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THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2010/2011
MEX 3271 – APPLIED MECHANICS & STRENGTH OF MATERIALS
DATE :03RD APRIL 2011
TIME ~~:0930 HRS - 1230 HRS~~ 1400 HRS – 1700 HRS.
DURATION :03 HOURS

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

SECTION A

QUESTION 01:

An engine runs at 100rev/min and a curve of the turning moment plotted on a crank angle base shows the following areas alternatively above and below the mean turning moment line.

780, 400, 520, 620, 260, 340 and 420 mm^2

The scales used were 1mm = 400Nm and 1mm = 1^0 crank angle.

If the total fluctuation in speed is limited to 1.5% of the mean speed, determine the mass of flywheel necessary. Take the radius of gyration of the flywheel as 1.05mm.

QUESTION 02:

In a reverted epicyclic gear train, the arm ***A*** carries two gears ***B*** and ***C*** and a compound gear ***D-E*** as shown in Fig.Q2. The gear ***B*** meshes with gear ***E*** and the gear ***C*** meshes with gear ***D***. The number of teeth on gears ***B***, ***C*** and ***D*** are 75, 30 and 90 respectively. Find the speed and direction of gear ***C*** when gear ***B*** is fixed and the arm ***A*** makes 100 revolution per miniute clockwise.

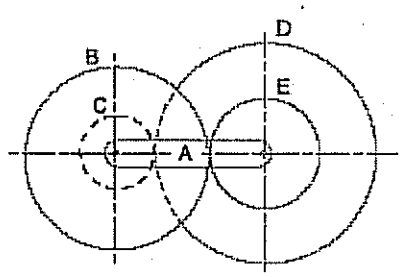


Fig.Q2

QUESTION 03:

A plate clutch consists of a flat driven plate gripped between a driving plate and a pressure plate so that there are two active driving surfaces, each having an inner diameter 200 mm and an outer diameter 350 mm. The coefficient of friction $\mu = 0.4$. The working pressure is limited to 170 kN/m^2. Assuming the pressure is uniform, calculate the power which can be transmitted at 1000 rev/min. If the clutch becomes worn so that the intensity of pressure is inversely proportional to the radius, the total axial force on the pressure plate remaining unaltered, calculate the power which can now be transmitted at 1000 rev/min and the maximum intensity of pressure on the friction surfaces.

QUESTION 04:

A shaft carries four masses A,B,C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm and 700mm. The angles between the cranks measured anticlockwise are A to B 45^0, B to C 70^0 and C to D 120^0. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at radius of 100 mm, find their magnitudes and angular positions.

SECTION B

QUESTION 05:

The stresses acting on three mutually perpendicular planes at a point in an elastic material are 72N/mm^2 tensile and 28N/mm^2 shear on plane1, 14N/mm^2 compressive and 28N/mm^2 complementary shear on plane 2, and no stresses on plane 3.

Use Mohr's circle diagram to show the stress components on different planes and thus calculate,

i. the principal stresses
ii. the maximum shear stress
iii. the position of the planes on which there is no normal stress
iv. the principal strain

Take $\nu = 0.3$ and $E = 200 \times 10^6$ N/mm^2

QUESTION 06:

A propped cantilever ABCD 10m long, carries the transverse loads as shown in Fig.Q6. Draw the shear force and bending moment diagrams. Find the magnitude of the maximum bending moment. Determine also the position of the point of contra flexure if any.

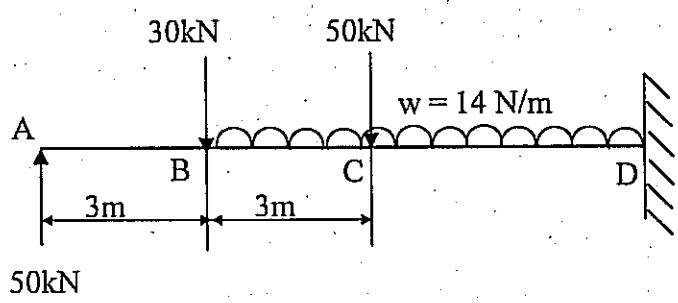


Fig.Q6

QUESTION 07:

Prove that the second moment of area of a triangle having a base 'b' and height 'h', about an axis along the base is $bh^3/12$. Hence show that a square has the same second moment of area about a diagonal and a centroidal axis parallel to a side of the square.

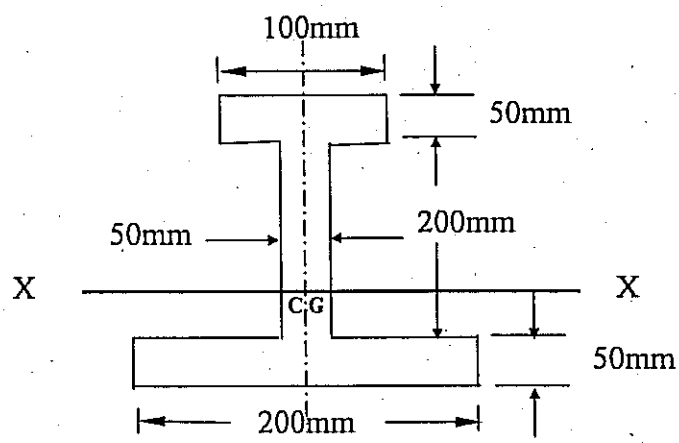


Fig.Q7

Fig.Q7 shows a rolled steel beam of an unsymmetrical I-section. Determine the second moment of area about the axes x-x passing through its center of gravity (C.G) for the section shown in the figure.

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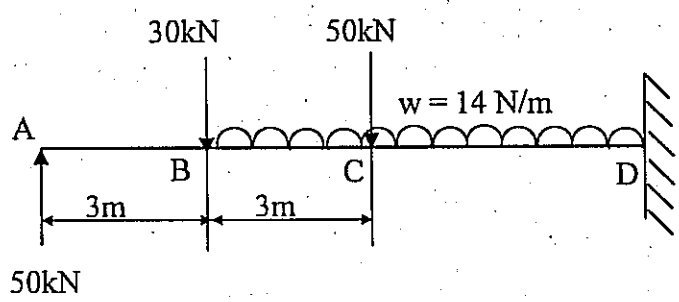


Fig.Q6

QUESTION 07:

Prove that the second moment of area of a triangle having a base 'b' and height 'h', about an axis along the base is $bh^3/12$. Hence show that a square has the same second moment of area about a diagonal and a centroidal axis parallel to a side of the square.

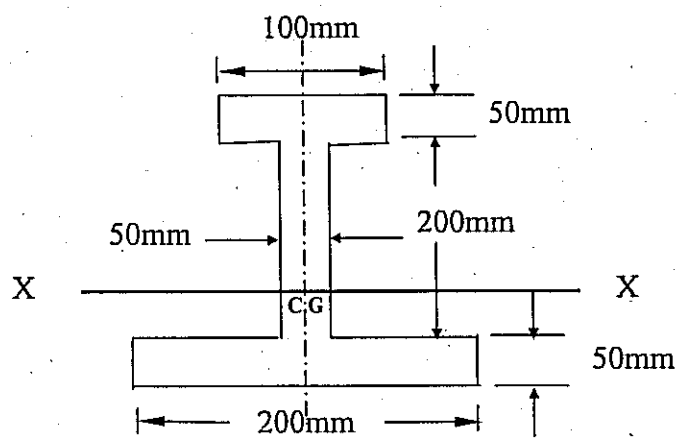


Fig.Q7

Fig.Q7 shows a rolled steel beam of an unsymmetrical I-section. Determine the second moment of area about the axes x-x passing through its center of gravity (C.G) for the section shown in the figure.

QUESTION 08:

(a) A copper tube with external diameter 40mm and 6mm thick fits over a steel rod 25mm diameter. The tube is secured to the bar by 2 pins each 10 mm diameter, fitted transversely one at each end. If the temperature after the assembly is raised by 50^0 C, calculate the shear stress in the pins.

(b) A copper bar 25 mm in diameter is enclosed centrally within a steel tube. The internal and external diameters of the tube are 30 mm and 36 mm respectively. At 0^0 C, the ends of the bar and the tube are rigidly fastened. The compound bar is then heated to a temperature of 80^0 C. Determine the stresses in the bar and the tube. Derive any formula used.

$E_{steel} = 200x10^3$ N/mm^2

$E_{copper} = 100x10^3$ N/mm^2

Linear coefficient of expansion for steel = 6×10^{-6} / ^{0}C

Linear coefficient of expansion for copper = 1×10^{-5} / ^{0}C

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