



MACHAKOS UNIVERSITY

University Examination 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN CIVIL ENGINEERING

BCECD 119: STRENGTH OF MATERIALS I

DATE: 9/5/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS:

Answer question one and any other two questions.

QUESTION ONE (30 MARKS)

- a) Explain the meaning of the following terms as used in the study of strength of materials
 - i. Stress
 - ii. Strain
 - iii. Elasticity and elastic limit
 - iv. Plasticity and ductility
 - v. Hooke's law and M.O.E (10 marks)
- b) A 2kg load is attached to the end of a vertical wire of length 2m and diameter 0.64mm, if the extension experienced by the wire is 0.6mm. Calculate the M.O.E of the steel in GPa (4 marks)
- c) A mild steel has to carry an axial pull of 40KN; the maximum permissible stress is 120MPa. Calculate a suitable diameter for the rod in mm (4 marks)
- d) Hydraulic jack has a ram area of 2000mm^2 and a lifting capacity of 30KN. Calculate the compressive stress in the ram when the jack is used 70% of its capacity (4 marks)
- e) A specimen of steel of diameter 10mm is subjected to a tensile load of 9KN which causes a length of 100mm to increase to 100.055mm. Calculate the M.O.E of the steel specimen (4 marks)

- f) Explain the meaning and the purpose of factor of safety in construction technology
(4 marks)

QUESTION TWO (20 MARKS)

- a) i Explain the tensile test process using a tensile testing machine in testing the test specimen (mild steel) to destruction (4 marks)
- ii Using a suitable load extension graph, explain the behavior of mild steel when subjected to tensile test to destruction (8 marks)
- b) The following results were obtained during a tensile test to destruction of a specimen of low carbon steel
- Diameter of specimen = 11.28mm
- Load at yield point = 26KN
- Maximum load on specimen = 47.5 KN
- Final length at point of fracture = 67mm
- Diameter of specimen at fracture = 8.2mm
- From the above results determine
- i. The yield stress (2 marks)
- ii. The tensile strength (2 marks)
- iii. The percentage elongation (2 marks)
- iv. Percentage reduction in area (2 marks)

QUESTION THREE (20 MARKS)

- a) Define the following terms as used in strength of materials
- i) Torque
- ii) Equilibrant
- iii) Centre of gravity
- iv) Resultant
- v) Simply supported beam
- vi) Equilibrium (6 marks)
- b) A beam 12m long is simply supported at its ends A and B, it carries a load of 2KN, 4M from point A, 4KN, 6m from point A and 6KN, 8m from point A. Calculate the reaction at point A and point B. (4 marks)
- c) A locomotive has 4 pairs of wheels in line, mounted on four parallel axles. The diameter between successive axles is 5ft, 9ft and 5ft. The loadings on the axles are 4KN (front),

12KN, 16KN and 4KN (rear) respectively. If the locomotive stands on a level track, find the total load on the rails and distance from the axle (in ft) in which it acts (6 marks)

- d) Determine the graphically, the magnitude and the direction of the resultant of the following three coplanar forces which may be considered as acting at a point Force A, 12N acting horizontally to the right, force B 7N inclined at 60° to force A, force C, 15N inclined at 150° to force A (4 marks)

QUESTION FOUR (20 MARKS)

- a) A hand break has a leverage of 8:1. The handbrake has an initial length of 2M and a cross-sectional area of 20mm^2 , if the change in length is 0.4mm when the driver applies a force of 100N in the handbrake calculate:
- Strain in the cable (4 marks)
 - M.O.E of the material of the cable (2 marks)
- b) A hollow cast iron column has an outside diameter of 200mm and a metal thickness of 25mm. it carries a compressive stress of 16MPa. Determine the load supported by the column (4 marks)
- c) A tile rod has a cross-sectional area of 500mm^2 and is subjected to a tensile load of 30KN. If the tensile strength of steel used is 450MPa. Calculate the factor of safety (4 marks)
- d) A brake rod 1.25M long is made from steel which has M.O.E of 200GPa. Using a factor of safety of 6, calculate the minimum diameter of the rod required to transmit a pull of 4000N, the tensile strength of the material being 480 MPa. Determine also the extension of the rod when subjected to this pull (6 marks)

QUESTION FIVE (20 MARKS)

- a) State the conditions for equilibrium in a simply supported beam (2 marks)
- b) A metal bar AB is 4.0m long and is simply supported at each end and in a horizontal position. It carries loads of 2.5KN and 5.5KN at distances of 2.0M and 3.0M respectively from point A. neglecting the mass of the beam, determine the reaction of the supports when the beam is in equilibrium (5 marks)
- a) A solid circular section bar of diameter 20mm is subjected to pure bending moment of 0.3KNM. If $E=2 \times 10^{11}\text{N/M}^2$ determine the resulting radius of curvature of the neutral layer of this beam and the maximum bending stress (8 marks)
- b) Calculate and sketch the bending moment and shearing force diagrams for a horizontal beam AB 5M long supported at point A and point B when a load of 6KN is placed at point C, 3M from point A (5 marks)