BTS-VI-04.18-0175 Reg. No. | | | | | | | | | |

A

B.Tech. Degree VI Semester Examination April 2018

ME 603 MACHINE DESIGN I

(2006 Scheme)

(Use of Design Data Handbook is permitted. Data not given may be suitably assumed. All such assumptions must be clearly stated)

Time: 3 Hours Maximum Marks: 100

PART A

(Answer *ALL* questions)

(8 × 5 = 40)

I. (a) What is the difference between failure due to static load and fatigue failure?

(b) Define the following terms:

(i) Stress concentration.

(ii) Thermal stress.

(c) Describe the various types of shaft couplings, mentioning the use of each type.

(d) Derive an expression for the efficiency of a square threaded screw.

(e) Write short notes on:

(i) Lozenge joint.

(ii) Caulking and Fullering.

(f) Explain A.M. Wahl's factor and state its importance in designing helical springs.

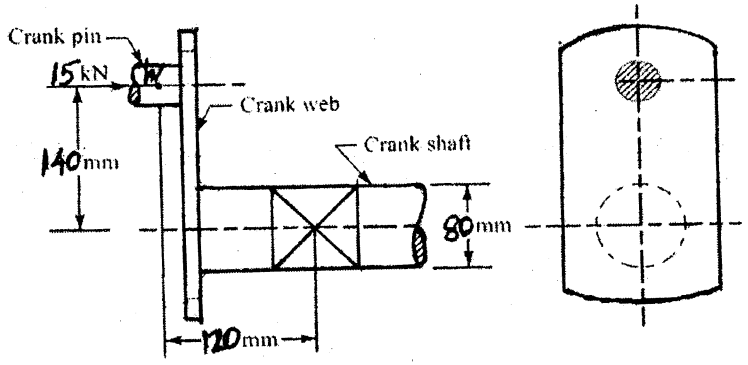
(g) A hollow shaft has greater strength and stiffness than a solid shaft of equal weight. Explain.

(h) With the help of figure, derive the strength for a transverse single fillet weld.

PART B

(4 × 15 = 60)

II. An overhang crank with pin and shaft is shown in figure. A tangential load of 15 kN acts on the crank pin. Determine the maximum principal stress and the maximum shear stress at the centre of the crankshaft bearing.



OR

(P.T.O.)

III. A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm clockwise to 110 Nm counter clockwise and an applied bending moment at the critical section varies from 440 Nm to -220 Nm. The shaft is of uniform cross section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and a yield strength of 410 MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62.

IV. Design a sleeve and cotter joint to connect two rods which transmits maximum tensile load of 100 kN. Assume that the rods, sleeve and cotter are made of same material and the permissible stresses in the material are 65 N/mm^2 (in tension), 130 N/mm^2 (in compression) and 50 N/mm^2 (in shear). Make a neat dimensioned sketch of the joint.

OR

V. A double threaded power screw with isometric trapezoidal threads is used to raise a load of 300 kN. The nominal diameter is 10 mm and the pitch is 12 mm. Coefficient of friction for thread is = 0.15. Neglect collar friction. Calculate:

(i) Torque required to rise the load.
(ii) Torque required to lower the load.
(iii) Efficiency of the screw.

VI. Design a riveted joint for the longitudinal and circumferential seam of boiler 2 m diameter to withstand maximum pressure of 10 N/cm^2 (gauge). The ultimate strength of plate is 370 N/mm^2 in tension and a factor of safety of 5 is recommended. The allowable stress in shearing of rivets is 60 N/mm^2 and in crushing of rivets is 100 N/mm^2. Sketch the joint.

OR

VII. A cylinder relief valve of diameter 70 mm is working at pressure of 1.5 N/mm^2 and lift 6 mm for 5 % increase in pressure. Design the valve spring by computing important parameters of the spring. The allowable shear stress is 50 N/mm^2 and $G = 0.85 \times 10^5$ N/mm^2 for the spring material.

VIII. A low carbon steel plate of 0.7 m width welded to a structure of similar material by means of two parallel fillet welds of 0.112 m length (each) is subjected to an eccentric load of 4000 N, the line of action of which has a distance of 1.5 m from the centre of gravity of the weld group. Design the required thickness of the plate when the allowable stress of the weld metal is 60 MPa and that of plate is 40 MPa.

OR

IX. The shaft of an axial flow rotary compressor is subjected to a maximum torque of 2000 Nm and a maximum bending moment of 4000 Nm. The combined shear and fatigue factor in torsion and bending may be taken as 1.5 and 2.0 respectively.

(i) Determine the diameter of the shaft if the shear stress should not exceed 50 MN/m^2.
(ii) Design a hollow shaft for the above Compressor taking $d_i/d_o = 0.5$. What is the % saving of material? Also compare the stiffness?

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