

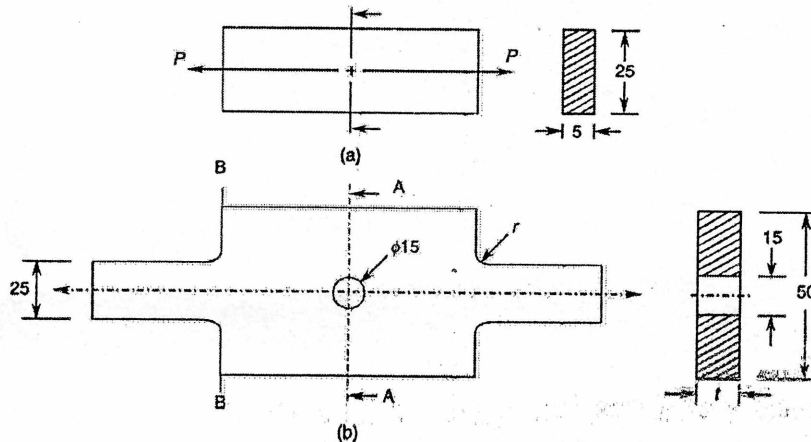
National Institute of Technology, Hamirpur (H.P.)
B.Tech. 3rd Year, End Term Examination

Branch: Mechanical Engineering
Course Name: Machine Design-I
Time Allowed: 3 Hr.

Semester: 5th
Course Code: ME-311
Maximum Marks: 50

➤ **Attempt all the questions.**

1. Explain the general procedure/steps to solve a design problem? Briefly discuss different methods of reducing stress concentration in machine components. (5)
2. A tension member as shown in figure (a) supports an axial load of P Newton. It is required to be replaced by another member as shown in figure (b). Determine the thickness and fillet radius of the second member so that the maximum stress in it does not exceed that in member (a). All dimensions in are in mm. (5)



3. A turbine shaft transmits 500 kW at 900 r.p.m. The permissible shear stress is 80 N/mm² while twist is limited to 0.5° in a length of 2.5 m. Calculate the safe diameter of shaft. Take $G=0.8 \times 10^5$ N/mm². If the shaft chosen is hollow with $(d_i/d_o)=0.6$, calculate the percentage saving in the material. (10)
4. It is required to design a square key for fixing a gear on the shaft which transmits 10 kW power at 720 rpm. The shaft and the key are both made of plain carbon steel C45 and the factor of safety is 3.0. The yield tensile strength of C45 material is 360 N/mm². The allowable tensile strength is 120 N/mm², and maximum shear strength according to maximum distortion energy theory is 69 N/mm². (10)
5. A helical spring made of C50 steel (Yield strength=340 N/mm²), has an outside diameter of 80 mm and a wire diameter of 12 mm. The spring has to support a maximum axial load of 1kN. Using Wahl's correction factor determine the maximum shear stress and total deflection. If the spring has 10.5 coils, determine the factor of safety. Take $G=0.89 \times 10^2$ kN/mm². (10)