CBCS SCHEME

USN | | | | | | | | | |

15ME54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Design of Machine Elements - I

Time: 3 hrs. Max. Marks: 80

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Design Data Handbook is permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

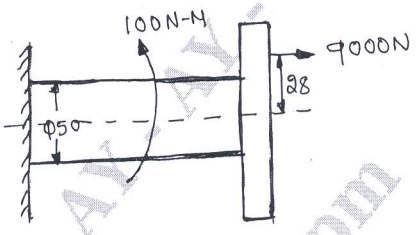
Module-1

1 a. Briefly explain the phases of design process. **(04 Marks)**

b. Define Standards and Codes. **(04 Marks)**

c. A 50mm diameter steel rod supports a 9kN load in addition is subjected to a torsional moment of 100N-m as shown in Fig. Q1(c). Determine the maximum tensile and the maximum shear stress. **(08 Marks)**

Fig. Q1(c)

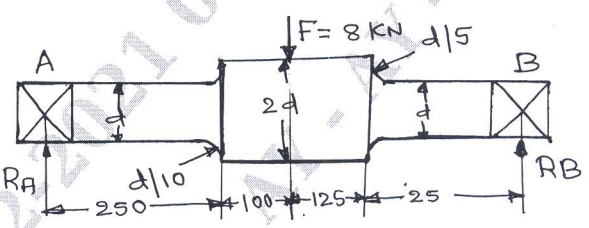


OR

2 a. Define the Stress concentration and give three examples of how to reduce stress concentration. **(06 Marks)**

b. A stepped shaft shown in Fig. Q2(b) is subjected to a transverse load. The shaft is made of steel with ultimate tensile strength of 400MPa. Determine the diameter'd' of the shaft based on the factor of safety of 2. **(10 Marks)**

Fig. Q2(b)



Module-2

3 a. Derive the equation for impact stress in Axial load. **(06 Marks)**

b. A machine element in the form of a cantilever beam has a rectangular cross section of 40mm width and 120mm depth. The span of the beam is 600mm. A transverse load of 5kN falls from a height of 'h' at the free end of the beam. Determine a safe value for 'h' limiting the maximum normal stress induced in the machine element , due to impact to 120MPa. The modulus of elasticity of the material of the beam is 210 GPa. **(10 Marks)**

OR

4 a. Derive the Soderberg equation for designing members subjected to fatigue loading. **(06 Marks)**

b. A cantilever beam made of cold drawn carbon steel (σ_u = 550 MPa , σ_y = 470 MPa , σ_{-1} = 275 MPa) of circular cross – section is subjected to load which varies from –F to 3F. Determine the maximum load that this member can withstand for an infinite life as shown in Fig.Q4(b). Using a Factor of safety of 2. Taking est = 0.85 , esr = 0.83 , eℓ = 1 and q = 1. **(10 Marks)**

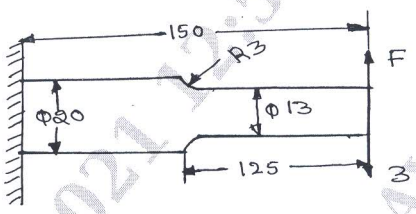


Fig. Q4(b)

Module-3

5 A machine shaft turning at 600rpm is supported on bearings 750mm apart. 15kW is supplied to the shaft through a 450mm pulley located 250mm to the right bearing. The power is transmitted from the shaft through a 200mm spur gear located 250mm to the right of the left bearing. The belt drive is at an angle of 60^0 above the horizontal. The pulley weights 800N to provide some fly wheel effect. The ratio of belt tensions is 3:1. The gear has a 20^0 tooth form and mesh with another gear located directly above the shaft. If the shaft material selected has an ultimate strength of 500MPa and a yield point of 310 MPa. Determine the necessary diameter using K_b = 1.5 and K_t = 1.0. **(16 Marks)**

OR

6 a. Design a Knuckle joint to connect two mild steel rods subjected to an axial pull of 100kN. The allowable stresses for rods and pin are 100MPa, 130Mpa and 60Mpa in tension , crushing and shear respectively. **(08 Marks)**

b. Design a protected type cast iron flange coupling for a steel shaft transmitting 30kW at 200rpm. The allowable shear stress in the shaft and key material is 40MPa. The maximum torque transmitted to be 20% greater than the full load torque. The allowable shear stress in the bolt is 60MPa and the allowable shear stress in the flange is 40MPa. **(08 Marks)**

Module-4

7 a. A double riveted lap joint is to be made between 9mm plate. If the safe working stresses in tension, crushing and shear are 80N/mm^2 , 120N/mm^2 and 60N/mm^2 respectively. Design the riveted joint. **(08 Marks)**

b. Determine the diameter of rivet for the joint show in Fig. Q7(b). The allowable stress in the rivets is 100N/mm^2. **(08 Marks)**

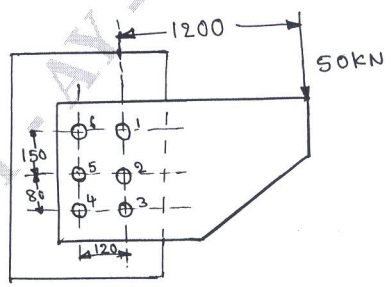
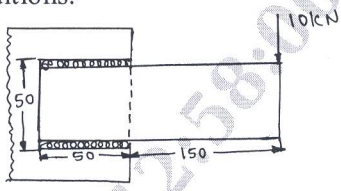


Fig. Q7(b)

OR

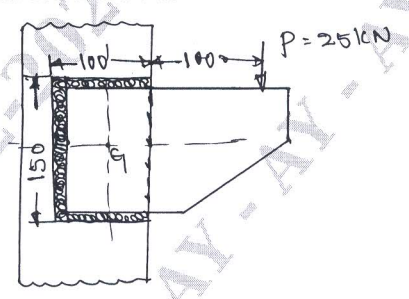
8 a. A welded connection of steel plates as shown in Fig. Q8(a), is subjected to an eccentric load of 10kN. Determine the throat dimensions of weld, if the permissible stress is limited to 95N/mm^2. Assume static conditions. **(08 Marks)**

Fig. Q8(a)



b. A bracket welded to the support is loaded eccentrically as shown in Fig. Q8(b). The permissible shear stress for the weld material is 60N/mm^2 and the load is static. Determine the throat and leg dimensions for the weld. **(08 Marks)**

Fig. Q8(b)

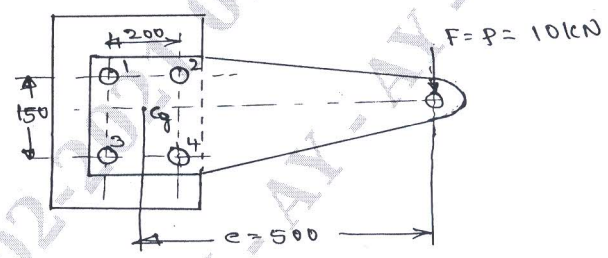


Module-5

9 a. A flat circular plate is used to close the flanged end of a pressure vessel of internal diameter 300mm. The vessel carries a fluid at a pressure of 0.7N/mm^2. A soft copper gasket is used to make the joint leak proof. 12 bolts are used to fasten the cover plate onto the pressure vessel. Find the size of bolts so that the stress in the bolts is not to exceed 100N/mm^2. **(08 Marks)**

b. The structural connection shown in Fig. Q9(b) is subjected to an eccentric load P of 10kN with an eccentricity of 500mm. The centre distance between bolts are 1 and 3 is 150mm and the centre distance between bolts at 1 and 2 is 200mm. All bolts are identical. The bolts are made of plain carbon steel having yield strength in tension of 400MPa and factor of safety is 2.5. Determine the size of bolts. **(08 Marks)**

Fig. Q9(b)



OR

10 a. Explain the self locking and overhauling in power screws. **(04 Marks)**

b. A square threaded power screw has a nominal diameter of 30mm and a pitch of 6mm with double threads. The load on the screw is 6kN and the mean diameter of the thrust collar is 40mm. The coefficient of friction for the screw is 0.1 and the collar is 0.09. Determine :

i) Torque required to raise the screw against load.
ii) Torque required to lower the screw with the load.
iii) Overall efficiency.
iv) Is this screw self – locking? **(12 Marks)**

* * * * *