

- (vi) The size of a fillet weld is given by
 - (a) $0.5 \times$ throat of weld
 - (b) throat of weld
 - (c) $2 \times$ throat of weld
 - (d) $\sqrt{2} \times$ throat of weld.
- (vii) According to Unwin's formula, the relationship between the diameter of rivet (d) and thickness of cylinder wall (t) is
 - (a) $d = 5\sqrt{t}$
 - (b) $d = 6\sqrt{t}$
 - (c) $d = 1.6\sqrt{t}$
 - (d) $d = \sqrt{t}$.
- (viii) Preferred number series R-10 has a common ratio of,
 - (a) 1.58
 - (b) 1.26
 - (c) 1.12
 - (d) 1.06.
- (ix) Angle of twist (θ) of a shaft with Rigidity modulus, G having length, L subjected to torque, T is estimated by,
 - (a) $\theta = T.J/(G.L)$
 - (b) $\theta = T.L/(G.J)$
 - (c) $\theta = G.J/(T.L)$
 - (d) $\theta = T.G/(J.L)$.
- (x) Stiffness of a helical spring of wire diameter "d", coil diameter "D", number no of turns "n", rigidity modulus "G" is given by,
 - (a) $8D^3N/(Gd^4)$
 - (b) $Gd^4/(8D^3N)$
 - (c) $Gd^3/(8D^4N)$
 - (d) $8d^3N/(GD^4)$.

Group - B

- 2. (a) Discuss the difference between Mode of Failure and Theory of Failure.
- (b) The crane hook carries a load of 20 kN as shown in Fig. 1. The section at X-X is rectangular whose horizontal side is 100 mm. Find the stresses in the inner and outer fibers at the given section.

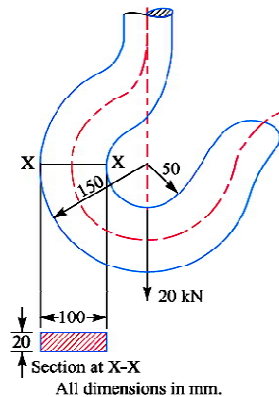


Fig.1

4 + 8 = 12

- 7. (a) A rectangular cross-section bar is welded to a support by means of fillet welds as shown in Figure 5 below. In the figure all dimensions are in mm. Determine the size of the welds, if the permissible stress in the weld is limited to 75 MPa.

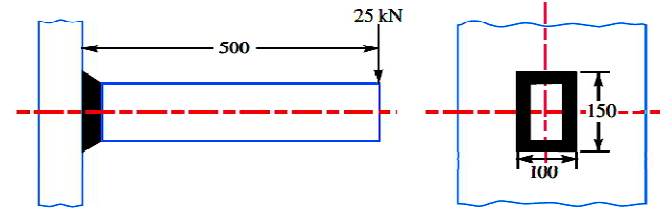


Fig.5

- (b) Discuss in detail about different types of riveted joints.

7 + 5

Group - E

- 8. A helical spring is used in the spring balance to measure the weight. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight that can be attached to the spring balance is 1500N and the length of scale should be 100mm. The spring index can be taken as 10. The spring is made of oil-hardened and tempered steel wire with an ultimate tensile strength of 1360 N/mm² and modulus of rigidity of 81,370 N/mm². The permissible shear stress in the spring should be taken as 30% of the ultimate tensile strength. Design the spring and determine (i) wire diameter, (ii) mean coil diameter, (iii) number of active coils, (iv) required spring rate.

3 + 3 + 3 + 3

- 9. 15 KW power is transmitted from a smaller pulley running at 1440 rpm to a larger pulley running at 480 rpm with the help of a flat belt. The belt should operate at a velocity of 20 m/s approximately. The centre distance between the two pulleys is 1700 mm. The strength of the belt should not exceed 2.25 N/mm². The density of leather is 950 Kg/m³ and the coefficient of friction between the pulley and belt materials is 0.35. Assume the ratio of smaller pulley diameter to larger pulley diameter to be 3. Determine: (i) Diameter of the pulleys, (ii) Belt thickness and belt width, (iii) Length of the belt.

2 + 7 + 3

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group. Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) A cotter joint is used to transmit
(a) axial tensile force only
(b) axial tensile or compressive force
(c) axial compressive force only
(d) combined bending and torsional moment.
- (ii) According to distortion energy theory of failure, the relationship between yield strength in shear (S_{sy}) and tensile yield strength (S_{yt}) is
(a) $S_{sy} = 0.5 S_{yt}$ (b) $S_{sy} = 0.577 S_{yt}$
(c) $S_{sy} = 0.75 S_{yt}$ (d) $S_{sy} = 0.4 S_{yt}$
- (iii) A stress that varies in sinusoidal manner with respect to time from zero to maximum value and which has same values for mean as well as amplitude is called
(a) reversed stress (b) fluctuating stress
(c) repeated stress (d) varying stress.
- (iv) The relationship between endurance limit of component subjected to fluctuating torsional shear stresses (S_{se}) and endurance limit in reversed bending (S_e) is
(a) $S_{se} = 0.5 S_e$ (b) $S_{se} = 0.75 S_e$
(c) $S_{se} = 0.577 S_e$ (d) $S_{se} = \pi S_e$
- (v) The maximum efficiency of square threaded power screw with friction angle of 30° is
(a) 25% (b) 33% (c) 47% (d) 41%.

3. (a) Mention the names of all the theories of failure.
 (b) It is required to design a Knuckle Joint to connect two circular rods subjected to an axial force of $P = 50$ kN. The rods are co-axial and a small amount of angular movement between their axes is permissible. Design the joint and specify the dimensions of different components as given in the following figure. Consider material to be Carbon Steel 30C8 ($S_{yt} = 400$ MPa).

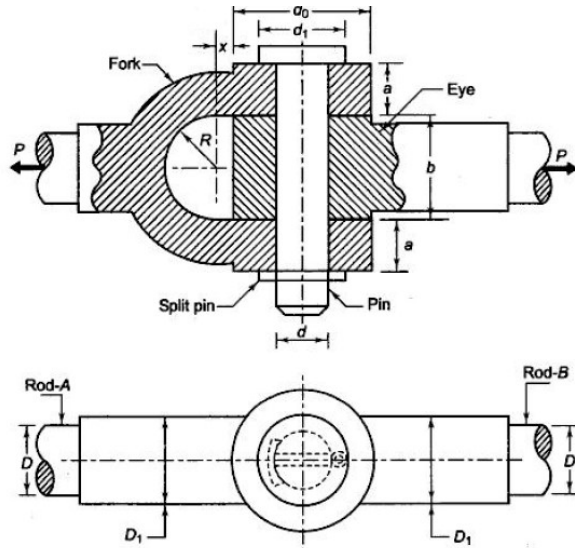


Fig.2

2 + 10 = 12

Group - C

4. (a) Represent schematically Fluctuating load, Repeated load and Reversed load.
 (b) A transmission shaft carries a pulley midway between two bearings. The bending moment at the pulley varies from 200 N-m to 600 N-m as the torsional moment in the shaft varies from 70 N-m to 200 N-m. The frequency of variation of bending moment as well as torsional moment is equal to the rotational speed of the shaft. The shaft is made of steel FeE 400 ($S_{ut} = 540$ MPa and $S_{yt} = 400$ MPa). The corrected endurance limit of the shaft is 200 MPa. Determine the diameter of the shaft considering factor of safety 2.0.

2 + 10 = 12

5. (a) A non-rotating shaft supporting a load of 2.5 kN has been shown below (Fig. 3). The shaft is made of brittle material with an ultimate tensile strength of 300 MPa. The factor of safety is 3. Determine the dimensions of the shaft.

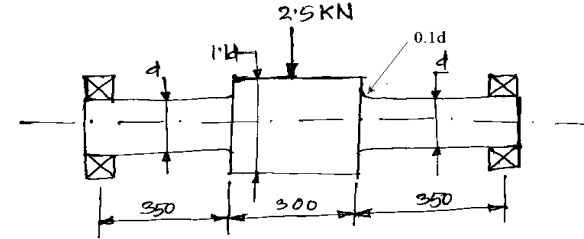


Fig.3

- (b) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 630 MPa. It is subjected to a torque that fluctuates between 2000 N-m to - 800 N-m. Using Soderberg method, calculate the factor of safety. Assume suitable values for other data needed. Assume the yield stress (σ_y) for carbon steel reversed bending as 510 N/mm², surface finish factor (K_a) as size factor (K_b) as 0.85 and Reliability factor (K_c) as 1.

5 + 7

Group - D

6. (a) Mention different types of welded joints.
 (b) The bracket as shown in Figure 4 below, is to carry a load of 45 kN. Determine the size of the rivet if the shear stress is not to exceed 80 MPa. Assume all rivets of the same size.

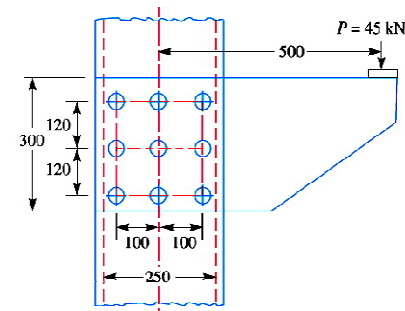


Fig.4

2 + 10