ANNA UNIVERSITY OF TECHNOLOGY, COIMBATORE

B.E. / B.TECH. DEGREE EXAMINATIONS : NOV / DEC 2011

REGULATIONS : 2008

FIFTH SEMESTER

080120025 - DESIGN OF MACHINE ELEMENTS

(COMMON TO MECHANICAL / AUTOMOBILE ENGINEERING)

(USE OF DESIGN DATA BOOK IS PERMITTED)

Time : 3 Hours **Max.Marks : 100**

PART - A

(10 x 2 = 20 Marks)

ANSWER ALL QUESTIONS

1. What is meant by stress concentration factor?
2. Express Goodman equation for ductile material and brittle material.
3. What is a journal bearing? List its types depending on the nature of lubrication.
4. What is the function of a flywheel?
5. What do you understand by leverage?
6. What is meant by nip in leaf springs?
7. What is the difference between caulking and fullering?
8. What are the two types of stresses induced in eccentric loading of loaded joint?
9. Under what circumstances are flexible couplings used?
10. Distinguish between cotter joint and knuckle joint.

PART - B

(5 x 16 = 80 Marks)

ANSWER ALL QUESTIONS

11. a. A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 Nm and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to (i) The maximum principal stress; (ii) The maximum shear stress; and (iii) The maximum distortion strain energy theory of yielding.

(OR)

11. b. (i) 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 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200 kN/mm^2. (8)

11. b. (ii) A rectangular strut is 150 mm wide and 120 mm thick. It carries a load of 180 KN at an eccentricity of 10 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section. (8)

12. a. Design a rigid muff coupling. Use C.I. for the muff. The power transmitted is 25 KW at 300 r/min S_{ut}=200 MPa, F.S=6, use 30C8 steel for the shaft. Consider. S_y=330 MPa and F.S=4.

(OR)

12.b. (i) A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of size 14 mm wide and 9 mm thick made of steel with yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2. (8)

Cont...Q.No.12.(b)

12.b.(ii) Find the diameter of a solid steel shaft to transmit 20 kW at 200 r/min. The ultimate shear strength for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5. (8)

13. a. Determine the size of the bolts and the thickness of the arm for the bracket as shown in Fig.1, if it carries a load of 40KN at an angle of 60^0 to the vertical. The material of the bracket and the bolts is same for which the safe stress can be assumed as 70, 50 and 105 MPa in tension, shear and compression respectively.

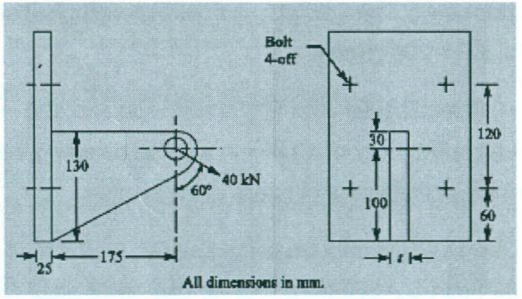

Fig.1

(OR)

13. b. Design the riveted joints for the longitudinal and circumferential seams of a boiler for the following requirements.

Internal diameter of boiler shell = 1.5 meter
Maximum steam pressure =1N/mm^2
Ultimate tensile pressure =300 N/mm^2
Factor of safety=4
Design shear strength for rivets = 60 N/mm^2
Design crushing strength for rivets =120 N/mm^2.

14. a. A handle for turning the spindle of a large valve is shown in Fig. 2. The length of the handle from the centre of the spindle is 450 mm. The handle is attached to the spindle by means of a round tapered pin. If an effort of 400 N is applied at the end of the handle, find: (i) mean diameter of the tapered pin, and (ii) diameter of the handle. The allowable stresses for the handle and pin are 100 MPa in tension and 55 MPa in shear.

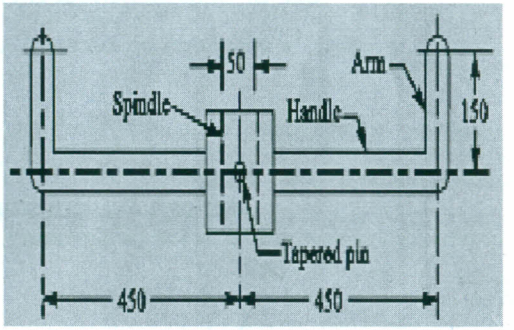

Fig.2

(OR)

14.b. A composite spring has two closed coil helical springs as shown in Fig. 3. The outer spring is 15 mm larger than the inner spring. The outer spring has 10 coils of mean diameter 40 mm and wire diameter 5mm. The inner spring has 8 coils of mean diameter 30 mm and wire diameter 4 mm. When the spring is subjected to an axial load of 400 N, find (i) Compression of each spring, (ii) Load shared by each spring, and (iii) Shear stress induced in each spring. The modulus of rigidity may be taken as 84 kN/mm^2.

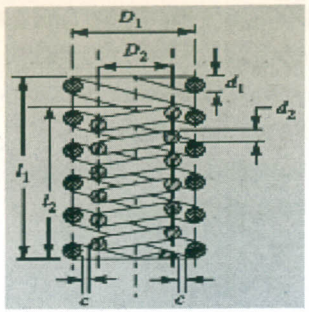

Fig.3

15.a. A shaft rotating at a constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing.

(OR)

15.b. The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r/min. Determine the following: (a) Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2, and (b) Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm.

*****THE END*****