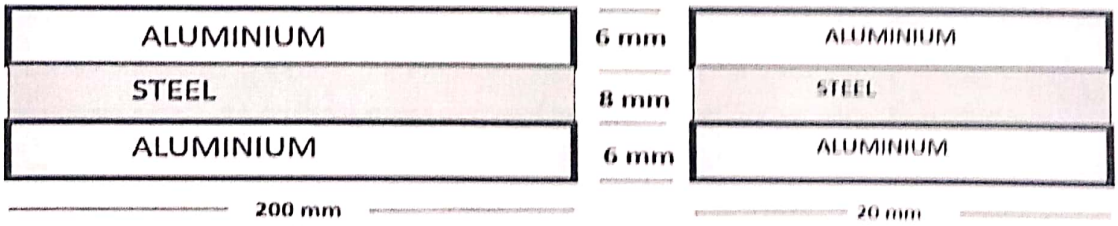

Figure Q2: Composite bar of Aluminum and Steel

(b) Define the following terms, stating the appropriate equations:

i. Stress
ii. Strain
iii. Hooke's Law
iv. Modulus of Elasticity
v. Thermal Stress
vi. Bending Moment

(6 marks)

QUESTION 3 (15 marks)

(a) For the bar shown in Figure Q3, calculate the reaction produced by the lower support on the bar. Take E = 200 GN/mm^2. Find also the stresses in the bar. (8 marks)

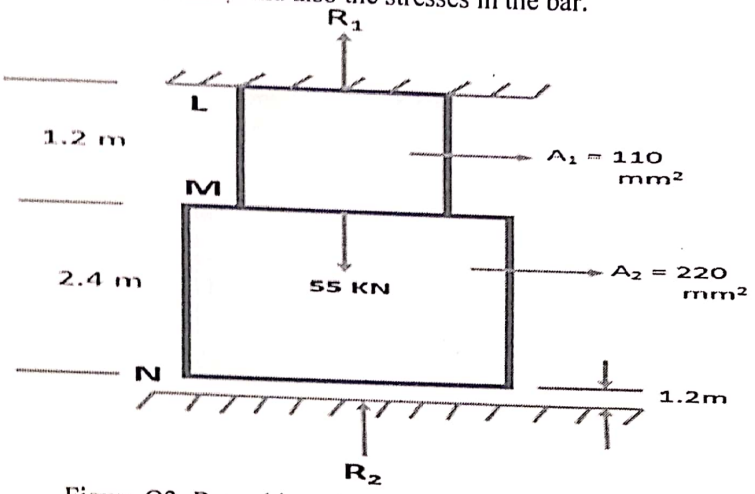

Figure Q3: Bar subjected to reaction forces and stresses

(b) The application of strain energy to impact loads involves a series of mathematical equations leading to the quadratic equation (In terms of stress): $AL\sigma^2 - 2WL\sigma - 2WEh = 0$. If the terms have their usual notations, obtain/derive valid solution of the equation above. (7 Marks)

QUESTION 4 (15 marks)

(a) Draw the shear force and bending moment diagrams for the single side overhanging beam subjected to loading as shown in Figure Q4. Determine the absolute maximum bending moment and shear forces. Also show the shear force and bending moment diagrams. (7 Marks)

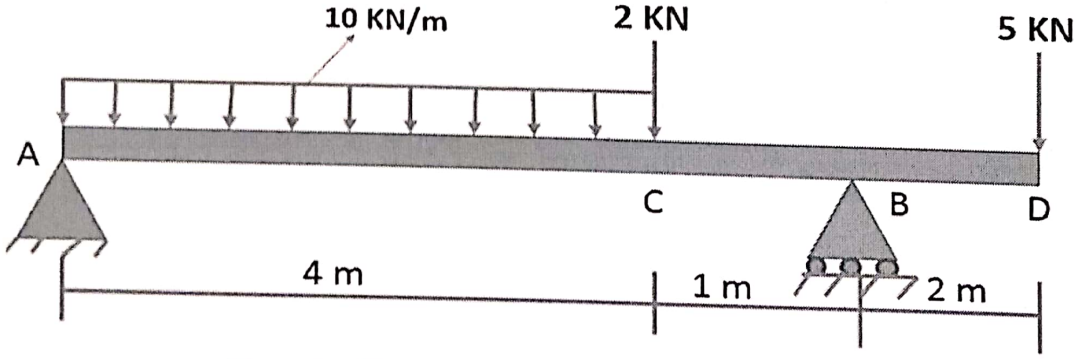

Figure Q4: Single side overhanging beam subjected to loading

(b) With the aid of diagrams, explain the following types of beams:

i. Cantilever beam
ii. Simply supported beam
iii. Overhanging beam
iv. Continuous beam

(8 marks)

QUESTION 5 (15 Marks)

(a) Draw the shear force and bending moment diagrams of a simply supported beam of length 7m carrying a uniformly distributed load as shown in Figure Q5. (9 marks)

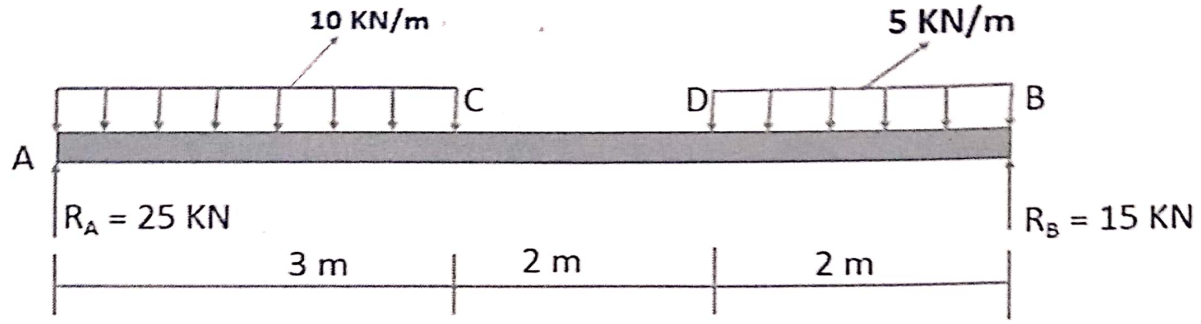

Figure Q5: Simply supported beam of length 7m

(b) With the aid of diagrams, explain the following types of load on a beam structure

i. Concentrated or Point Load
ii. Uniformly Distributed Load
iii. Uniformly Varying Load. (6 marks)

QUESTION 6 (15 marks)

(a) Draw the shear force and bending moment diagrams for the beam AB shown in Fig Q6.(7 marks)

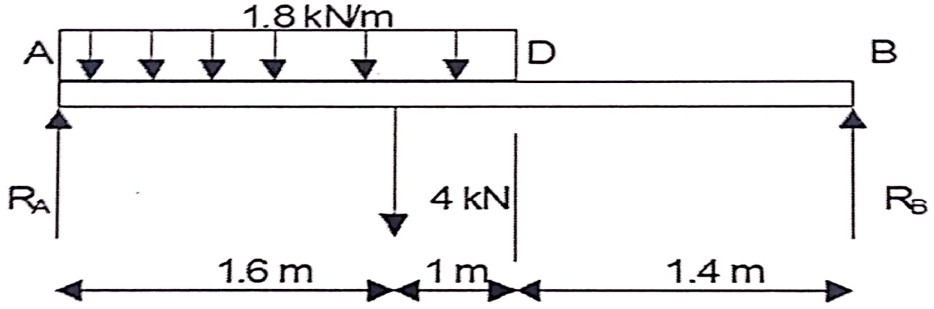

Figure Q6: Beam AB subjected to loadings

(b) Explain the following terms in relation to internal and external forces; force acting on the body and the direction of supports:

i. Free body diagrams
ii. Principle of Transmissibility (8 marks)