

BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - IV R&A :SUMMER- 2022
SUBJECT : DESIGN & ANALYSIS OF MACHINE COMPONENTS

Day : Tuesday
Date : 14-06-2022

S-24786-2022

Time : 10:00 AM-01:00 PM
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) Assume suitable data, if necessary.

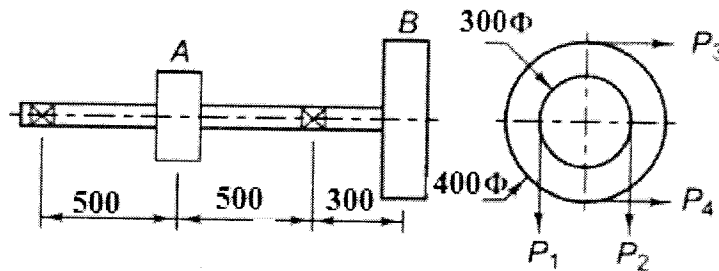
Q. 1 State the design consideration for : (ANY THREE) (10)

- i) Machined parts
- ii) Forging
- iii) Hot and cold worked parts
- iv) Casting
- v) Welded assembly?

OR

It is required to design a cotter joint to connect two steel rods of equal diameter. Each rod is subjected to an axial tensile force of 40 kN. Design the joint and specify its main dimensions. Take material for cotter as 30C8 ($s_{yt} = 350 \text{ N/mm}^2$) and factor of safety 5. (10)

Q. 2 A line shaft supporting two pulleys A and B is shown in fig. Power is supplied to the shaft by means of a vertical belt on the pulley A, which is then transmitted to the pulley B carrying a horizontal belt. The ratio of belt tension on tight and loose sides is 4 : 1. The limiting value of tension in the belts is 3kN. The shaft is made of plain carbon steel 40C8 ($S_{ut} = 700 \text{ N/mm}^2$ and $S_{yt} = 400 \text{ N/mm}^2$). The pulleys are keyed to the shaft. Determine the diameter of the shaft according to the ASME code if $kb = 1.5$ and $kt = 1.0$ (10)



OR

List the types of keys and explain any one in detail. A rigid coupling is used to transmit 35 kW power at 200 rpm. There are six bolts. The outer diameter of the flanges is 150 mm, while the recess diameter is 120 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of steel 40C8 ($S_{yt} = 300 \text{ N/mm}^2$) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. (10)

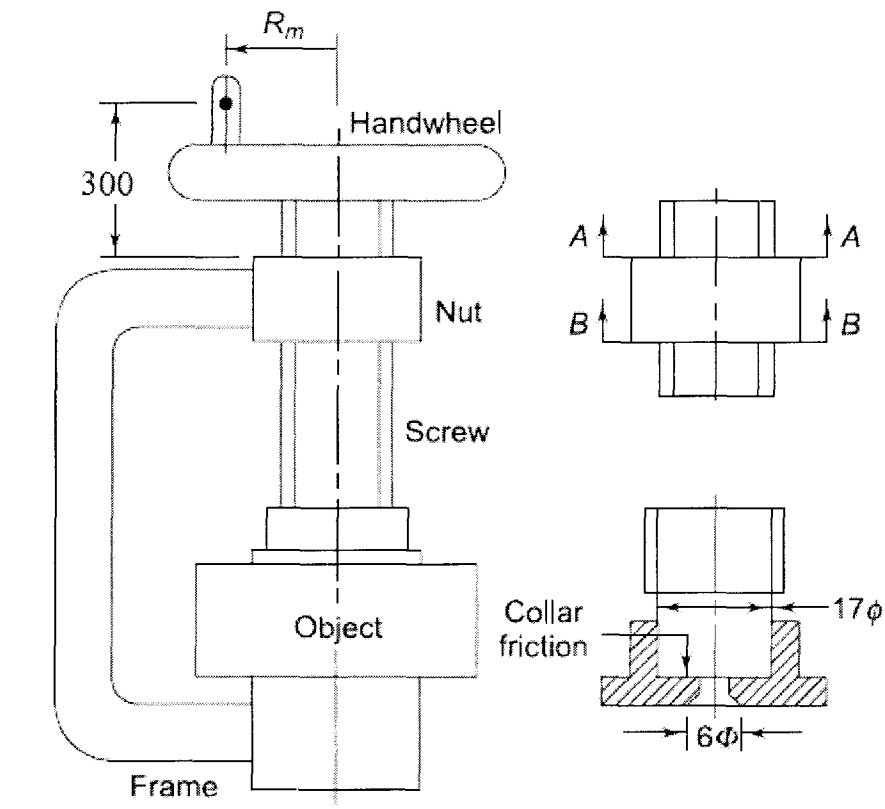
P. T. O.

- Q. 3** A helical compression spring of the exhaust valve mechanism is initially compressed with a pre-load of 300 N. When the spring is further compressed and the valve is fully opened, the torsional shear stress in the spring wire should not exceed 850 N/mm^2 . Due to space limitations, the outer diameter of the spring should not exceed 45 mm. The spring is to be designed for minimum weight. Calculate the wire diameter and the mean coil diameter of the spring. (10)

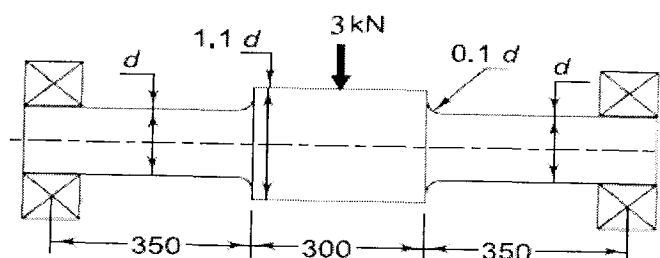
| C | K | $(C+1)^2$ | $CK(C+1)^2$ |
|---|-------|-----------|-------------|
| 5 | 1.311 | 36 | 235.98 |
| 6 | 1.253 | 49 | 368.38 |
| 7 | 1.213 | 64 | 543.42 |
| 8 | 1.184 | 81 | 767.23 |

OR

- Q. 3** It is required to design a double-start screw with square threads for the C-Clamp shown in fig. The maximum force exerted by the clamp is 4 kN. It is assumed that the operator will exert a force of 150 N at the ball handle of the hand wheel. The screw is made of plain carbon steel 45 C 8 ($S_{yt} = 350 \text{ N/mm}^2$), while the nut is made of grey cast iron FG 200 ($S_{ut} = 210 \text{ N/mm}^2$). The dimensions of the collar are given in fig. The factor of safety is 2.5. Determine the dimensions of the screw and the nut and calculate the radius R_m of the ball handle. (10)



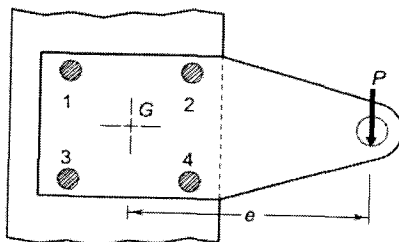
- Q. 4** What is stress concentration? Reasons of stress concentration? Explain any one of the methods to reduce stress concentration? A non-rotating shaft supporting a load of 3 kN is shown in fig. The shaft is made of brittle material, with an ultimate tensile strength of 280 N/mm^2 . The factor of safety is 3. Determine the dimensions of the shaft. Take K_t as 1.62 (10)



OR

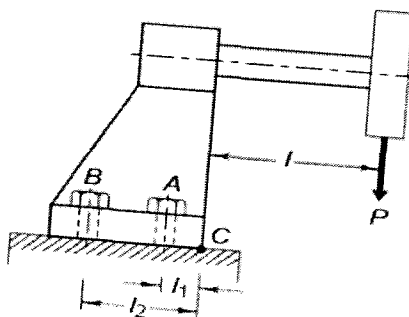
A spherical pressure vessel, with a 550 mm inner diameter, is welded from steel plates. The welded joints are sufficiently strong and do not weaken the vessel. The plates are made from cold drawn steel 25C8 ($S_{ut} = 460 \text{ N/mm}^2$ and $S_{yt} = 250 \text{ N/mm}^2$). The vessel is subjected to internal pressure, which varies from zero to 5.5 N/mm^2 . Factor of safety is 3. The size factor is 0.85. The vessel is expected to with stand infinite number of stress cycles. Calculate the thickness of the plates. Take $K_a = 0.81$, $K_b = 0.85$. For 50% reliability $K_c = 1.0$. (10)

Q. 5 The structural connection shown in fig. is subjected to an eccentric force P of 15kN with an eccentricity of 600 mm from the CG of the bolts. The centre distance between bolts 1 and 2 is 250 mm, and the centre distance between bolts 1 and 3 is 200 mm. All the bolts are identical. The bolts are made from plain carbon steel 30C8 ($S_{yt} = 420 \text{ N/mm}^2$) and the factor of safety is 3. Determine the size of the bolts. (10)

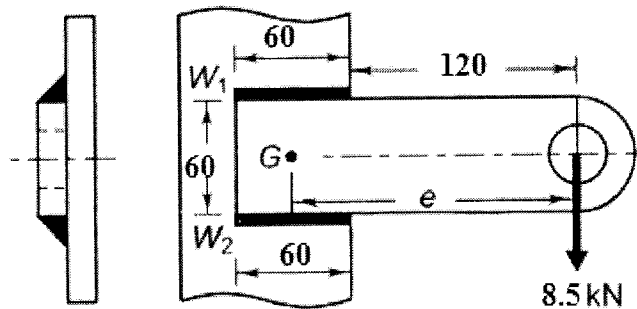


OR

A cast iron bracket, supporting the transmission shaft and the belt pulley, is fixed to the steel structure by means of four bolts as shown in fig. There are two bolts at A and two bolts at B. The tensions in slack and tight sides of the belt are 4 kN and 8 kN respectively. The belt tensions act in a vertically downward direction. (10)
The distances are as follows, $l_1 = 60 \text{ mm}$ $l_2 = 120 \text{ mm}$ $l = 150 \text{ mm}$. The maximum permissible tensile stress in any bolt is 70 N/mm^2 . Determine the size of the bolts.

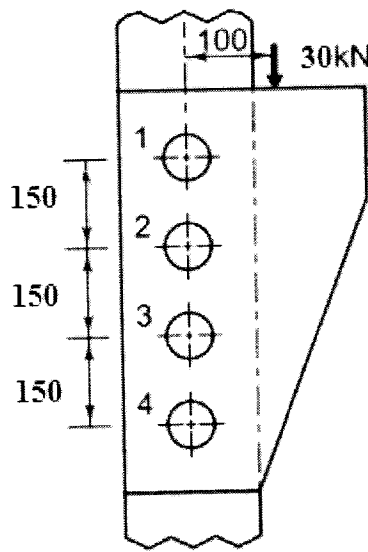


- Q. 6** A welded connection as shown in fig. is subjected to an eccentric force of 8.5 kN. Determine the size of welds if the permissible shear stress for the weld is 115 N/mm^2 . Assume static conditions. (10)



OR

- A bracket, attached to a vertical column by means of four identical rivets, is subjected to an eccentric force of 30 kN as shown in fig. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm^2 . (10)



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