

B.Tech 5th Semester Exam., 2017

MECHANICS OF SOLID—II

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

↓ Select the correct answer for any seven of the following : 2×7=14

(a) The neutral axis of the cross-section of a beam is that axis at which the bending stress is

- (i) zero
- (ii) minimum
- ~~(iii)~~ maximum
- (iv) infinity

(b) The stress induced in a body, when suddenly loaded, is ____ the stress induced when the same load is applied gradually.

(i) equal to

~~(ii)~~ one-half

(iii) twice

(iv) four times

(c) A masonry dam may fail due to

(i) tension in the masonry of the dam and its base

(ii) overturning of the dam

(iii) crushing of masonry at the base of the dam

(iv) All of the above

(d) Strain rosettes are used to

(i) measure shear strain

(ii) measure linear strain

(iii) measure volumetric strain

(iv) relieve strain

(e) The maximum stress in a ring under tension occurs at _____ with the line of action of the load.

(i) 0° (ii) 30°

(iii) 45° (iv) 90°

(f) Compression members always tend to buckle in the direction of the

(i) axis of load

(ii) perpendicular to the axis of load

(iii) minimum cross-section

(iv) least radius of gyration

(g) For a rectangular section, the value of shape factor is

(i) 2 ~~(ii)~~ 1.5

(iii) 1 (iv) 0.5

(h) When two shafts of same length, one of which is hollow, transmit equal torques and have equal maximum stress, then they should have equal

(i) polar moment of inertia

(ii) polar modulus

(iii) diameter

(iv) angle of twist

(i) According to Euler's column theory, the crippling load for a column of length (l) fixed at both ends is _____ the crippling load for a similar column hinged at both ends.

(i) equal to

(ii) two times

(iii) four times

(iv) eight times

(j) Shear centre of a semi-circular arc is at

(i) $4r / \pi$

(ii) $3r / \pi$

(iii) $2r / \pi$

(iv) r / π

~~2~~ (a) What are plane stress and principal stress? 4

(b) The Cartesian components of stress at a point are $\sigma_x = 200$, $\sigma_y = -100$, $\sigma_z = -100$, $\tau_{xy} = \tau_{yz} = \tau_{xz} = 200$ MPa. Determine the normal and shear stresses on a plane whose direction cosines are $1/\sqrt{3}$, $1/\sqrt{3}$, $1/\sqrt{3}$. 10

(5)

- 3/ Determine the principal stresses of given state of stress and the directions of the principal stresses :

14

$$[\tau_{ij}] = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

4. (a) Differentiate between symmetrical and unsymmetrical bending.

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- (b) A cantilever beam of span 4 m has a rectangular cross-section 40 mm wide by 60 mm deep. The beam is subjected to a concentrated load of 1 kN which is inclined at an angle of 30° to the vertical plane and located at the free end of the cantilever. Calculate the bending stress developed at points A, B and C near the fixed end.

10

- 5/ (a) What do you understand by shear centre? Explain the shear centre for symmetrical and unsymmetrical section.

6

(6)

- (b) Determine the position of the shear centre for an 80 mm by 40 mm outside by 5 mm thick channel section, as shown in Fig. 1 :

8

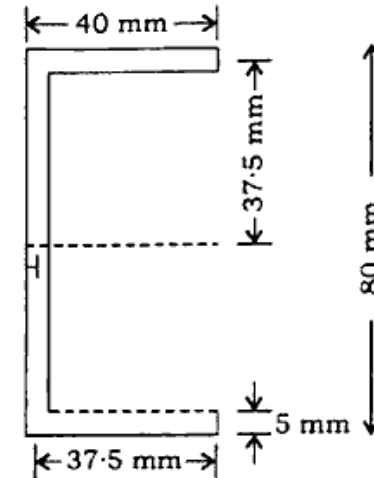


Fig. 1

6. (a) How is position of neutral axis located in curve beam?

5

- (b) A curve bar of rectangular cross-section has a width 40 mm and depth 60 mm and radius of curvature 80 mm about the centroidal axis parallel to width. Find the position of neutral axis and bending stresses at inner and outer faces caused by a moment of 500 Nm tending to increase the curvature.

9

- 7/ (a) What do you mean by plastic deformation of a material? Discuss the behaviour of the material when loaded beyond the elastic limit.

6

(7)

- (b) Find the shape factor for a T cross-section as shown in Fig. 2 : 8

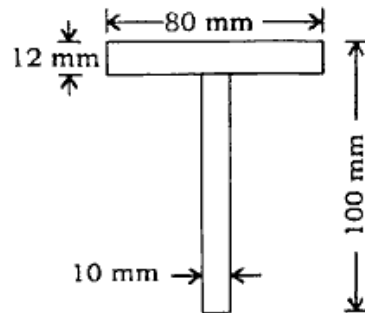


Fig. 2

8. (a) State and prove Castigliano's first theorem. 6

- (b) A cantilever is supported at the free end by an elastic spring of spring constant k . Determine the reaction at A by energy method, when it is loaded uniformly distributed as shown in Fig. 3 : 8

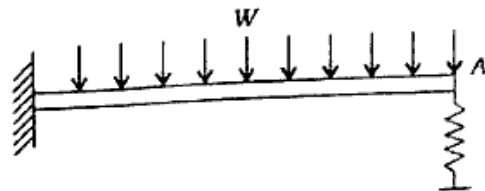


Fig. 3

(8)

9. (a) Define slenderness ratio. What are the limitations of Euler's formula? 5

- (b) A 1.5 m long column has a circular cross-section of 50 mm diameter. One of the ends of the column is fixed and the other end is free. Considering factor of safety as 3, calculate safe load using—

(i) Rankine's formula, when $\sigma_c = 560 \text{ N/mm}^2$ and $a = 1/1600$ for pinned ends;

(ii) Euler's formula, E for CI $= 1.2 \times 10^5 \text{ N/mm}^2$. 9
