

have square cross-section. Design the coupling and specify the dimensions of its parts.

15

10. (a) A 200×200 mm steel strap is spliced as shown in Fig.2. The rivets are 30 mm in diameter. The allowable working stress are 70 MPa in shear, 180 MPa in bearing and 90 MPa in tearing. What is the safe load on the spliced strap and efficiency of the joint?

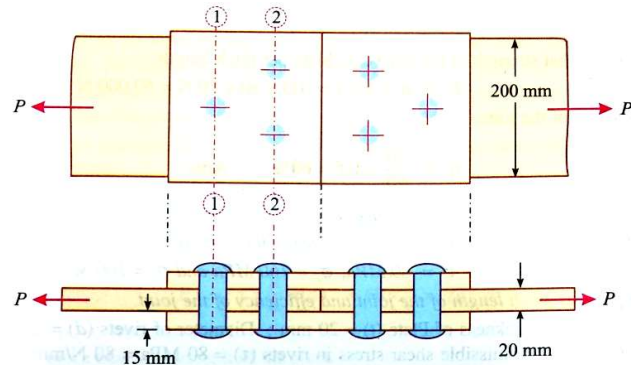


Fig.2

- (b) A flat bar 32 mm wide and 12 mm thick is loaded by a steady tensile load of 85 kN. The material is mild steel with yield point stress of 315 N/mm^2 . Find factor of safety based on yield point.

10 + 5

11. (a) Two steel rods are to be joined by means of a cotter joint. Design a suitable joint, if the rods have to resist a load of 120 kN. Take $\tau = 70 \text{ MPa}$, $\sigma_t = 100 \text{ MPa}$ and $\sigma_b = 150 \text{ MPa}$.
- (b) Write modifying factors for Endurance limit.
- (c) Describe classification of Pressure Vessels.

9 + 3 + 3

MACHINE DESIGN [CHE 504B(ME)]

Time Allotted : 3 hrs

Full Marks : 70

The questions are of equal value.

The figures in the margin indicate full marks

Candidates are required to give answer in their own words as far as practicable.

All symbols are of usual significance.

Group - A (Multiple Choice Type Questions)

1. Choose the correct alternative for **any ten** of the following: **10 × 1 = 10**
- If a force acts on a body, it sets up some resistance to the deformation. This resistance is known as
 - (a) stress
 - (b) strain
 - (c) elasticity
 - (d) modulus of elasticity.
 - The maximum stress produced in a bar of tapering section for an axial load is at
 - (a) large end
 - (b) smaller end
 - (c) middle
 - (d) anywhere.
 - When the temperature of a body is increased, the stress induced will be
 - (a) tension
 - (b) compression
 - (c) both (a) and (b)
 - (d) neither (a) nor (b).
 - The ratio of lateral strain to the linear strain is called
 - (a) modulus of elasticity
 - (b) modulus of rigidity
 - (c) bulk modulus
 - (d) Poisson's ratio.
 - The bending moment at the free end of a cantilever beam carrying any type of load is
 - (a) zero
 - (b) minimum
 - (c) maximum
 - (d) equal to the load.
 - The neutral axis of a section is an axis, at which bending stress is
 - (a) minimum
 - (b) zero
 - (c) maximum
 - (d) infinity.
 - Soderberg criterion is particularly applicable to
 - (a) ductile materials
 - (b) brittle materials
 - (c) none of (a) & (b)
 - (d) both (a) and (b).

- (viii) A riveted joint may fail due to
 (a) shearing of rivets (b) crushing of rivets
 (c) tearing of rivets (d) all of (a), (b) & (c).
- (ix) On a triple thread screw, lead equals _____ of pitch
 (a) one-third (b) two-third
 (c) three times (d) 1.5 times.
- (x) When a solid shaft is subjected to torsion, the shear stress induced in the shaft at its centre is
 (a) zero (b) minimum
 (c) maximum (d) average.
- (xi) The ratio of tension on the tight side to that on the slack side in a flat belt drive is
 (a) proportional to the product of co-efficient of friction and lap angle
 (b) an exponential function of the product of co-efficient of friction and lap angle
 (c) proportional to the lap angle
 (d) proportional to the co-efficient of friction.
- (xii) Design of a thin cylindrical shell, the relation $f_1 = \frac{pd}{2t}$ is considered.

Here f_1 means

- (a) circumferential stress or hoop stress (b) tensile stress
 (c) compressive stress (d) shear stress.

Group - B (Short Answer Type Questions)

Answer any three of the following:

3 × 5 = 15

2. A hollow shaft of external diameter 100 mm transmits 400 kW power at 300 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft does not exceed 60 N/mm².

5

3. (i) What is stress concentration?
 (ii) Explain different types of cyclic loads and stresses.

(1 + 4)

4. (i) What do you understand by the term 'riveted joint'?
 (ii) Describe the common types riveted joints. Illustrate your answer with neat sketch.

(1 + 4)

5. A steel column is of length 7 m and diameter 500 mm with both ends hinged. Determine the crippling load by Euler's formula. Take $E = 2.1 \times 10^5$ N/mm².
6. A flat circular plate of 400 mm diameter is supported around the edge and is subjected to a uniform pressure of 1.15 N/mm². The stress is to be limited to 70 N/mm². Determine the thickness of the steel plate required, if $\nu = 0.3$, where ν is poisson's ratio.

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Group - C (Long Answer Type Questions)

Answer any three of the following:

3 × 15 = 45

7. (a) Draw the SF and BM diagrams for the simply supported beam as shown in Fig.1.

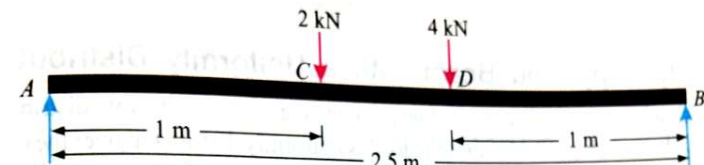


Fig 1

- (b) A rectangular bar of cross-sectional area 9,000 mm² is subjected to an axial load of 20 kN. Determine the normal and shear stress on a section, which is inclined at an angle of 30° with normal cross section of the bar.

10 + 5

8. (a) Explain Soderberg and Goodman Criterion for fatigue loading.
 (b) A cast iron pipe is to deliver water at the rate of 120 m³/min and the velocity is 0.5 m/s. The maximum pressure in the pipe is 0.875 N/mm². The permissible stress in the C.I. is 21 N/mm². Determine the pipe diameter and the wall thickness.

7 + 8

9. A rigid flange coupling is used to transmit 20 kW power at 720 rpm between two shafts. The shafts, keys and bolts are made of plain carbon steel 30C8 ($S_{yt} = 400$ N/mm²) and the factor of safety is 2. The yield strength in compression can be taken as 150% of the tensile yield strength. The flanges are made of grey cast iron of grade FG200 ($S_{ut} = 200$ N/mm²) and the factor of safety is 5. The keys