

Code No: 55019

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, November/December - 2016

DESIGN OF MACHINE MEMBERS-I  
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 75

Answer any five questions  
All questions carry equal marks

1. The stresses induced at a critical point in a machine component made of steel 45C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ) are as follows:  
 $\sigma_x = 100 \text{ N/mm}^2$ ;  $\sigma_y = 40 \text{ N/mm}^2$ ;  $\tau_{xy} = 80 \text{ N/mm}^2$   
Calculate the factor of safety by (a) the maximum normal stress theory, (b) the maximum shear stress theory and (c) the distortion energy theory. [5+5+5]
2. A cantilever beam made of steel Fe 540 ( $S_{ut} = 540 \text{ N/mm}^2$  and  $S_{yt} = 320 \text{ N/mm}^2$ ) and subjected to a completely reversed load (P) of 5 kN is shown in figure 1. The beam is machined and reliability is 50%. The factor of safety is 2 and the notch sensitivity factor is 0.9. Calculate  
a) Endurance limit at the fillet section  
b) Diameter d of the beam for infinite life. [7+8]

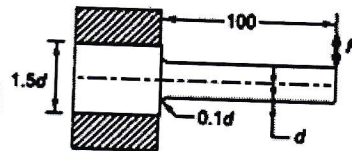


Figure 1

3. A welded connection of steel plates is shown in figure 2. It is subjected to an eccentric force of 50 kN. Determine the size of the weld, if the permissible shear stress in the weld is not to exceed  $70 \text{ N/mm}^2$ . [15]

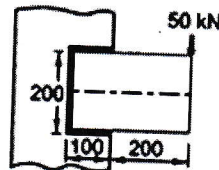


Figure 2

4. A cast iron bracket, as shown in figure 3, supports a load of 10 kN. It is fixed to the horizontal channel by means of four identical bolts, two at A and two at B. The bolts are made of steel 30C8 ( $S_{yt} = 400 \text{ N/mm}^2$ ) and the factor of safety is 6. Determine the major diameter of the bolts. [15]

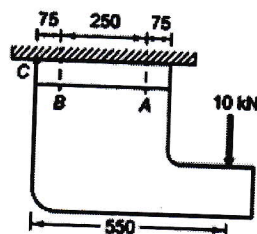


Figure 3

5. Draw neat sketch of a socket and spigot joint and write its design procedure. [15]
6. A solid shaft of diameter 'd' is used in power transmission. Due to modification of the existing transmission system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further, the weight of the hollow shaft per metre length should be half of the solid shaft. Determine the outer diameter of the hollow shaft in terms of 'd'. [15]
7. A rigid coupling is used to connect a 45 kW, 1440 rpm electric motor to a centrifugal pump. The starting torque of the motor is 225% of the rated torque. There are 8 bolts and their pitch circle diameter is 150 mm. The bolts are made of steel 45C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ) and the factor of safety is 2.5. Determine the diameter of the bolts. Assume that the bolts are finger tight in reamed and ground holes. [15]
8. A railway wagon moving at a velocity of 2.1 m/s is brought to rest by a bumper consisting of two helical compression springs arranged in parallel. The springs are compressed by 150 mm in bringing the wagon to rest. The mass of the wagon is 1200 kg. The spring index is 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of  $1500 \text{ N/mm}^2$  and modulus of rigidity of 81 GPa. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. Design the springs. [15]

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