00293

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: CVX3234/CVX3534/CVX3442 – Strength of Materials**
Academic Year	: 2019/20
Date	: 25th July 2020
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Three (3)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Relevant charts / codes are provided.
6. This is a Closed Book Test **(CBT).**
7. Answers should be in clear hand writing.
8. Do not use red colour pen.

Q1. (a) Explain the elastic and plastic behavior of an Engineering material.

(02 marks)

(b) The diameters of the brass and steel segments of the axially loaded bar shown in Fig. Q1 are 30 mm and 12 mm respectively. The diameter of the hollow section of the brass segment is 20 mm. Taking E_s = 210 GPa and E_b = 105 GPa, determine
i) The displacement of the free end, and
ii)The maximum normal stress in steel and brass.

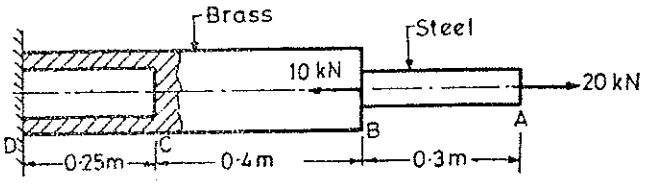

Fig. Q1

(10 marks)

(c) A timber beam of rectangular section of length 8 m is simply supported. The beam carries a U.D.L. of 12 kN/m run over the entire length and a point load of 10 kN at 3 metres from the left support. If the depth is two times the width and the stress in the timber is not to exceed 8 N/mm², find the suitable dimensions of the section.

(08 marks)

Q2.(a) Explain "Radius of Gyration". Determine the radius of gyration of a rectangular beam section about its centroidal axis when the depth of the beam is twice its width.

(04 marks)

(b) A beam, supported at A and B, is loaded as shown in Fig. Q2. Find the position and magnitude of maximum bending moment and position of point at which bending moment is zero. Draw the shear force and bending moment diagrams.

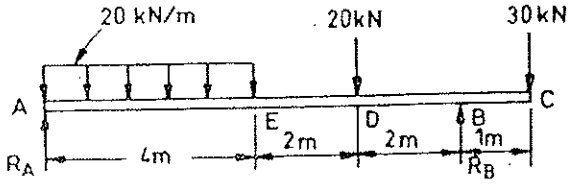

Fig. Q2

(16 marks)

Q3.(a) At a certain point in a material under stress the intensity of the resultant stress on a vertical plane is 1000 N/cm² inclined at 30⁰ to the normal to that plane and the stress on a horizontal plane has a normal tensile component of intensity 600 N/cm² as shown in Fig. Q3. Find the magnitude and direction of the resultant stress on the horizontal plane and the principal stresses.

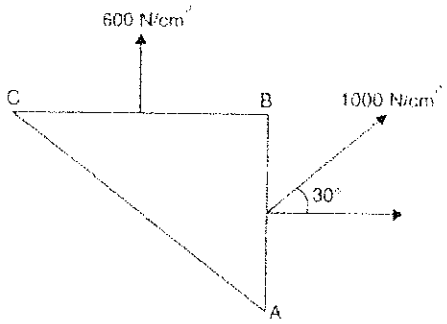

Fig. Q3

(10 marks)

(b) An elemental cube is subjected to tensile stresses of 30 N/mm² and 10 N/mm² acting on two mutually perpendicular planes and a shear stress of 10 N/mm² on these planes. Draw the Mohr 's circle of stresses and hence determine the magnitudes and directions of principal stresses and also the greatest shear stress.

(10 marks)

Q4.(a) A circular section rod ABC is fixed at ends A and C. It is subjected to torque T at B. AB = BC = L and the polar moment of inertia of portions AB and BC are 2 J and J respectively. If G is the modulus of rigidity, show that the angle of twist at point B is $^{TL}/_{3GJ}$.

(08 marks)

(b) A torque transmitting solid steel shaft of 100 mm diameter is replaced by a hollow one of the same material having its outside diameter twice its inside diameter. Maximum shear stress in the hollow shaft remains same as that in the solid one. Compare torsional rigidity of the two shafts.

(12 marks)

Q5.(a) A short column of external diameter D and internal diameter d carries an eccentric load w. Show that the greatest eccentricity which the load can have without producing tension on the cross-section of the column would be, $[(D^2 + d^2)/8]^{1}/_{2}$.

(08 marks)

(b) A hollow alloy tube 5 m long with external and internal diameters 40 mm and 25 mm respectively was found to extend 6.4 mm under a tensile load of 60 kN. Find the buckling load for the tube when used as a column with both ends pinned. Also find the safe load for the tube, taking a factor of safety = 4.

(12 marks)

Q6.(a) Explain factor of safety and Poisson's ratio.

(04 marks)

(b) A beam of rectangular cross-section 50 mm wide and 100 mm deep is simply supported over a span of 1500 mm. it carries a concentrated load of 50 kN, 500 mm from the left support. Calculate

i) The maximum tensile stress in the beam and indicate where it occur.

ii) The vertical deflection of the beam at a point 500 mm from the right support.

E for the material of the beam = $2 \times 10^5\ MPa$.

(16 marks)

Q7. (a) Bending formula is given as $\frac{M}{I} = \frac{E}{R} = \frac{\sigma}{y}$. Explain briefly all the terms of the bending formula and state their units.

(06 marks)

(b) Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30 mm and of length 1.5 m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm². Take E = 1 x 10^5 N/mm².

(14 marks)

Q8. (a) Explain the "neutral plane" and "principal pane".

(04 marks)

(b) A wooden beam shown in Fig. Q8 is 8 cm wide and 12 cm deep with a semi-circular groove of 2 cm radius planned out in the centre of each side. Calculate the maximum stress in the section when simply supported on a span of 3 m, loaded with a concentrated load of 450 N at a distance of 1 m from the one end and a uniformly distributed load of 500 N/m run over the whole span.

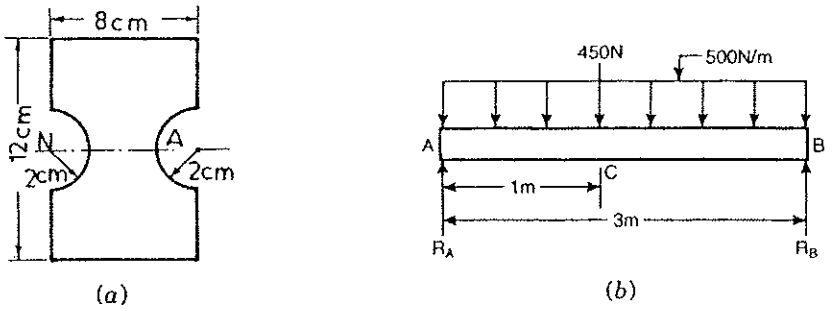

Fig. Q8

(16 marks)