Lib. (3) III Sem. 2009-10 (41)

3E1411

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3E1411

B.Tech. (Sem. III) (Main/Back) Examination, February - 2010
(Common for Mech., P. & I. & Automobile Engg.)
(3AE1 Mechanics of Solids)

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

*Attempt overall **five** questions in all. Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Select one question from each **unit**.*

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. Nil 2. Nil

UNIT - I

1 (a) What is the effect of thermal stresses of a body when its ends (i) Do not yield and (i) Yield by a small amount.

1.5+1.5

(b) Find 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. Take $E = 1 \times 10^5\ N/mm^2$.

3+2

(c) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameter and length of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take $E_s = 2 \times 10^5\ N/mm^2$ and $E_C = 1 \times 10^5\ N/mm^2$.

4+4

OR

1 (a) Define the following terms : Elasticity, Elastic limit, Poisson's ratio and Factor of safety.

1+1+1+1

(b) A steel wire ABC, 16 m long having cross-sectional area of 4 mm^2, weights 20 N as shown in **Fig. (i)**. Find the deflection at C and B. Take E = 200 GPA.

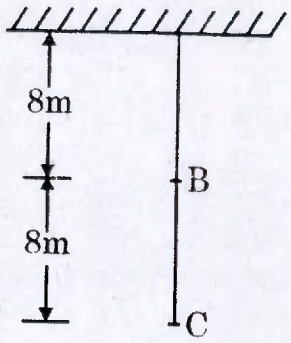

Fig. (i)

2+2

(c) A steel tube of 30 mm external diameter and 25 mm internal diameter encloses a gun metal rod of 20 mm diameter to which it is rigidly joined at each end. The temperature of the whole assembly is raised to 140°C and the nuts on the rod are then screwed lightly home on the ends of the tube. Find the intensity of stress in the rod when common temperature has fallen to 30°C.
Where

$$E_s = 2.1\times10^5\ N/mm^2,\quad E_g = 1\times10^5\ N/mm^2$$

$$\alpha_s = 12\times10^{-6}\ /\ ^\circ C,\qquad \alpha_g = 20\times10^{-6}\ /\ ^\circ C$$

8

UNIT - II

2 (a) What do you mean by simple bending ? What are the assumptions made in the theory of simple bending ?
Prove the relation $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$.

1+2+7

(b) A steel plate of width 120 mm and of thickness 20 mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will produce the maximum stress. Take $E = 2\times10^5\ N/mm^2$.

3+3

OR

2 (a) A cantilever of length 2 m carries a uniformly distributed load of 1.5 kN/m run over the whole length and a point load of 2 kN at a distance of 0.5 meter from the free end. Draw S.F. and B.M. diagram.

4+4

(b) A beam of 10 m length is simply supported at its ends. It carries a uniformly distributed load of 20 kN/m run over the length of left half of its span, together with concentrated load of 20, 40 and 20 kN situated at 1.5, 2.5 and 5 m respectively from right hand support. Draw S.F. and B.M. diagram. Also find out the mangnitude and position of the Max. B.M.

2+2+2+2

UNIT - III

3 (a) At a point in strained material the principal stresses are 100 kN/m^2 tensile and 40 kN/m^2 compressive. Find the resultant stress in magnitude and direction on a plane inclined at 60°C to the axis of the major principal stress. What is the maximum intensity of shear stress in the material at the point.

3+3+2

(b) A point in a strained material is subjected to stresses shown in **Fig. (ii)**. Using Mohr's circle methods, draw and find the normal and tangential stresses across the oblique plane.

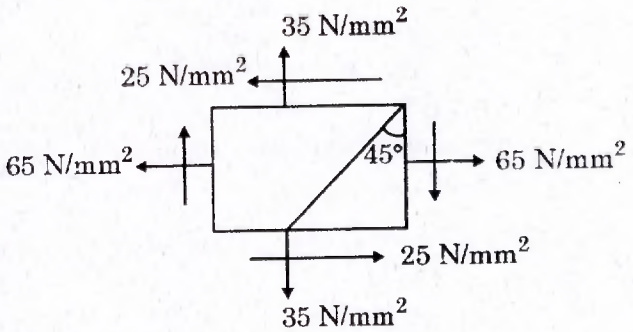

Fig. (ii)

2+3+3

OR

3 (a) A hollow mild steal shaft having 100 mm external diameter and 50 mm internal diameter is subjected to a twisting moment of 8 kNm and a bending moment of 2.5 kNm. Calculate the principal stresses and direct stress which, acting alone, would produce the same (i) Maximum elastic strain energy, (ii) Maximum elastic shear strain energy, as that produced by the principal stresses acting together. Take Poisson's ratio = 0.25.

5+5

(b) Define and explain the following theories of failure :

(i) Maximum Principal Stress Theory

(ii) Maximum Principal Strain Theory.

3+3

UNIT - IV

4 (a) When a circular shaft is subjected to torsion, show that the shear stress varies lineanity from the axis to the surface.

6

(b) A hollow shaft having an internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 r.p.m. Find the external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque = 1.25 mean torque and modulus of rigidity = $9\times10^4\ N/mm^2$.

5+5

OR

4 (a) Explain how the failure of a short and of a long column takes place.

2+2

(b) Find the Eular crushing load for a hollow cylindrical C.I. column 20 cm external dia. and 25 mm thick, if it is 6 m long and is hinged at both ends. Take $E=1.2\times10^6\ N/mm^2$. Compare the load with the crushing load as given by Rankine's formula, taking $\sigma_c=550\ N/mm^2$ and $a=\frac{1}{1600}$; for what length of the column would these two formulae give the same crushing load ?

4+4+4

UNIT - V

5 (a) What is Moment-area method ? Where is it used ? Find the slope and deflection of a simply supported beam carrying a u.d.l. over the entire length using moment-area method.

2+2+6

(b) A beam 4 m long, simply supported at its ends carries a Point load W at its centre. If the slope at the ends of the beam is not to exceed 1°. Find the deflection at the centre of the beam.

6

OR

5 (a) Explain in detail "Castigliano's theorem".

10

(b) A load of 100 N falls through a height of 2 cm on to a collar rigidly attached to the lower end of a vertical bar 1.5 m long and of 1.5 cm^2 cross-sectional area. The upper ends of the vertical bar is fixed. Find : (i) Max. instantaneous stress induced in the vertical bar (ii) Max. instantaneous elongation in the vertical bar and (iii) Strain energy stored in the vertical bar. Take $E=2\times10^5\ N/mm^2$.

2+2+2