C 31822 (Pages : 4) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
JUNE 2007

ME 04 405—ADVANCED MECHANICS OF SOLIDS

(2004 admissions)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions in part 1.*
Answer any **one** *full question in each of the parts 2, 3, 4 and 5.*
Assume suitable data if necessary.

1. (a) Write the three differential equations of equilibrium including inertial forces.

(b) Explain body force and surface force giving examples for each.

(c) Explain axisymmetric problem and give examples.

(d) Sketch the various stress components of a radial element in polar co-ordinates and write equilibrium equations in polar co-ordinates.

(e) Define strain energy and list its various types.

(f) Locate the shear centre for the sections shown below Fig. 1 :

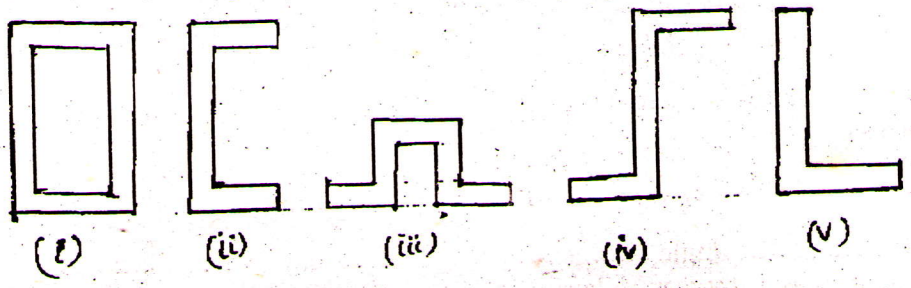

Fig.1

(g) Explain the phenomenon of warping in torsional members.

(h) Comment on the torsional efficiency of the cross-sections and pick-up the most efficient section from Fig. 2 given below :

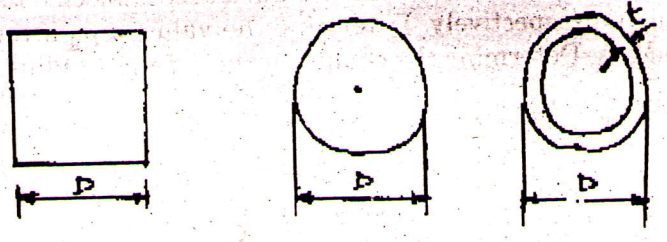

Fig. 2

(8 × 5 = 40 marks)

Turn over

2. (a) The parallelopiped shown in Fig. 3 is deformed into the shape indicated by the dashed straight lines (Small displacements). The displacements are given by the following relations $u = C_1 xyz$ $v = C_2 xyz$ and $w = C_2 xyz$.

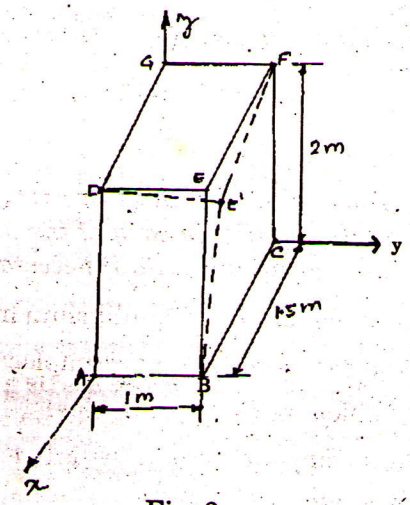

Fig. 3

(i) Determine the state of strain at point E, when the co-ordinates of point E' for the deformed body are (1.504, 1.0002, 1.996).

(ii) Determine the normal strain E in the direction of line EA.

Or

(b) (i) Determine the principal stresses and the maximum shearing stress for the give state of stress.

$$\sigma_{xx} = 150 \text{ MPa}, \ \sigma_{yy} = 70 \text{ MPa}, \ \sigma_{zz} = -80 \text{ MPa and } \sigma_{xy} = -45 \text{ MPa}.$$

(ii) Determine the angle between the x-axis and x-axis where the x-axis is in the direction of the principal stress with largest absolute magnitude.

3. (a) A thick walled tube with an internal radius of 12 cm. is subjected to an internal pressure of 200 MPa ($E = 2.1 \times 10^5$ MPa) and $\upsilon = 0.3$. Determine the optimum value of the external radius if the maximum shear stress developed is limited to 3.5 MPa. Also determine the change in the internal radius due to the pressure.

Or

(b) The internal and external radii of a thick walled tube subjected to an external pressure p_2 are 10 cm. and 15 cm. respectively. Determine the value of p_2 if the maximum shear stress is limited to 2.5 MPa. Determine the change in the external radius.

4. (a) Locate the shear center for the hat section beam shown in Fig.4. Assume a uniform thickness of 12 mm. throughout.

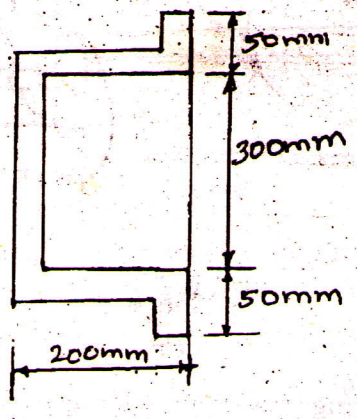

Fig. 4

Or

(b) Determine the horizontal and vertical displacements of the free end (c) of the rigid cantilever frame shown in Fig. 5. Assume EI to be constant throughout the frame. Neglect axial deformations.

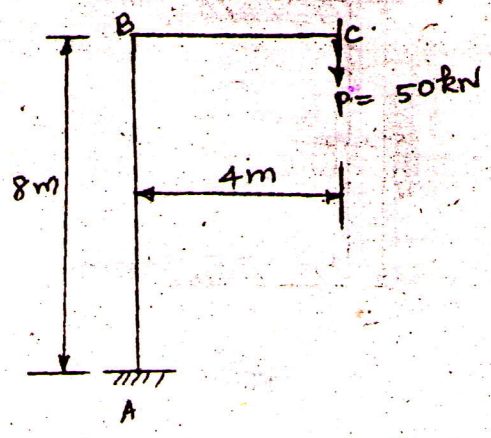

Fig. 5

5. (a) Determine the maximum shearing stress in the torsion member shown in Fig. 6 (on page 4). T_1 = 850 Nm, T_2 = 500 Nm, G = 77.5 × 10^3 MPa. The support prevents rotation of the cross-section but does not prevent warping of the cross-section. Use appropriate values of k_1 and k_2 given.

$\frac{b}{h}$:	1.0	1.5	2.0
k_1 :	0.141	0.196	0.229
k_2 :	0.208	0.231	0.246

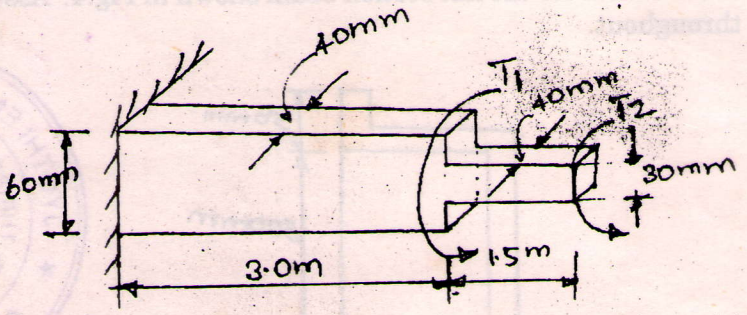

Fig. 6

Or

(b) Find the maximum shearing stress and unit angle of twist of the bar having the cross-section shown in Fig. 7 when subjected to a torque at its ends of 600 Nm. The bar is made of the steel for which G = 77.5 GPa.

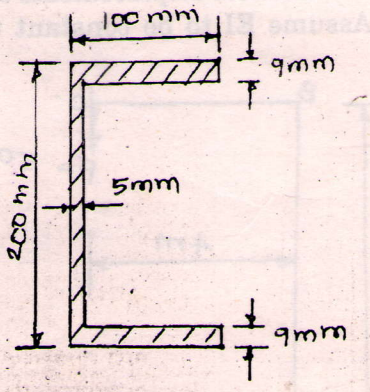

Fig. 7

(4 × 15 = 60 marks)