

BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - IV MECHANICAL : WINTER- 2022
SUBJECT : MACHINE DESIGN & ANALYSIS-I

Day : Friday

Time : 02:30 PM-06:30 PM

Date : 25-11-2022

W-24497-2022

Max. Marks : 60

N. B. :

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Draw neat and labelled diagrams **WHEREVER** necessary.
- 4) Use of non-programmable calculator is **ALLOWED**.
- 5) Assume suitable data, if necessary.

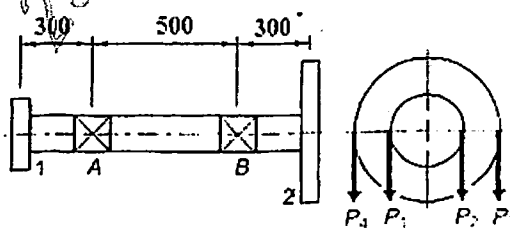
Q. 1 State the importance of Concurrent engineering and design for manufacturing and assembly? (10)

OR

Two rods, made of plain carbon steel 45C8 ($S_{yt} = 400 \text{ N/mm}^2$) are to be connected by means of a cotter joint. The diameter of each rod is 60 mm and the cotter is made from a steel plate of 12 mm thickness. Calculate the dimensions of the socket end making the following assumptions: (10)

- i) The yield strength in compression is twice of the tensile yield strength
- ii) The yield strength in shear is 50 % of the tensile yield strength. The factor of safety is 6.

Q. 2 The layout of a shaft carrying two pulleys 1 and 2, and supported on two bearings A and B is shown in fig. The shaft transmits 9 kW power at 400 rpm from the pulley 1 to the pulley 2. The diameters of pulleys 1 and 2 are 300 mm and 500 mm respectively. The masses of pulleys 1 and 2 are 20 kg and 30 kg respectively. The belt tensions act vertically downward and the ratio of belt tensions on the tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 40C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 3. Estimate suitable diameter of shaft. If the permissible angle of twist is 0.5° per metre length, calculate the shaft diameter on the basis of torsional rigidity. Assume $G = 80000 \text{ N/mm}^2$. (10)



OR

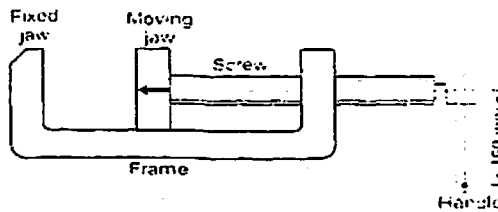
It is required to design a bushed pin type flexible coupling to connect the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 30 kW power at 900 rpm. The starting torque of the motor can be assumed to be 150 % of the rated torque. Design the coupling and specify the dimensions of its components. The shafts is made of 50C8 ($S_{yt} = 500 \text{ N/mm}^2$) and factor of safety 2. Material for keys and pin is 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and FOS 2. It is assumed that the compressive yield strength is 150 % of the tensile yield strength. Flange is made of FG 200 ($S_{ut} = 200 \text{ N/mm}^2$) factor of safety 6. It is assumed that the ultimate shear strength is one-half of the ultimate tensile strength. (10)

P. T. O.

Q.3

A machine vice as shown in fig., has single start, square threads with 25 mm nominal diameter and 5 mm pitch. The outer and inner diameter of the friction collar are 60 and 50 mm respectively. The coefficient of friction for thread and collar are 0.15 and 0.17 respectively. The machinist can comfortably exert a force of 120 N on a handle at a mean radius of 130 mm. Assuming uniform wear for the collar, Calculate:

- i) The clamping force developed between the jaws.
- ii) Overall efficiency of the clamp.



OR

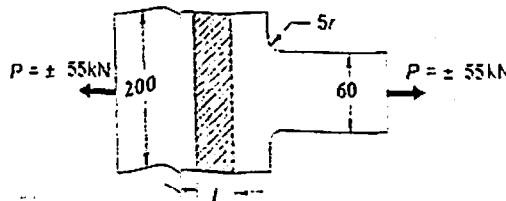
It is required to design a helical torsion spring for a window shade. The spring is made of patented and cold drawn steel wire of grade-4. The yield strength of the material is 60 % of the ultimate tensile strength and factor of safety is 2. From space consideration, the mean coil diameter is kept as 18 mm. The maximum bending moment acting on the spring is 240N-mm. The modulus of elasticity of the spring material 207000 N/mm². The stiffness of the spring should be 3 N-mm/ rad. Determine:

- i) The wire diameter
- ii) Number of active coils

d	1.4	1.6	1.8
S_u	2290	2250	2210

Q.4

A component machined from a plate made of steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$) is shown in fig. It is subjected to completely reverse axial force of 55kN. The factor of safety is 2. The size factor is 0.85. Determine the plate thickness t for infinite life, if the notch sensitivity is 0.8. Take $K_a = 0.80$, $K_b = 0.88$, for 90% reliability, $K_c = 0.87$ and $K_t = 2.27$.

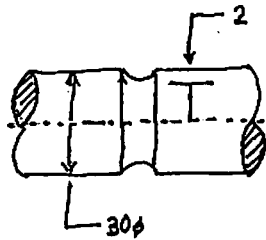


OR

A polished steel bar is subjected to axial tensile force that varies from 0 to P_{max} . It has a groove 2mm deep and having a radius of 3 mm. The theoretical stress concentration factor and notch sensitivity factor at the groove are 1.8 and 0.95 respectively. The outer diameter of the bar is 30 mm. The ultimate tensile strength of the bar is 1100 MPa. The endurance limit in a reversed bending is 700 MPa. (10)

Find the maximum force that the bar can carry for 105 cycles with 90% of reliability.

Take $K_a = 1$, $K_b = 0.82$, for 90% reliability, $K_c = 0.88$.



Q. 5

A bracket, subjected to a force of 6kN inclined at an angle of 60° with the vertical, is shown in fig. The bracket is fastened by means of 4 identical bolts to the structure. The bolts are made of plain carbon steel 30C8 ($S_{yt} = 450 \text{ N/mm}^2$) and factor of safety is 6 based on maximum shear stress. Assume maximum shear stress theory and determine the size of the bolts. (10)

