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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 19ME4DCDM1 **Max Marks: 100**
Course: Design of Machine Elements - 1 **Date: 22.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of design data hand book is permitted.

UNIT - I

1 a) What is a standard? What are the advantages of standardization? List a few standard organizations. **06**

b) Define factor of safety. Explain the factors influencing the selection of factor of safety. **04**

c) A shaft of diameter 1.5d is stepped down to diameter 'd' with a fillet radius of 1/8 of smaller diameter, carries a transverse load of 90kN as shown in fig -1. Determine the diameter of the shaft taking stress concentration factor into account. Assume factor of safety as 3 and yield stress as 480 MPa **10**

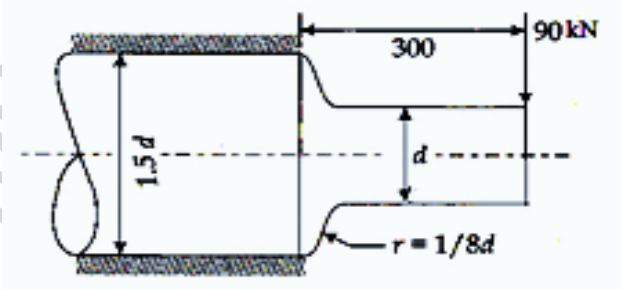

Fig –1 (Q.No.1c)

OR

2 a) A rod of circular section is to sustain a torsional moment of 300 kN-m and bending moment of 200 kN-m. Selecting C45 steel (σ_y = 353 MPa) and assuming factor of safety = 3, determine the diameter of rod as per the following theories of failure. (i) Maximum shear stress theory ii) Distortion energy theory. **06**

b) A mass of 500 kg is being lowered by means of steel wire rope having cross-sectional area of 250 mm^2. The velocity of the mass is 0.5m/sec. When the length of the extended rope is 20mts, the sheave gets stuck up. Determine the impact stress induced in the rope due to sudden stoppage of the sheave. Neglect friction. Modulus of elasticity of steel wire rope is 210 GPa. **04**

c) A point in a structural member subjected to plane stress is shown in fig 1. Determine the following: **10**

i) Normal and Tangential stress intensities on a plane inclined at 45°

ii) Principal stresses, Resultant Stress and their directions.

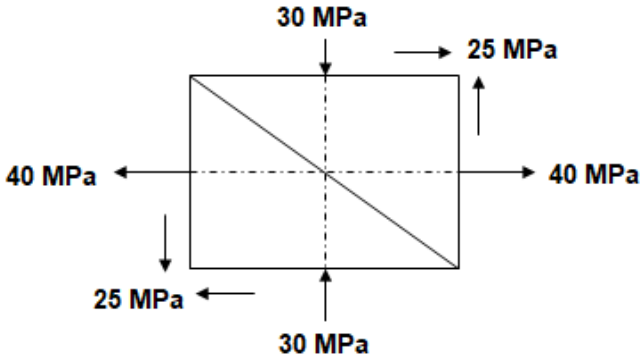

Fig – 2 (Q.No.2c)

UNIT - II

3 a) A cantilever shaft is subjected to a load of F Newton (up) and 3F Newton (down). The shaft is stepped down from 20mm diameter to 13 mm diameter and is provided with a fillet of radius 3mm. The length of the shaft is 150mm. The fillet section is at a distance of 25mm from the fixed end. Determine the maximum load that the member can withstand for infinite life. Using Soderberg and Goodman's equations assume a factor of safety of 2 and Notch sensitivity of 0.9. The material is cold drawn "C26" for which σ_u = 550 MPa. σ_y = 470 MPa. Take size and surface finish factors as 0.85 & 0.89 respectively. **12**

b) Distinguish between 'Low cycle fatigue' & 'High Cycle fatigue'. **08**

UNIT - III

4 A commercial shaft is supported by two bearings 1.5m apart. A keyed gear 20° involute and 175mm in diameter is located 400mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The ratio of belt tensions is 3. The drive transmits 45kW of power at 330 rpm. Assume both shock and fatigue factors to be 1.5. Use allowable shear stress 40MPa and Modulus of Rigidity as 84GPa. Calculate the necessary diameter of the shaft and angular deflection in degrees. **20**

OR

5 a) Design a cast iron flange coupling for a mild steel shaft transmitting 90 kW of power at a rated speed of 250 rpm. The allowable shear stress is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. Take modulus of rigidity = 84 GPa. **12**

b) What is a cotter joint? List its advantages. **04**

c) A square key 12mm x 12mm is used to transmit a power of 100kW at 560 rpm. The key is made of SAE 1045 annealed steel. Using the ASME code procedure, determine the length of the key required based on normal stress. Assume FOS = 2.0. **04**

UNIT - IV

6 a) Design a double riveted double cover butt joint with unequal covers and zig-zag riveting to connect two plates of 25mm thick. Assume σ_t = 115 MPa, τ = 70 MPa, σ_c = 140 MPa. **12**

b) A circular shaft, 50 mm in diameter, is welded to the support by means of circumferential fillet weld as shown in Fig – 3. It is subjected to torsional moment of 2500 N-m. Determine the size of the weld, if the permissible shear stress in the weld is limited to 140 N/mm2. **04**

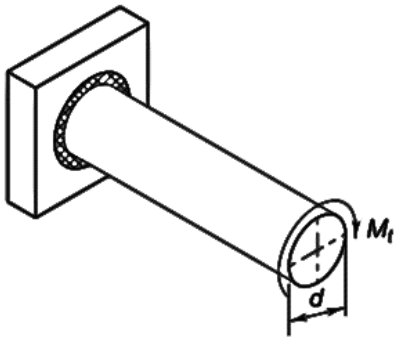

Fig – 3 (Q.No.6b)

c) List any two advantages & disadvantages of welded joints over riveted joints. **04**

UNIT - V

7 a) The cylinder head of a steam engine is held by 14 bolts. The effective diameter of the cylinder is 350mm and the steam pressure is 0.85MPa. Assuming that the bolts are not initially stressed, find the size of bolt, if permissible tensile stress is 20MPa. Take K = 0.5. **08**

b) A weight of 500kN is raised at a speed of 6m/min by two screw rods with square threads of 50 x 8 on them. The two screw rods are driven through bevel gears driven by a motor. Determine **12**

i. The torque required to raise the load
ii. Speed of rotation of the screw rod assuming the threads are double start
iii. Efficiency of the screw rod

Assume the coefficient of friction between all contacting surfaces as 0.101 and collar diameter as 1.5d

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