

MACHINE DESIGN AND DRAWING

Time: Three hours

Full Marks: 100

Missing data, if any, are to be reasonably chosen. Give sketches wherever applicable.

Answer any Five (05) questions

- Design and draw a knuckle joint subjected to a tensile load of 100 kN. All components are made up of plain carbon steel. The allowable stresses are 150 MPa in tension, 87 MPa in shear and 240 MPa in crushing. 20
- Discuss the classification and designation of cast iron material.
 - What is/are the importance(s) of failure theories in design?
 - A shaft is subjected to a bending moment of 80 N-m and at the same time, subjected to a torsional moment of 120 N-m. The material is plain carbon steel ($\sigma_{yt} = 320$ MPa, $\sigma_{ut} = 540$ MPa). Calculate the shaft diameter using a suitable failure theory (with justification) and appropriate factor of safety (with justification). (02+04)+02+12
- Two shafts are perfectly aligned and it is required to transmit a power of 55 kW at 550 rpm from driving shaft to the driven shaft. Suggest a suitable machine elements which may be used to couple the shafts. Also, design and draw the machine element. Choose suitable materials for the machine elements. 20
- Define- nominal diameter, major diameter and core diameter of threads.
 - What are the different stresses developed due to preloading/ initial tightening?
 - A bracket is fixed to the wall by means of 6 identical bolts and loaded by a vertical load as shown in the Fig. Q4. Material of bolts is C30 carbon steel ($\sigma_y = 340$ N/mm²) and factor of safety is 3. If the bolt is M20, calculate the maximum load, the bracket may sustain without failure. 03+05+12
- What is S-N diagram?
 - What is modified endurance limit and why the modification is required?
 - What is cumulative damage in fatigue?
 - A solid circular shaft is subjected to torsional moment that varies from 180 N-m to 400 N-m and at the same time, is subjected to bending moment that varies from 70 N-m to 200 N-m. The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of plain carbon steel ($\sigma_y = 400$ N/mm² & $\sigma_{ut} = 540$ N/mm²) and the corrected endurance limit of the shaft is 200 N/mm². Determine the shaft diameter considering a factor of safety of 1.5. 02+03+03+12
- What is open belt drive and crossed belt drive?
 - Deduce the expression for belt length considering crossed belt drive.
 - What is/are the effect(s) of belt speed on power transmission capacity of belt drive?
 - A cylindrical pressure vessel with closed ends, made up of steel is subjected to internal pressure. Deduce the expression for cylinder wall thickness of the pressure vessel. 01+03+02+14

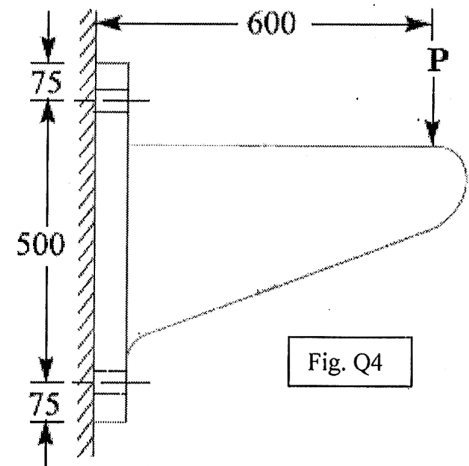


Fig. Q4