Code: 15A03504 **R15**

B.Tech III Year I Semester (R15) Regular Examinations November/December 2017

DESIGN OF MACHINE MEMBERS – I

(Mechanical Engineering)

Use of Design data books is permitted in the examination hall

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What is machine design?
(b) What is the difference between modulus of elasticity and modulus of rigidity?
(c) How the stress concentration in a component can be reduced?
(d) List the important factors that influence the magnitude of factor of safety.
(e) What are the factors that influence the amount of initial tension?
(f) What are the different types of threads? Explain.
(g) Define the term critical speed.
(h) What is meant by equivalent bending moment?
(i) What is the main use of woodruff keys?
(j) Under what circumstances flexible couplings are used?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Explain the general procedure in machine design.

(b) An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 kN/mm^2.

OR

3 A rotating shaft of 16 mm diameter is made of plain carbon steel. It is subjected to axial load of 5000 N, a steady torque of 50 N-m and maximum bending moment of 75 N-m. Calculate the factor of safety available based on: (i) Maximum normal stress theory. (ii) Maximum shear stress theory. Assume yield strength as 400 MPa for plain carbon steel. If all other data remains same, what maximum yield strength of shaft material would be necessary using factor of safety of 1.686 and maximum distortion energy theory of failure. Comment on the result you get.

UNIT – II

4 (a) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 600 MPa. It is subjected to a torque which fluctuates between 2000N-m to -900 N-m. Using Soderberg method calculate the factor of safety.

(b) What is notch sensitivity? Explain.

OR

5 (a) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate tensile strength according to: (i) Soderberg relation. (ii) Gerber relation. Take Yield point = 0.55 ultimate tensile strength, endurance limit = 0.5 ultimate tensile strength, factor of safety = 2.

(b) Explain the significance of Goodman's line and Soderberg line in design of members subjected to reversal of stresses.

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UNIT – III

6 A steam engine cylinder has an effective diameter of 350 mm and the maximum steam pressure acting on the cylinder cover is 1.25 N/mm^2. Calculate number of studs required to fix the cylinder cover. Assume the permissible stress in the stud to be 70 N/mm^2.

OR

7 (a) Design a single riveted lap joint to connect two mild steel plates, 12.5 mm thick, the joint being designed for maximum efficiency. The allowable stresses are σ_t = 35.0 N/mm^2, τ = 28.5 N/mm^2 and σ_c = 53.0 N/mm^2. Also calculate the minimum force per pitch which will rupture the joint.

(b) Sketch and explain the types of riveted joint failure.

UNIT – IV

8 Design a knuckle joint to withstand a tensile load of 70 kN using steel with the following permissible stresses σ_t = 60 MPa, σ_c = 72 MPa and τ = 48 MPa.

OR

9 The shaft of an axial flow rotary compressor is subjected to a maximum torque of 2 kN-m and maximum bending moment of a 4 kN-m. The combined shear and fatigue factors in torsion and bending may be taken as 1.5 and 2.0 respectively. Determine the diameter of the shaft, the shear stress in shaft should not exceed 5.0 MN/m^2. Design a hallow shaft for the above compressor taking the ratio of inner diameter to outer diameter as 0.5. Calculate the percentage saving in material?

UNIT – V

10 Design muff coupling to connect two steel shafts transmitting 25 kW power at 360 r.p.m. The shafts and key are made of plain carbon steel 30C8. The sleeve is made of gray cast iron FG 200. The factor of safety of the shaft and key are 4 and for the sleeve is 6.

OR

11 Design a cast iron flange coupling (protected type) to connect two shafts and transmits a torque of 5000 Nm. The following permissible stresses may be used. Permissible shear stress for shaft, bolt and key material = 50 MPa. Permissible shear stress for CI = 16 MPa.

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