JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATIONS FOR THE DIPLOMA IN BUILDING AND CIVIL ENGINEERING

2ND YEAR 2ND SEMESTER 2017/2018 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TBC 2221

COURSE TITLE: MECHANICS OF STRUCTURES II

EXAM VENUE: LR 15 **STREAM: DIP IN BLD & CIV ENG**

DATE: 21/12/2017 **EXAM SESSION: 9.00 – 10.30AM**

DURATION: 1 ½ HOURS

Instructions

1. **Answer question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

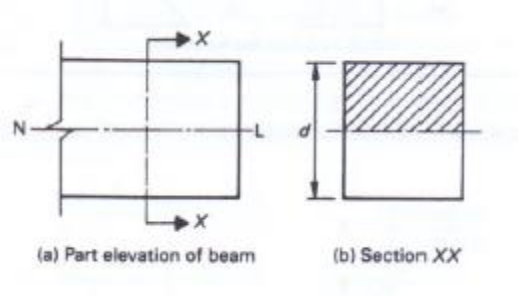
QUESTION ONE (MARKS 30)

i. Differentiate between bending stresses and direct stresses (**4 marks**)

ii. Concerning the bending of beams, define the following (**6 marks**)

a) Radius of curvature
b) Neutral axis
c) Tension layer

iii. The diagram below shows part of a beam. The beam is subjected to traverse loads that cause the beam to bend. Using diagrams, show the stress strain and stress distribution across the beam section (**5 marks**)



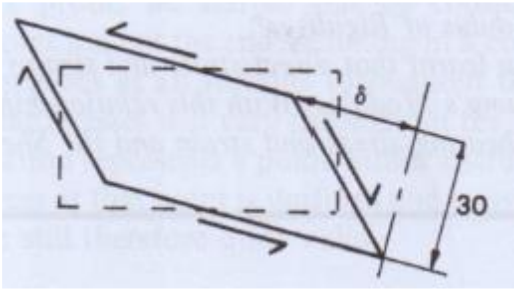
iv. State two important observations that one has to make in using Macaulay's method (**4 marks**)

v. Briefly explain the following (**6 marks**)

a) Second moment of area
b) Polar moment of inertia
c) Radius of gyration

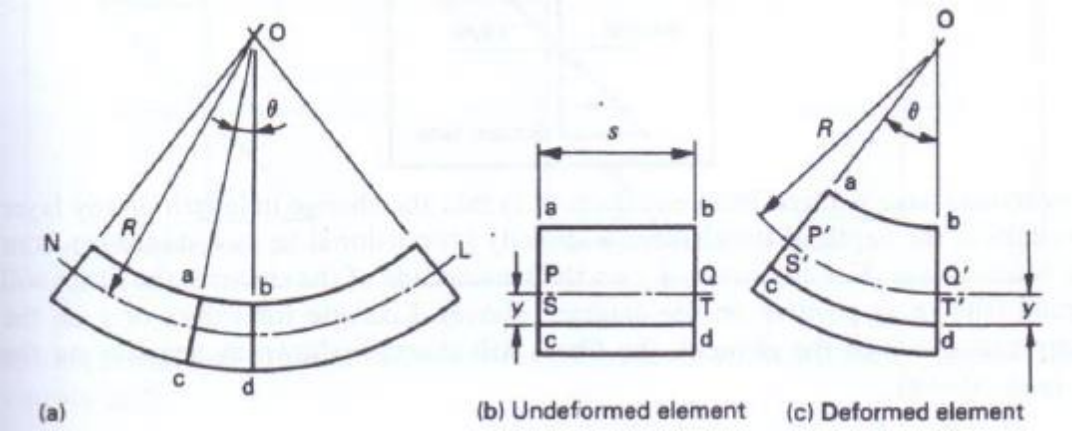
vi. An aluminium plate is subjected to shear stress of 50N/mm2 and has a shear modulus of 26 kN/mm^2 as shown below. Determine (**5 marks**)

a) The shear strain
b) The total shear distortion, δ



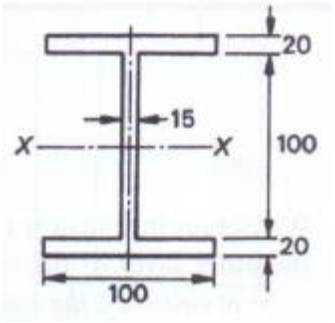
QUESTION TWO (MARKS 20)

i. The diagram below shows a section of a bent beam. With the aid of the diagram, show that $\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$ (simple bending formula) (**10 marks**)



ii. State the assumptions made in coming up of the simple bending formula (**5 marks**)

iii. The steel beam carries a single concentrated load of 30kN at the midpoint and is simply supported. The beam has a span of 3m. Determine the maximum bending stresses and the curvature of the beam at the point of maximum bending moment. The Youngs modulus for steel is 200 x 10^3kN/mm^2. (**10 marks**)



QUESTION THREE (MARKS 20)

i. A cantilever beam is L m long and has a point load, W kN at the free end. The flexural stiffness is EI.

a) Develop a mathematical expression for bending moment, M at a section x metres from the free end (**2 marks**)

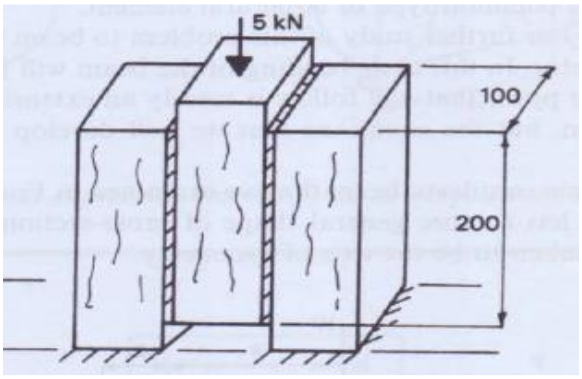
b) Develop an expression for slope, $\frac{dv}{dx}$ (**2 marks**)

c) Develop an expression for deflection, v ((**2 marks**)

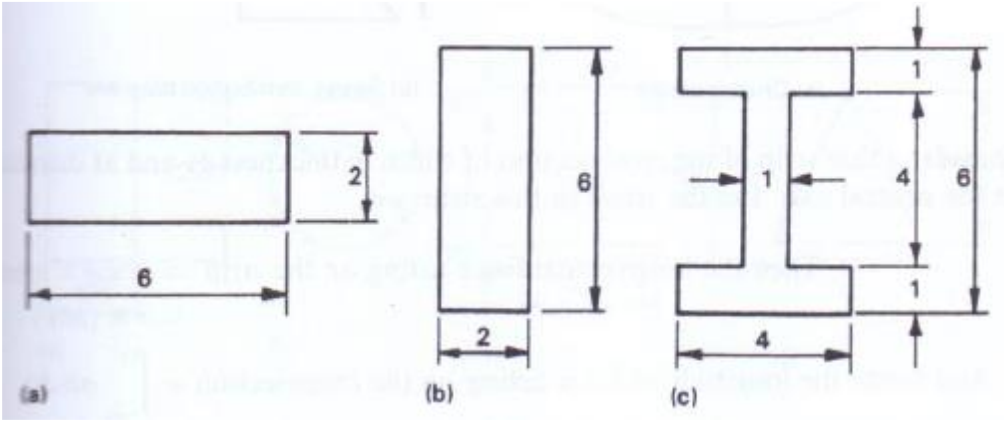
d) If L = 6m, W = 20kN and EI = 110 MNm2, determine the slope and deflection at the free end (**4 marks**)

ii. To test the shear strength of brickwork, a simple test was devised using three bricks mortared together and loaded in a test rig as shown. If at some point in the test a load of 5kN is applied,

determine the average shear stress along the surface between the mortar and the bricks. (**5.5 marks**)



iii. The diagram below shows cross-sections of various beams. Arrange the beams in order of increasing moment of resistance (**4.5 marks**)

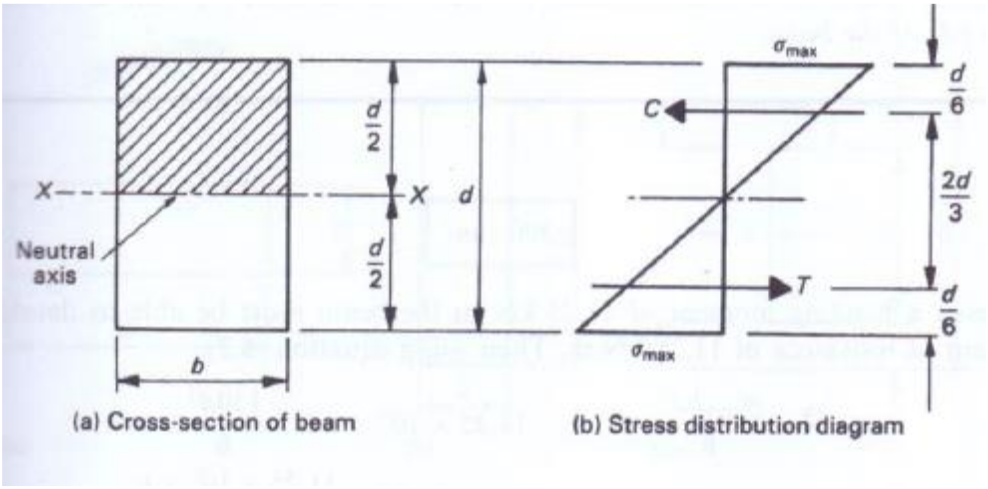


QUESTION FOUR (MARKS 20)

i. Define and briefly explain the following terminologies as concerns beam deflection (**10 marks**)
   a) curvature
   b) slope
   c) deflection
   d) flexural stiffness
   e) slenderness ratio

ii. Using the diagram given below, develop expressions for
   a) Total compressive or tensile force on the section
   b) Moment of resistance on the section

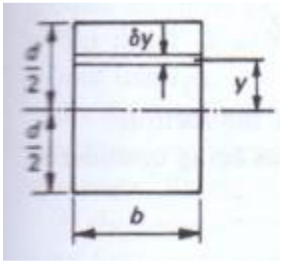
(**10 marks**)



QUESTION FIVE (MARKS 20)

i. A beam of symmetrical section of depth 200mm with a moment of Inertia 1 x 10^8 mm^4 is simply supported over a span of 4m. What uniformly distributed load can it carry if the maximum bending stress is not to exceed 120 N/mm2? With the same permissible stress, what concentrated load may be carried by the beam at the midspan? (**10 marks**)

ii. Determine the second moment of area of the given rectangular cross-section about the neutral axis. (**5 marks**)



iii. A timber beam of solid rectangular cross-section is required to withstand an external bending moment of 11.25kN.m. If the maximum permissible bending stress is 5.0 N/mm2 and the beam has a breadth of 150mm (6 inch), calculate the minimum required depth, d (**5 marks**)