B. FTBE, 2nd Year, 2nd Sem, 2018

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.

1a) State the stepwise procedure for mechanical engineering design through a block diagram.

b) State the significance of manufacturing processes in engineering design procedure.

c) Classify the types of common engineering materials by following a tree structure.

d) Describe any three important mechanical properties of engineering materials.

e) What are the types of fits? Describe their differences.

f) State the difference between fit and tolerance.

g) What is meant by "50 H7 e6"? Explain with a neat schematic diagram.

h) Specify the required type of fits at locations 'A' and 'B' of the pipe expansion joint, shown below.

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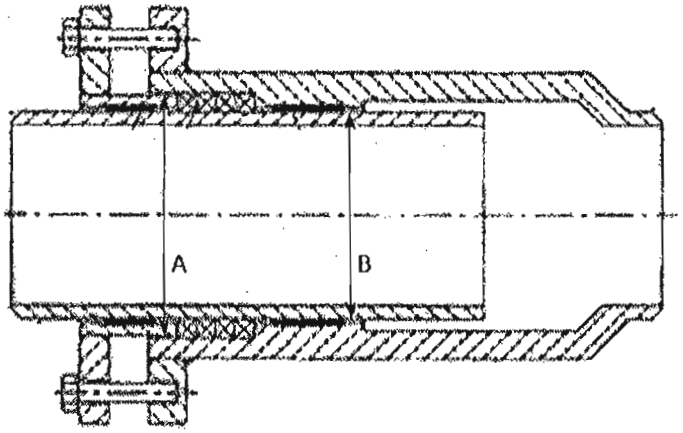

2 i) Define pitch, lead, core diameter and pitch diameter of a thread with supporting sketches.

ii) Name the thread profiles commonly used in power screw and show their profiles by hand sketches.

iii) Distinguish between bolt, screw and stud with supporting sketches.

iv) Why the thread profiles commonly used for the purpose of fastening are different than that of the thread profiles used in power screw applications.

v) Discuss the different stresses developed in the threads due to initial tightening.

vi) Prove that the maximum load on a preloaded bolt is given by $P_i + P/(1+\alpha)$, where P_i is initial tightening load, P is externally applied load and α is the ratio of stiffness.

5x2 + 10

3a) Draw 'load-vs-time' diagrams for reversed and repeated type fatigue loading and indicate mean and amplitude loads in the diagrams.

b) Draw a typical S-N diagram for a steel specimen and indicate its fatigue strength.

c) State how S-N diagrams are obtained experimentally.

d) Explain theoretical stress concentration factor and notch sensitivity factor.

e) A shaft is subjected to torsional moment that varies from 100 N-m to 250 N-m and at the same time, it is subjected to a bending moment of 50 N-m. The shaft is made of plain carbon steel (σ_{yt} = 350 N/mm^2 & σ_{ut} = 500 N/mm^2). Determine the shaft diameter considering the following: Surface finish factor: 0.9, Reliability factor: 0.9, theoretical stress concentration factor: 2, notch sensitivity: 0.25 and factor of safety: 1.5.

2 + 2+ 3 + 3 + 10

4i) An offset link subjected to a force of 22 kN is shown in figure Q2(i). It is made of grey cast iron FG 300, which has an ultimate tensile stress of 300 N/mm^2. Determine the cross section dimensions of the link, assuming ***fos*** = 3.

ii) Design an eccentrically loaded riveted joint as shown in figure Q2(ii). The bracket plate is 50 mm thick and all rivets are of same size. The load on the bracket (P) is 50 KN and it's eccentricity (***e***) from CG (***c***) is 550 mm. The horizontal rivet spacing (***x***) is 300 mm and vertical rivet spacing (***y***) is 250 mm. Assume that permissible shear strength of the rivet material is 50 N/mm^2.

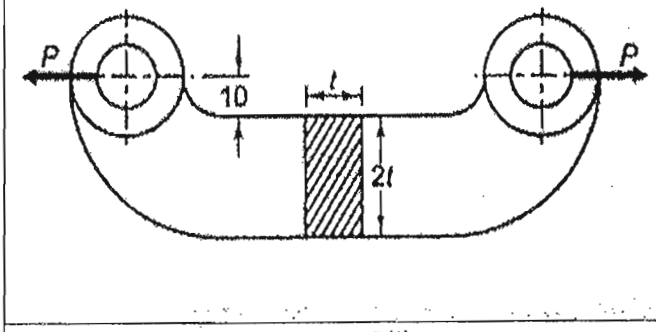

Figure Q2(i)

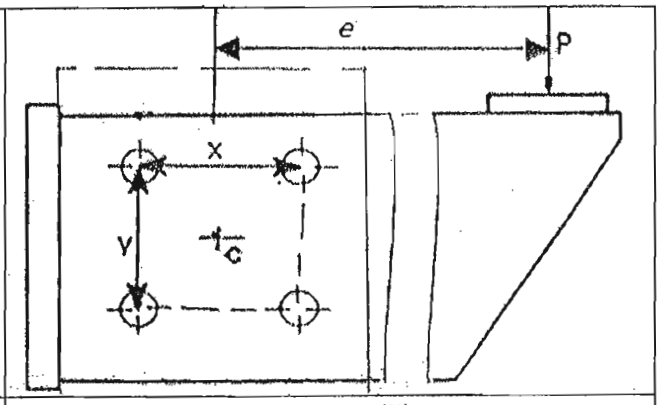

Figure Q2(ii)

7 + 13

5a) Design a knuckle joint to connect two rods under a tensile load of 12 kN. The allowable stresses are 65 MPa in tension, 50 MPa in shear and 83 MPa in crushing.

b) Design a turn buckle which supports 10 kN load and allows 100 mm axial movement. The allowable stress values given in part (a) may be assumed. Also draw a neat sketch of the joint.

7 + (10 + 3)

6a) Design a rigid coupling to transmit 25 kW at 980 rpm (Consider a service factor of 1.2). The bolts are made of 45C8 steel having tensile yield strength of 380 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. Assume that the coupling body is made from FG 250 cast iron. The factor of safety can be taken as 2.5.

b) How the design of the coupling will change if it is made flexible (pin-bush type) instead of rigid? Design the pin and bush of such a coupling.

13 + 7

7) A counter-shaft supports two flat-belt pulleys, as shown in figure Q7. For the pair of pulleys, the minimum center distances (**C**) are restricted to 2 m and 3 m, as shown. The power requirement of the pump is 10 kW at 3000 rpm whereas the rating of the motor is 12 kW at 740 rpm. Design an identical belt-pulley drive system for the application, i.e., the small and large pulley diameters should be same for both pair. Also obtain belt tensions and pulley weights and determine missing dimensions 'A', 'B' and 'C' of the counter-shaft, considering only the static strength of the shaft.

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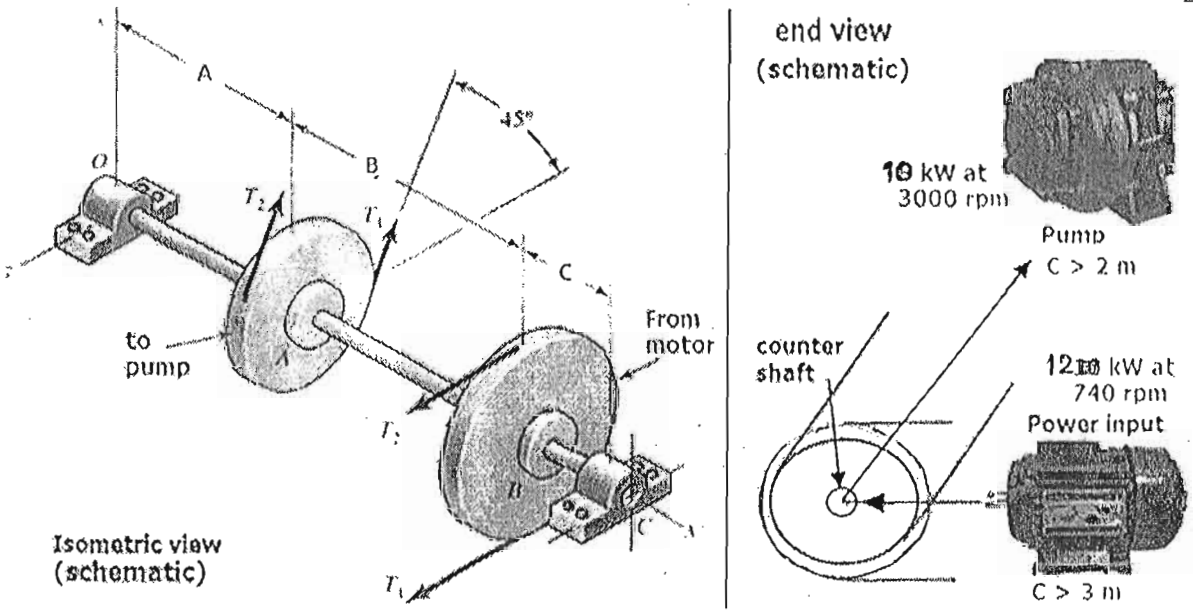

Fig. Q7 - A counter-shaft transmitting power from a motor to a pump

8) Write short notes (any four) on: 4x5

a) Differential and compound screw

b) Significance of theories of failure in engineering design

c) Electric arc welding

d) Design of keys for uniform strength

e) Difference between shaft, counter-shaft and axle