



Max. Marks : 80
Duration : 3 hours

- Instructions:** 1) Question No. 1 is compulsory
2) Answer any **three** from the remaining five questions
3) Use of recommended **Design data book** is permitted.
4) Use your judgment for unspecified data, if any.

Q. No 1. Solve any **four** of the followings:

- What do you understand by following designations of materials
i) FG350 ii) 40C8 iii) FeE400 iv) 30Mn4Cr1 v) 40Cr1Mo28
- Explain the modes of failures in the mechanical components.
- Why factor of safety is necessary in the design of mechanical components? Discuss the important factors influencing the selection of factor of safety.
- 'Curved beams cannot be designed by applying the simple bending theory of straight beams'. Justify the statement.
- What is surging of springs? What remedial measures you will suggest to avoid the surging?

Q.No.2 a) Design a spigot-socket type cover joint to transmit an axial load of 42 kN. Select appropriate materials for its components and draw its neat sketch showing major dimensions on it. (14)

- State the following theories of failure and state the relation between yield strength in shear and the yield strength for each of the theory. (2x3=6)
i) Maximum shear stress theory ii) Octahedral shear stress theory

Q.No. 3 a) State the assumptions made in the analysis of curved beams. (4)

- Design a single start square threaded screw for a C-clamp shown in figure 1. The maximum force exerted by the clamp is 5 kN. Use the following data: (16)
i) yield strength of the screw material = 390 N/mm²
ii) shear strength of the nut and body material = 230 N/mm²
iii) coefficient of the screw friction = 0.14
iv) coefficient of the collar friction = 0.16

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- v) mean collar radius = 8 mm
- vi) factor of safety = 3
- vii) permissible bearing pressure = 12 N/mm^2
- viii) distance between axis of the handle and nut surface, $l = 150 \text{ mm}$

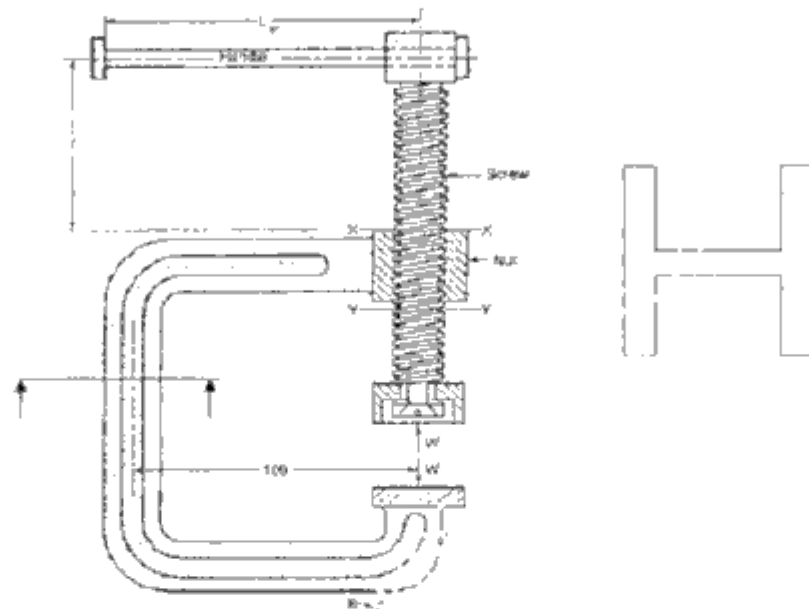


Figure 1 C-clamp

Also, design the I-section as shown by the side of figure 1, taking web = flange = $4t$, where t = thickness of flange and web of the I-section of the clamp body.

Q.No. 4 a) Explain Soderberg diagram and derive equation for a factor of safety based on this concept. (10)

b) The most critical point of component made of steel C40 is subjected to the following variable stresses. Determine the factor of safety based on Soderberg criterion and Octahedral shear theory. (10)

- σ_x - varies from $+12$ to -10 N/mm^2
- σ_y - varies from $+14$ to $+6 \text{ N/mm}^2$ and
- τ_{xy} - varies from $+10$ to -10 N/mm^2

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Q.No. 5 a) A shaft is supported by two bearings placed 1.5 m apart. A 450 mm diameter flat belt pulley is mounted at a distance of 350 mm to the right of LH bearings and drives a pulley directly below it with the help of flat belt having tension on the tight side of 2.8 kN. Another V-groove pulley 300 mm p.c.d. is placed 300 mm to the left of RH bearing and is driven with the help of electric motor and V- belt. The motor is placed horizontally in front. The angle of contact of both the pulley is 180° and $\mu = 0.25$. the angle of V-groove is 35° . Select suitable material for the shaft and determine the diameter of the shaft.

What will be the diameter of the shaft, if it is a hollow shaft with ratio $\frac{d_i}{d_o} = 0.5$?

Which one will you prefer ? Comment on it. (16)

b) Explain the working of split-muff coupling with neat sketch. (4)

Q.No. 6 a) A helical coil compression spring is to be subjected to a maximum force of 4600 N with a corresponding deflection of 58 mm. The spring is to operate over a 40 mm diameter rod. Determine the wire diameter and number of active turns. Also, decide other details such as free length, pitch, helix angle etc. Check for the solid stress for the material of the spring as follows: (14)

$$S_u = \frac{2000}{10^{17}} \text{ N/mm}^2, S_{ys} = \frac{1200}{10^{17}} \text{ N/mm}^2 \text{ and } G = 79300 \frac{\text{N}}{\text{mm}^2}.$$

b) Explain any three different types of Springs. (3)

c) What is spring index of a helical spring ? Discuss the significance of it in the design of it. (3)