VIT
Vellore Institute of Technology

Final Assessment Test – November 2019

Course: MEE3001 - Design of Machine Elements
Class NBR(s): 1145 / 1376 / 1250
Slot: D2+TD2+V6
Time: Three Hours
Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS EXAM MALPRACTICE

General Instruction: PSG Design data book is permitted

Answer any FIVE Questions
(5 X 20 = 100 Marks)

1. a) A man weighing 60 kg jumps from a height of 50 cm on a diving board of rectangular cross-section having 30 cm width and 2 m long. If the maximum induced stress is limited to 400 Kg/cm^2 and the modulus of elasticity of the board is 1×10^5 Kg/cm^2, find the thickness of diving board. [8]

   b) A medium carbon steel shaft of 48 mm diameter is subjected to a bending moment of 1900 N-m and a torque T. If the yield point of the medium carbon steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to i) The maximum principal stress theory ii) The maximum shear stress theory and iii) The maximum distortion strain energy theory. [12]

2. a) A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N-m clockwise to 110 N-m counter clockwise and an applied bending moment at a critical section varies from 440 N-m to – 220 N-m. The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and a yield strength of 410 MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. [15]

   b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. [5]

3. a) A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are: tearing (σ_t) = 120 MPa; shearing (τ) = 100 MPa; and crushing (σ_c) = 150 MPa. Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear. [10]

   b) A bracket, as shown in Fig. 1, carries a load of 10 kN. Find the size of the weld if the allowable shear stress is not to exceed 80 MPa. [10]

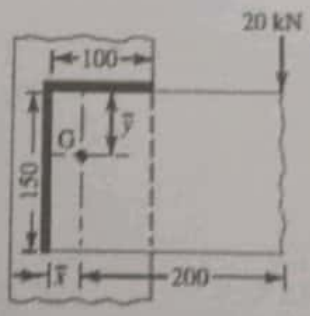

Fig.1

4. a) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. [10]

   b) A semi-elliptical laminated spring 900 mm long and 55 mm wide is held together at the centre by a band 50 mm wide. If the thickness of each leaf is 5 mm, find the number of leaves required to carry a load of 4500 N. Assume a maximum working stress of 490 MPa. If the two of these leaves extend the full length of the spring, find the deflection of the spring. The Young's modulus for the spring material may be taken as 210 kN/mm^2. [10]

5. The shaft, as shown in Fig. 2, is driven by pulley B from an electric motor. Another belt drive from pulley A is running a compressor. The belt tensions for pulley A are 1500 N and 600 N. The ratio of belt tensions for pulley B is 3.5. The diameter of pulley A is 150 mm and the diameter of pulley B is 480 mm. The allowable tensile stress for the shaft material is 170 MPa and the allowable shear stress is 85 MPa. Taking torsion and bending factors as 1.25 and 1.75 respectively, find the shaft diameter. Also find out the dimensions for a hollow shaft with outside diameter limited to 30 mm. Compare the weights of the two shafts. [20]

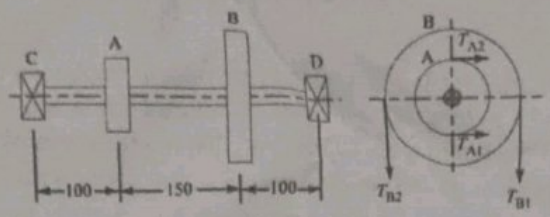

Fig.2

6. The following particulars refer to a four stroke cycle diesel engine: [20]
Cylinder bore = 150 mm; Stroke = 187.5 mm; R.P.M. = 1200; Maximum gas pressure = 5.6 N/mm^2; Mass of reciprocating parts = 1.75 kg.

i) The dimensions of an I-section connecting rod of forged steel with an elastic limit compressive stress of 350 MPa. The ratio of the length of connecting rod to the length of crank is 4 and the factor of safety may be taken as 5;

ii) The wrist pin and crankpin dimensions on the basis of bearing pressures of 10 N/mm^2 and 6.5 N/mm^2 of the projected area respectively; and

iii) The dimensions of the small and big ends of the connecting rods, including the size of the securing bolts of the crankpin end.

Assume that the allowable stress in the bolts, is not to exceed 35 N/mm^2. Draw dimensioned sketches of the connecting rod showing the provisions for lubrication.

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