THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2011/2012
MEX3271 –APPLIED MECHANICS AND STRENGTH OF MATERIALS 1
DATE :24TH MARCH 2012
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS

Answer any FIVE (05) questions selecting not more than THREE from each section.

SECTION A

Question 01:

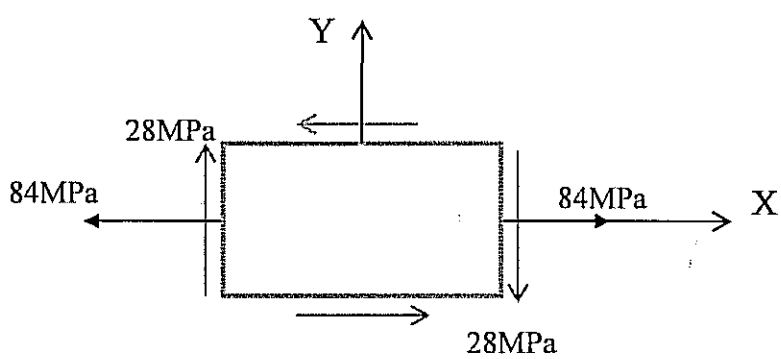


Fig.Q1

A plane element is subjected to the stresses as shown in Fig.Q1. Using Mohr's circle determine:

(a) The principal stresses and their directions.
(b) The maximum shearing stresses, the directions of the planes on which they occur, and the normal stresses on these planes.
The directions of the planes should be shown clearly by suitable sketches.

Question 02:

A beam **AB** having a total length of 9.6 m rest on supports **C** and **D** 7.5 m apart. Support **C** is 1.2m from '**A**' and the other support **D** is 0.9 m from **B**. The beam carries a uniformly distributed load of intensity 20 kN/ m for a length of 6 m, measured from the end **A** and a point load of 10kN at the end **B**.

(a) Draw the shearing force and bending moment diagrams due to the given loading.

(b) Hence find the magnitude of maximum bending moment.

Question 03:

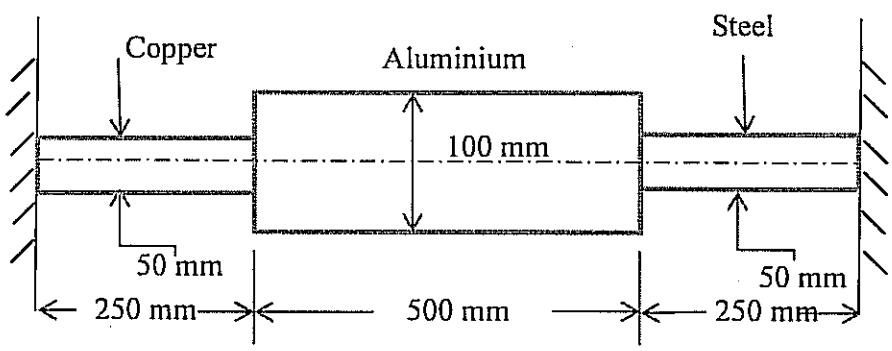


Fig.Q3

A composite bar shown in Fig.Q3 is rigidly attached to the end supports. The temperature of the composite system is raised by 60^0C. Determine the stresses in three portions of the bar if

(a) the supports are rigid
(b) the supports yield by 0.5 mm

Modulus of elasticity (E) and Coefficient of temperature (α) of each material are

For steel	$E_s = 200$GPa, $\alpha_s = 12\text{x}10^{-6}/^0$C
For aluminium	$E_a = 90$GPa, $\alpha_s = 20\text{x}10^{-6}/^0$C
For copper	$E_c = 100$GPa, $\alpha_c = 16\text{x}10^{-6}/^0$C

Question 04:

(a) State the parallel axes theorem.

(b)

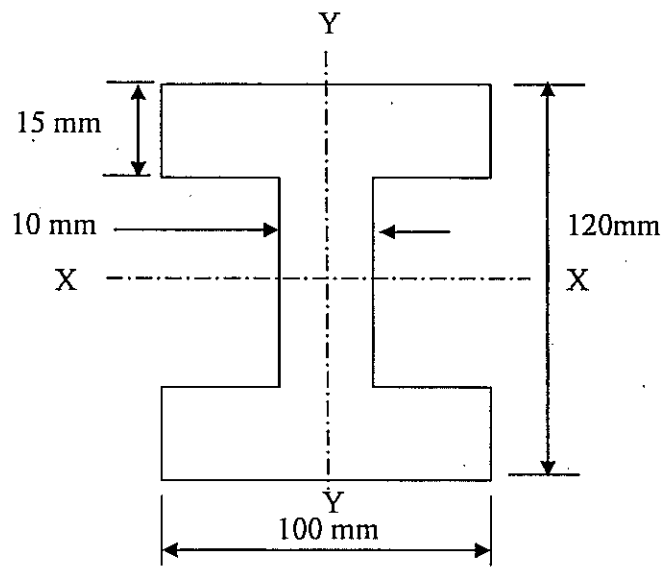


Fig.Q4

(i) Find the second moment of area of the beam section shown in Fig.Q4 about the axes X-X and Y-Y.

(ii) Calculate the ratio of the moment of resistance to bending in the Y-Y plane to that for bending in the X-X plane if the maximum allowable stress due to bending is the same in both cases.

SECTION B

Question 05:

(a) Establish a formula for the maximum torque transmitted by a single plate clutch of external and internal radii r_1 and r_2 if the limiting coefficient of friction is μ and the axial spring load is W. Assume that the pressure intensity on the contact faces is uniform.

(b) An old single plate clutch, effective on both sides, is required to transmit 30 kW at 2500 rev/min. If the coefficient of friction is 0.3, the ratio of radii is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2, determine

(i) the outer and inner radii of frictional surface.
(ii) the axial thrust to be provided by springs.

Question 06:

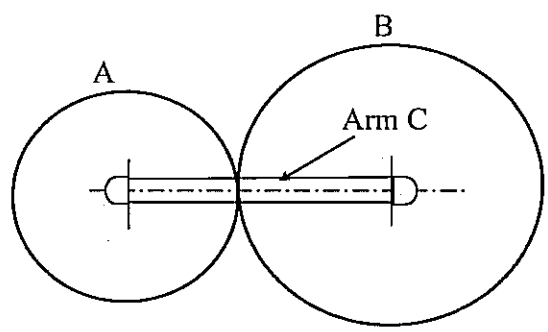


Fig.Q6

In an epicyclic gear train shown in Fig.Q6, an arm carries two gears **A** and **B** having 36 and 45 teeth respectively. If the arm rotates at 150 rev/min. in the anticlockwise direction about the center of the gear **A** which is fixed, determine the speed of gear **B**.

If the gear **A**, instead of being fixed, makes 300 rev/min in the clockwise direction, what will be the speed of gear **B**?

Question 07:

A. B, C and **D** are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the masses of **B, C** and **D** are 10 kg, 5 kg and 4 kg respectively.
Find the required mass **A** and the relative angular settings of the four masses so that the shaft be in complete balance.

Question 08:

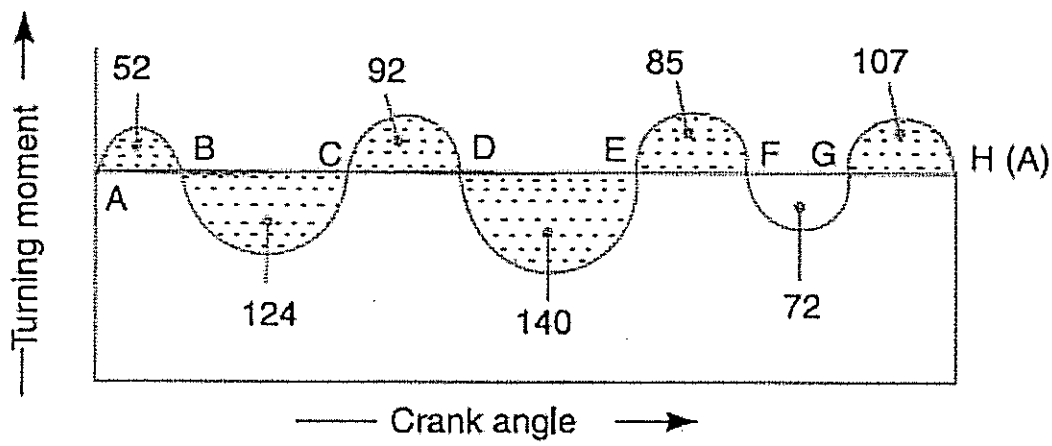


Fig.Q8

The turning moment diagram for a multi cylinder engine shown in Fig.Q8 has been drawn to a scale 1mm = 600 Nm vertically and 1 mm = 3^0 horizontally.
The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end are as follows:
+52, -124, +92, -140, +85, -72 and +107 mm^2. When the engine is running at a speed of 600 rev/min, if the total fluctuation of speed is not to exceed ±1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m.

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