**B. FTBE, 2nd Year, 2nd Sem, 2017**

Machine Design and Drawing Time : 3 hrs Full Marks: 100

(Answer any five questions)

Data if missing may be assumed suitably. The symbols used in the questions, bear their usual meaning. Necessary sketches may be drawn as freehand drawings.

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1 a) State the stepwise procedure for mechanical engineering design.
b) What are the common materials for 1) shaft, 2) coupling, 3) bolt and 4) belt.
c) State the significance of manufacturing methods in engineering design process.
d) What is meant by "50 H7-g6" and "40 H7-m6"? Describe the difference in their types of fits.

5+4+4+(5+2)

2a) i) State the significance of failure theories in engineering design.
ii) A machine member is subjected to a tensile load of 25 kN, a bending moment of 12 kN-m and a torsional moment of 6 kN-m. The member has a solid circular cross section and the allowable stresses of the material in tension and shear are 65 MPa and 35 MPa respectively. Determine the diameter by using i) principal stress failure theory and ii) maximum shear stress failure theory.

b) i) Make a comparative study between riveted and welded joints.
ii) Draw a sketch of fillet welded joint and indicate parallel and transverse welding.
iii) How a weld joint is specified by using welding symbols?

(3+7)+(3+3+4)

3i) Design the cotter of a sleeve type joint, under a tensile load of 20 kN. Assume that the allowable tensile and shear stresses of cotter material are 50 MPa and 28 MPa respectively. Determine the complete dimensions of the cotter.
ii) State the failure modes of the cotter with necessary supporting diagrams.
iii) How the failure modes will change if the cotter joint is made of "socketed end–rod end" type?
iv) Design a knuckle joint, under the same tensile load of 20 kN and with same material of construction. Determine the knuckle pin dimensions and state the failure modes.

7+3+3+7

4a) In a screw jack, one end of the screw is fixed in the nut and the other end supports a load of 25 kN. The maximum free length of the screw between the nut and the cup, when the load is completely raised, is 300 mm. The screw material is steel with yield strength 380 MPa and elastic modulus 207 Gpa, whereas the nut is made from aluminum-bronze having yield strength 180 MPa and elastic modulus 210 Gpa. Assuming a factor of safety of 3.0, determine the dimensions of the screw and nut.

b) The cup of the screw jack is mounted by using suitable roller thrust bearing. Determine the length of the tommy bar.

..c) Also draw a neat free-hand sketch of the jack (screw-jack).

10+5+5

5a) Prove that the maximum load on a preloaded bolt is given by $P_i + P/(1+a)$, where $P_i$ is initial tightening load, P is externally applied load and **a** is the ratio of stiffness. Draw load deflection diagram of the bolted joint in support of your derivation.

b) A 25mm thick steel bracket is to be attached to a wall with the help of seven identical bolts as shown in Fig 1. Select standard bolts made of suitable material for the eccentrically loaded bolted joint application.

(10+10)

6a) A rigid coupling is used to transmit 25 kW power at 980 rpm (Consider a service factor of 1.2). The bolts are to be made of 45C8 steel having tensile yield strength of 350 N/mm$^2$. The yield strength in shear and compression can be taken as 0.5 and 1.2 times the yield strength in tension. The factor of safety can be taken as 2.5. Design the coupling and draw a free hand sketch of the coupling indicating major dimensions.

b) i) Discuss relative merits and demerits of power transmission through belt-pulley drive.
ii) Write short notes on belt slip and centrifugal tension.

(10) + (4 + 6)

7a) i) Draw 'load-vs-time' diagrams for reversed and repeated type fatigue loading and indicate mean and amplitude loads in the diagrams.
ii) Draw a typical S-N diagram for a steel specimen and state how such a diagram is obtained.
iii) Explain theoretical stress concentration factor and notch sensitivity factor.

b) A rotating shaft of 25 mm diameter is made of plain carbon steel. It is subjected to axial load of 5000 N, a steady torque of 150 N-m and maximum bending moment of 75 N-m. Calculate the factor of safety available based on Soderberg and Goodman failure criteria. Assume yield strength for plain carbon steel as 400 MPa. Also indicate Soderberg line and Goodman line in a fatigue diagram.

(4+3+3) + (8+2)

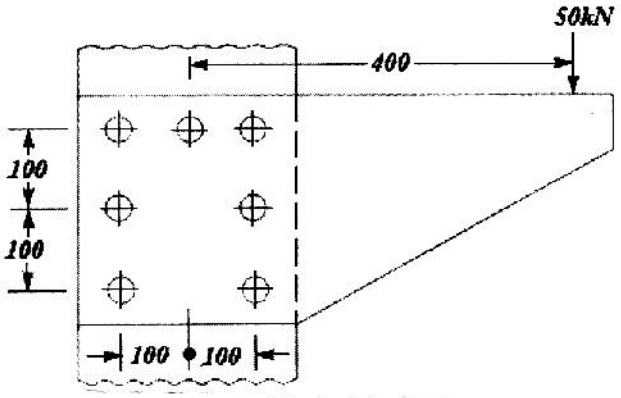


Fig 1.