Total No. of printed pages = 11

CT-303/SoM/3rd Sem/2018/M

STRENGTH OF MATERIALS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Note: (I) Answer *all* the questions :

(ii) Section-I (Q.1-Q.25) contains MCQ's and carries 01 mark each.

(iii) Section-II (Q.26-Q.30) contains subjective questions and carries 09 mark each.

SECTION – I

1×25=25

1. A rectangular bar of width b and height h is being used as a cantilever. The loading is in a plane parallel to the side b. The section modulus is

(a) $\frac{bh^3}{12}$ (b) $\frac{bh^2}{6}$

(c) $\frac{b^2h}{6}$ (d) None of these.

[Turn over

2. In a loaded beam, the point of contra flexture occurs at a section where

(a) Bending moment is minimum

(b) Bending moment is zero or changes sign

(c) Bending moment is maximum

(d) Shearing force is maximum

(e) Shearing force is minimum.

3. A three-hinged arch is said to be :

(a) Statically determinate structure

(b) Statically indeterminate structure

(c) A bent beam

(d) None of these.

4. The shape of the bending moment diagram over the length of a beam, having no external load, is always

(a) Linear (b) Parabolic

(c) Cubical (d) Circular

5. A beam of length L is pinned at both ends and is subjected to a concentrated bending couple of moment M at its centre. The maximum bending moment in the beam is

(a) M (b) M/2

(c) M/3 (d) ML/2

6. The maximum bending moment due to a moving load on a simply supported beam, occurs

(a) At the mid span

(b) At the supports

(c) Under the load

(d) Anywhere on the beam

(e) None of these.

7. In a shaft rotated by a couple, the shear force varies

(a) From zero at the centre to a maximum at the circumference

(b) From minimum at the centre to a maximum at the circumference

(c) From maximum at the centre to zero at the circumference

(d) Equally throughout the section

(e) None of these.

8. The bending moment is maximum on a section where shearing force

(a) is maximum (b) is minimum

(c) is equal (d) changes sign

9. The stress necessary to initiate yielding, is considerably

(a) More than that necessary to continue it

(b) Less than that necessary to continue it

(c) More than that necessary to stop it

(d) Less than that necessary to stop it.

10. If a circular beam of diameter d experiences a longitudinal strain $\frac{p}{E}$ and a lateral strain $\frac{2p}{mE}$ the volumetric strain is

(a) $\left(\frac{p}{E}+\frac{2p}{mE}\right)$ (b) $\left(\frac{p}{E}-\frac{2p}{mF}\right)$

(c) $\left(\frac{P}{E}+\frac{mE}{2P}\right)$ (d) $\left(\frac{P}{E}-\frac{mE}{2P}\right)$

(e) none of these.

11. In a three hinged arch, the shear force is usually

(a) Maximum at crown

(b) Maximum at springings

(c) Maximum at quarter points

(d) Varies with slope.

12. An arch may be subjected to

(a) Shear and axial force

(b) Bending moment and shear force

(c) Bending moment and axial force

(d) Shear force and thrust

(e) Thrust, shear force and bending moment.

13. The law which states, "within elastic limits strain produced is proportional to the stress producing it", is known as

(a) Bernoulli's law

(b) Stress law

(c) Hooke's law

(d) Poisson's law

(e) None of these.

14. When a rectangular beam is loaded longitudinally, shear develops on

(a) Bottom fibre

(b) Top fibre

(c) Middle fibre

(d) Every horizontal plane.

15. For a given material, if E, C, K and m are Young's modulus, shearing modulus, bulk modulus and Poisson ratio, the following relation does not hold good

(a) $E = \frac{9kC}{3K + C}$

(b) $E = 2K\left(1 - \frac{2}{m}\right)$

(c) $E = 2C\left(1 + \frac{1}{m}\right)$

(d) $\frac{1}{m} = \frac{3K - 2C}{6K + 2C}$

(e) $E = 3C\left(1 - \frac{1}{m}\right)$

16. The under mentioned type is simple strain

(a) Tensile strain

(b) Compressive strain

(c) Shear strain

(d) Volumetric strain

(e) All the above.

17. The ratio of the effective length of a column and minimum radius of gyration of its cross-sectional area, is known as

(a) Buckling factor

(b) Slenderness ratio

(c) Crippling factor

(d) None of these.

18. The value of Poisson's ratio always remains

(a) Greater than one

(b) Less than one

(c) Equal to one

(d) None of these.

19. If the beam is supported so that there are only three unknown reactive elements at the supports. These can be determined by using the following fundamental equation of statics

(a) $\Sigma H = 0$

(b) $\Sigma V = 0$

(c) $\Sigma H = 0 ; \Sigma V = 0$

(d) $\Sigma H = 0 ; \Sigma V = 0 ; \Sigma M = 0$

(e) $\Sigma M = 0 ; \Sigma H = 0$

20. A simply supported beam of span L carries a uniformly distributed load W. The maximum bending moment M is

(a) $\frac{WL}{2}$ (b) $\frac{WL}{4}$

(c) $\frac{WL}{8}$ (d) $\frac{WL}{12}$

(e) $\frac{WL}{16}$

21. A three hinged arch is loaded with an isolated load 1000 kg at a horizontal distance of 2.5m from the crown, 1m above the level of hinges at the supports 10 metres apart. The horizontal thrust is

(a) 1250 kg (b) 125 kg

(c) 750 kg (d) 2500 kg

(e) 2325 kg.

22. The phenomenon of slow extension of materials having constant load, i.e., increasing with the time is called

(a) Creeping (b) Yielding

(c) Breaking (d) None of these.

23. The equivalent length of a column fixed at one end and free at the other end, is

(a) $0.5l$ (b) $0.7l$

(c) l (d) $2l$

(e) $1.5l$.

24. The stress at which extension of a material takes place more quickly as compared to the increase in load, is called

(a) Elastic point (b) Plastic point

(c) Breaking point (d) Yielding point.

25. As compared to uniaxial tension or compression, the strain energy stored in bending is only

(a) $\frac{1}{8}$ (b) $\frac{1}{4}$

(c) $\frac{1}{3}$ (d) $\frac{1}{2}$

SECTION – II

26. (a) A steel bar 2m long, 40 mm wide and 20 mm thick is subjected to an axial pull of 160 KN in the direction of its length. Find the changes in its length, width and thickness of the bar. Take E= 200. GPa and Poisson's ratio = 0.8 6

(b) Explain in brief that for every direct stress, it is always accompanied by a strain in its own direction and an opposite kind of strain in every direction at right angle to it. 3

27. A steel bar shown in fig. 1 is subjected to a tensile force of 120 KN. Calculate the elongation of the bar. Take E = 200 GPa. 9

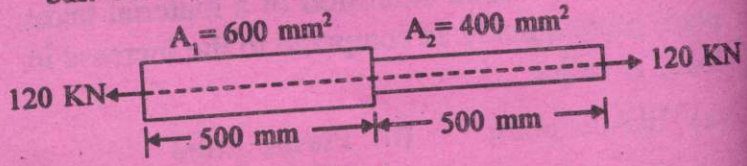

Fig. 1

28. A simply supported beam of 2.5m span is carrying loads as shown in fig. 2. Draw the shear force and bending moment diagrams for the beam. Show all the calculations. 9

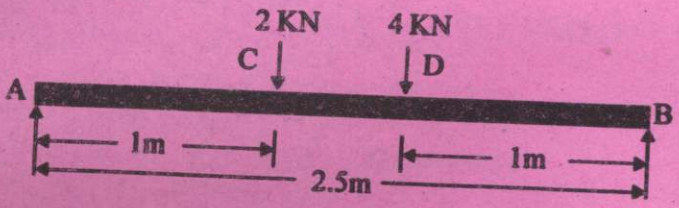

Fig. 2

29. (a) In case of simple bending derive that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$, where symbols have their usual meaning. 7

(b) List out the assumptions made in the theory of simple bending. 2

30. The stresses at a point in a component are 100 MPa (Tensile) and 50 MPa (Compressive). Determine the magnitude of the normal and shear stresses on a plane inclined at an angle of 20° with the tensile stress. Also determine the direction of the resultant stress and the magnitude of the maximum intensity of shear stress. 9