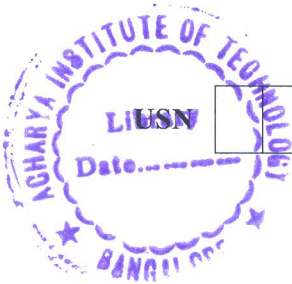


# CBCS SCHEME



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15AU53

Fifth Semester B.E. Degree Examination, June/July 2019

## 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 hand book is permitted.  
3. Assume missing data if any suitably.*

### Module-1

- 1 a. Draw the stress-strain diagrams for a ductile and brittle materials and show the salient points on them. (06 Marks)  
b. The load  $F$  on C-clamp shown in Fig.Q.1(b) is 37.5 kN. Determine the dimensions  $b$  and  $h$ , if allowable stress is 100MPa,  $b = 3h$  and  $e = 200$ mm. (10 Marks)

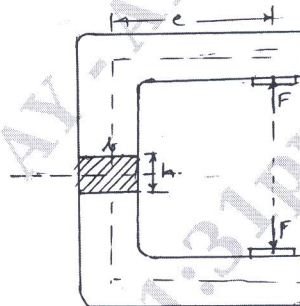


Fig.Q.1(b)

OR

- 2 a. Define factor of safety, list the factors which effect on factor of safety. (04 Marks)  
b. A shaft is made up of steel having yield strength 700MPa. It is subjected to combined load of bending moment 10kN-m and twisting moment of 30kN-m. Determine the diameter of shaft according to  
i) Max normal stress theory of failure.  
ii) Max shear stress theory of failure.  
Assuming factor of safety as 2 and  $\mu = 0.25$ . (12 Marks)

### Module-2

- 3 a. What is stress concentration? How to reduce it? (04 Marks)  
b. Determine the diameter of member subjected to bending moment 200N-m as shown in Fig.Q.3(b) taking stress concentration into account, if maximum stress of material is 120MPa. (06 Marks)

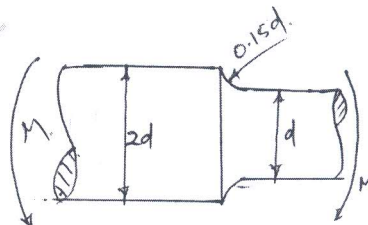


Fig.Q.3(b)

- c. A unknown weight falls through 20mm on a collar rigidity attach to the lower end of a vertical bar 2m long and  $500\text{mm}^2$  section. If the maximum instantaneous extension is 2mm. What is the corresponding stress and the value of unknown weight? Take  $G = 200\text{GPa}$ .

(06 Marks)

OR

- 4 a. Derive soderberge relation for fatigue failure. (04 Marks)  
 b. A cantilever beam shown in Fig.Q.4(b) is subjected to a load varying from  $-F$  to  $+3F$ . Determine the maximum load that the member can withstand for infinite life using facts of safety as 2. The material of the beam is cold drawn steel. Assume notch sensitivity = 0.9, size factor = 0.85, surface finish factor = 0.88,  $\sigma_u = 550\text{MPa}$ ,  $\sigma_y = 470\text{MPa}$  and  $\sigma_{en} = 275\text{MPa}$ . (12 Marks)

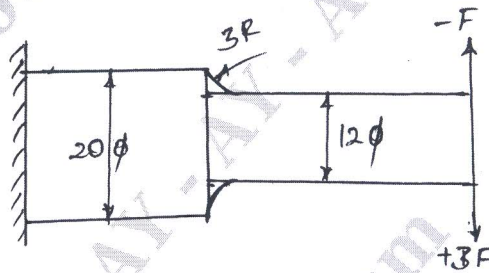


Fig.Q.4(b)

**Module-3**

- 5 a. Design a protected type CI flanged coupling is used to transmit 50kW at 300rpm. The overall torque is 20% greater than mean torque. The allowable shear stress for the shaft is 40MPa and shear stress for CI flange is 15MPa. (08 Marks)  
 b. Design the knuckle joint to transmit a loads of 40kN. The material selected for the data has the following stress.  $\sigma_t = 100\text{MPa}$ ,  $\sigma_c = 120\text{MPa}$  and  $\tau = 55\text{MPa}$ . (08 Marks)

OR

- 6 A commercial steel shaft with allowable sheer stress 40MPa, with shock factors for bending and twisting are 1.5 and 1 respectively. The length of the shaft between bearings is 600mm carries a pulley of 400mm diameter having weight 400N, mounted in the middle of the shaft, shaft receives 40kW at 600rpm weighing 600N overhanging to the right hand bearing by 200mm. The belt drives on pulleys are right angles to each other. Take ratios of belt tensions as 3, determine the diameter of the shaft. (16 Marks)

**Module-4**

- 7 a. Explain failures of riveted joint. (06 Marks)  
 b. Design a triple riveted lap joint of zig-zag type for pressure vessel of 1.5m diameter. The maximum pressure is 1.5MPa. Allowable stresses in tension, crushing and shear are 100MPa, 125MPa and 75MPa respectively. (10 Marks)



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OR

- 8 a. Derive an expression for strength of double parallel single transverse welded joint. (06 Marks)  
b. Determine the size of weld for a welded joint loaded as shown in Fig.Q.8(b). The permissible shear stress for the weld material is 75MPa. (10 Marks)

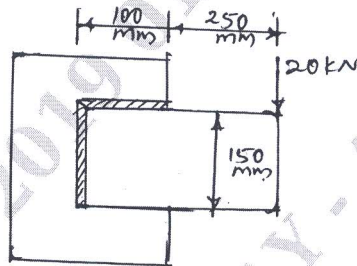


Fig.Q.8(b)

**Module-5**

- 9 a. The cylinder head of a reciprocating air compressor is held by ten bolts. The total joint stiffness is four times the total bolt stiffness. Each bolt is tightened to an initial tension of 5kN. The total external force acting to separate the joint is 20kN. Find the size of the bolt so that the stress in bolts is not to exceed 100MPa. (06 Marks)  
b. A radial drilling machine with circular base is mounted to the base plate by means of three steel bolts equally spaced on a bolt circle diameter of 0.3m. The diameter of the circular base is 0.4m. The spindle is positioned at a radial distance of 0.335m from the centre of the column. During the drilling operation the spindle is subjected to a force of 4.5kN. Determine the size of the bolts. If the allowable stress in bolt material is limited to 100MPa. (10 Marks)

OR

- 10 a. Explain overhauling and screws. Derive condition for self locking of square thread with collar friction. (04 Marks)  
b. A single threaded power screw is used to rise a load of 120kN. The screw has mean diameter of 24mm and threads per 24mm length. The mean collar diameter is 40mm. The coefficient of friction is estimated as 0.1 per both thread and collar. Determine:  
i) The major diameter of screw  
ii) Torque required to raise the load  
iii) Overall efficiency. (12 Marks)

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