THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2009/2010
MEX 3271 – APPLIED MECHANICS & STRENGTH OF MATERIALS
DATE :17 MARCH 2010
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS

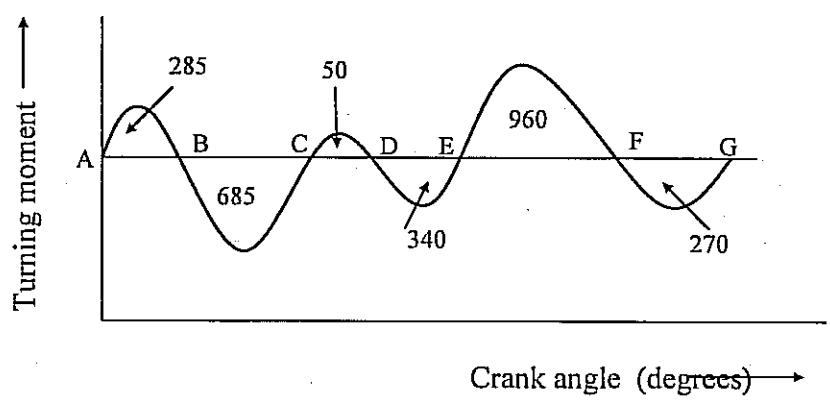
Answer any FIVE (05) questions selecting not more than TWO from each section.

SECTION A

QUESTION 01:

The turning moment diagram shown in Fig.Q1 repeats in every half revolution of the engine, and the areas above and below the mean turning moment line taking in order, are +285, -685, +50, -340, +960, -270 mm^2.

The rotating parts are equivalent to a mass of 40 kg at a radius of gyration of 150mm. Determine the coefficient of fluctuation of speed when the engine runs at 1,200 rpm.



Scales: Turning moment, 1mm ≡ 6 Nm; Crank angle, 1 mm ≡ 1^0

Fig.Q1

(20 marks)

QUESTION 02:

The pitch of 50 mm diameter single threaded screw of a screw jack is 12.5 mm. The coefficient of friction between the screw and the nut is 0.13. Determine the torque required on the screw to raise a load of 25 kN, assuming that the load rotates with the screw. Determine the ratio of the torque required to raise the load to the torque required to lower the load. Also determine the efficiency of the machine.

(20 marks)

QUESTION 03:

A rotating mass carries four masses A, B, C and D rigidly attached to it. The mass centers are at 32mm, 38mm, 41mm and 35mm respectively from the axis of rotation. A, C and D have masses 30 kg, 20 kg and 16 kg respectively. The axial distance between A and B is 400 mm and that between B and C 500 mm. The eccentricities of A and C are at 90^0 to one another.
For complete balance, determine:

(a) The angles between
  (i) A and B
  (ii) B and D
(b) The axial distance between the planes of revolution of C and D.
(c) The mass of B.

(20 marks)

QUESTION 04:

Fig.Q4 shows a compound epicyclic gear train, of which gears S_1 and S_2 being rigidly attached to the shaft **Q**. If the shaft **P** rotates at 1000 rev/min clockwise, while the annulus A_2 is driven in the opposite direction at 500 rev/min, determine the speed and direction of rotation of the shaft **Q**. The numbers of the teeth in the wheels are S_1, 24: S_2 , 40: A_1, 100: A_2, 120.

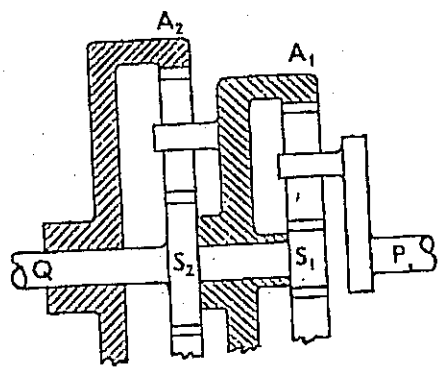


Fig.Q4

(20 marks)

SECTION B

QUESTION 05:

a) Briefly discuss the followings

(i) Elastic limit
(ii) Hook's Law
(iii) Modulus of Elasticity
(iv) Poisson Ratio **(08 marks)**

b)

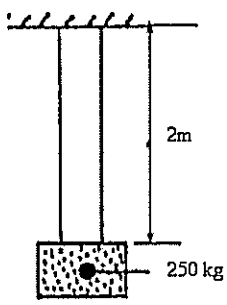


Fig Q5

A 2m long vertical steel rod, which supports a weight having a mass of 250 kg, is illustrated in Fig Q5. The allowable stress in the steel is 1.27 MPa and its modulus of elasticity E = 210MPa. Calculate

(a) the diameter of the rod
(b) the strain in the material
(c) the elongation due to the load.

(12 marks)

QUESTION 06:

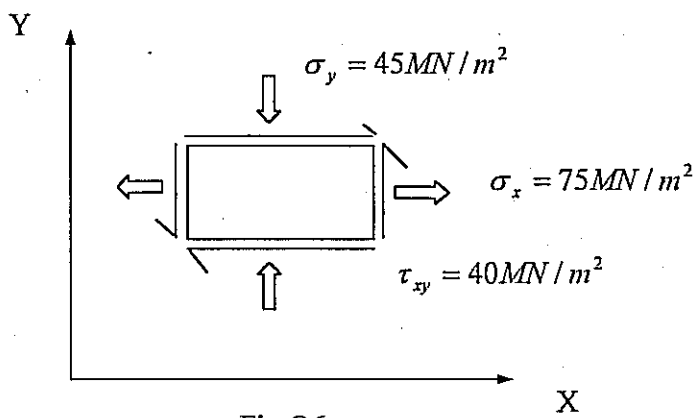


Fig.Q6

A thin plate whose stress element is shown in Fig.Q6 is made of a material with poison's ratio $\upsilon = 0.3$ and modulus of elasticity E = 200 GN/m^2. If the plate is subjected to stresses

$\sigma_x = 75MN/m^2$ (tensile)

$\sigma_y = 45MN/m^2$ (compressive) and

$\tau_{xy} = 40MN/m^2$, draw a Mohr's circle of stresses and determine the principal stresses and the maximum shear stress.

(20 marks)

QUESTION 07:

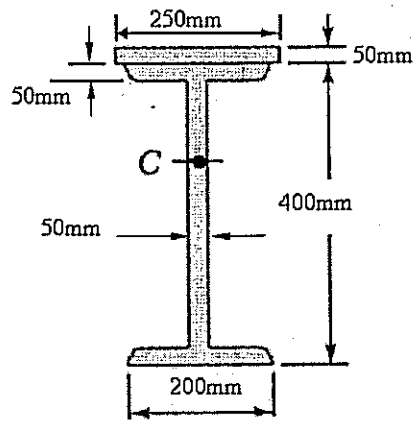


Fig.Q7

The strength of a W14x38 rolled steel I beam is increased by attaching a plate to its upper flange as shown in Fig.Q7.

Determine the moment of inertia with respect to an axis which is parallel to the plate and passes through the centroid of the section.

(20 marks)

QUESTION 08:

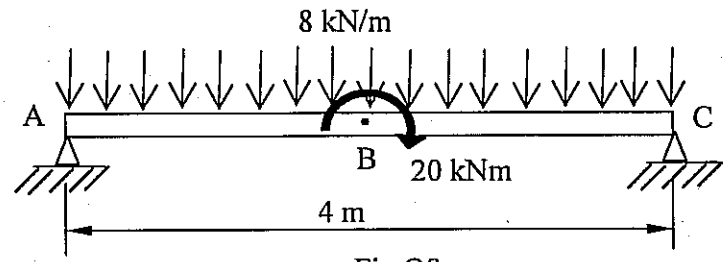


Fig.Q8

(a) A beam of length 4 m. simply supported at its ends A and C. carries a uniformly distributed load of 8 kN/m, as shown in Fig.Q8. Draw shear force and bending moment diagrams for the beam (without the applied moment shown at B).

(10 marks)

(b) An additional clockwise moment of 20 kNm is introduced at the center (B) of the beam. Using the principle of superposition draw the resulting shear force and bending moment diagrams for the beam and hence show that the maximum bending moment occurs at the beam center.

(05 marks)

(c) If an external moment of 20 kNm is applied at point A instead of point B, determine the position and magnitude of the maximum bending moment.

(05 marks)

ALL RIGHT RESERVED