FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
SECOND SEMESTER EXAMINATION
(AUGUST 2018)
2017/2018 ACADEMIC SESSION

Course Title: Strength of Materials

Course Code: GNE 216

HOD'S SIGNATURE

Instructions:

1) **Attempt Questions one and any other three**
2) **Time Allowed: 3 hours**
3) **SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAMINATION**

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

B.Sc. (Engineering) Degree Examination

Second Semester 2017/2018 Session

GNE 216: Strength of Materials

August 2018 **Time Allowed:** 3 Hours

Instruction: Attempt Questions one and any other three.

QUESTION 1 (15 Marks)

a) A composite bar is made up by connecting a steel member and a copper member rigidly fixed at their ends as shown in Figure Q1. The cross-sectional area of the steel member is A mm^2 for half of the length and 2A mm^2 for the other half of the length; while that of copper is A mm^2. The coefficient of expansion of steel and copper are 8.3×10^{-6}/K and 10.79×10^{-6}/K; while the elastic moduli are 500×10^3 N/mm^2 and 250×10^3 N/mm^2 respectively. Determine the stresses induced in both the members when the composite bar is subjected to a rise in temperature of t degrees **(10 Marks).**

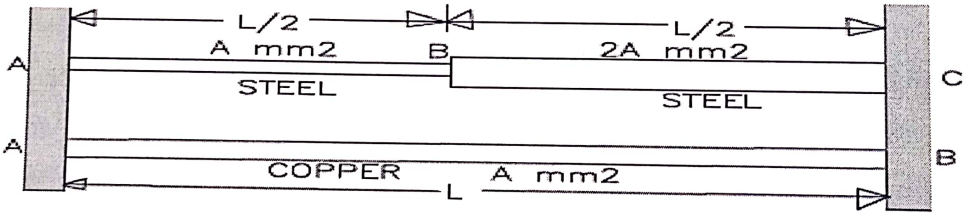

Figure Q1: Composite bar of Steel and Copper Member

b) Two forces of 100N and 150N are acting simultaneously at a point. What is the resultant of these two forces if the angle between them is 45°? **(5 Marks)**

QUESTION 2 (15 Marks)

a) Figure Q2 shows a beam AB of length 3.5m, determine the reaction at A (R1) and the reaction at B (R2). Also, draw the shear force and bending moment diagrams **(10 Marks).**

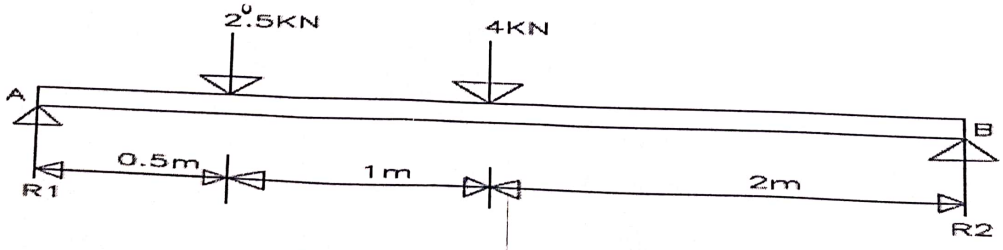

Figure Q2: Beam AB of length 3.5m

b) Define the following terms, stating the appropriate formula(s):

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) 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).**

b) Explain the following terms: (a) Free body diagrams (b) Principle of Transmissibility **(8 Marks)**

QUESTION 4 (15 Marks)

a) A composite bar is made up of aluminum and steel is held between two supports as shown in Fig. Q4. The bars are stress free at a temperature of 38°C. What will be the stresses in the two bars when the temperature is 21°C, if (i) the supports are unyielding (ii) the supports come nearer to each other by 0.1 mm. It can be assumed that the change in temperature is uniform along the length of the bar. Take E for steel as 200 GPa and E for aluminum as 75 GPa. Coefficient Of linear expansion (α_s) = $11.7 \cdot 10^{-6}$/K; Coefficient Of linear expansion (α_A) = $23.4 \cdot 10^{-6}$/K. **(10 Marks).**

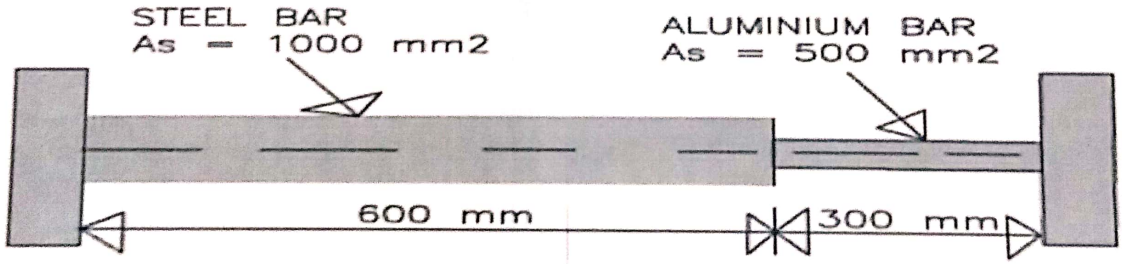

Figure Q4: A Composite bar of Aluminum and Steel

b) The following observations were made during a tensile test on a mild steel specimen 40mm in diameter and 200mm long. Elongation with 40kN load (within limit of proportionality), ∇l = 0.0304mm, yield load = 161kN, maximum load = 242kN, Length of specimen at fracture = 249mm.

Determine:

i. Young modulus of elasticity

ii. Yield point stress

iii. Ultimate stress
iv. Percentage elongation **(5 Marks)**

QUESTION 5 (15 Marks)

a) Draw the shear force and bending moment diagram for the overhanging beam shown in Figure. Q5 **(10 Marks).**

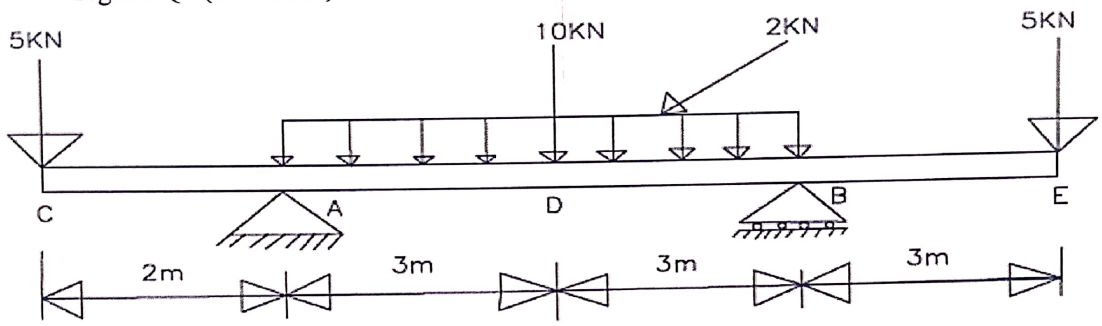

Figure. Q5: Overhanging beam

b) Find the magnitude of the two forces such that if they act at right angles, their resultant is $\sqrt{10}$N. But if they act at 60°, their resultant is $\sqrt{13}$N **(5 Marks).**

QUESTION 6 (15 Marks)

a) Draw the Shear force and bending moment diagram for a simply supported beam subjected to three-point loads as shown in Figure Q6a **(10 Marks).**

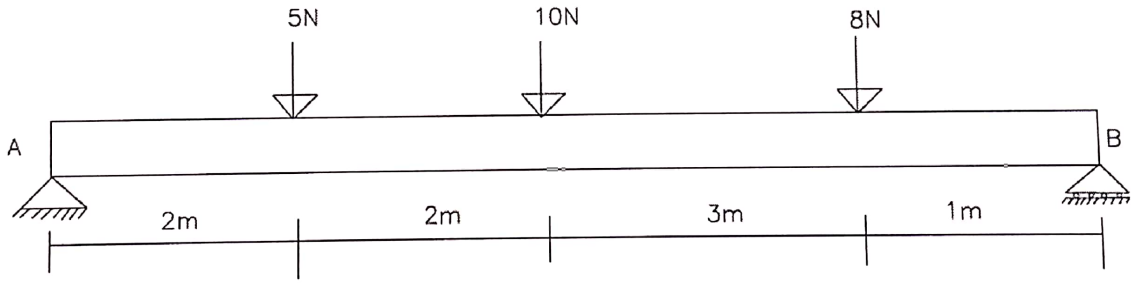

Fig. Q6a: Simply Supported Beam AB

b) Two forces act at an angle of 120. the bigger force is 40N and the resultant is perpendicular to the smaller one. Find the smaller force as shown in Figure Q6b **(5 Marks)**

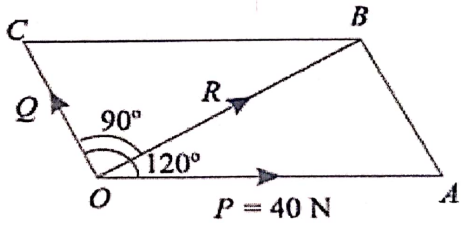

Fig. Q6b: Forces on the Parallelogram body