Roll No:

B.E.FULL-TIME DEGREE END SEMESTER EXAMINATIONS, MAY 2012

INDUSTRIAL ENGINEERING

FOURTH SEMESTER- (REGULATION-2008)

ME9305 DESIGN OF MACHINE ELEMENTS

(Use of Design Data Book is permitted)

Time: 3 hr Max. Mark: 100

Answer ALL Questions

Part-A (10 X 2 = 20 Mark)

1. Show the framework of elements of Engineering Design Philosophy
2. Define Scuffing and Frettage
3. What is Oldham Coupling?
4. What are the stresses induced in the shafts?
5. What are the failures of riveted joints?
6. How will you determine the combination of single transverse & double parallel fillet weld?
7. What are the stresses acting in a flywheel rim?
8. Define Spring Index and Spring Rate
9. What are the various types of Roller Bearings?
10. Define Sommerfeld Number

Part-B (5 X 16 = 80 Marks)

11. Design a Journal bearing for a Centrifugal Pump from the following data:
Load on the Journal=20,000N, Speed of the Journal=900 rpm, Type of oil is SAE10 for which the absolute viscosity at 55°C=0.017Kg/m-s, Ambient Temperature of oil=15.5°C, Maximum bearing pressure for the pump=1.5N/mm^2, Clearance Ratio=0.0013. Calculate also Mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C, Heat dissipation Coefficient=1232 W/m^2/°C

12 (a) (i) Give the dimensions for the hole and shaft for a 50mm sleeve bearing on the elevating mechanisms of a road grader. (4)

(ii) A copper bar 50mm in diameter is placed within a steel tube 75mm external diameter & 50mm internal diameter of exactly the same length. The two pieces are rigidly fixed together by two pins 18mm in diameter, one at each end passing through the bar and tube. Calculate the stress induced in the copper bar, steel tube and pins, if the temperature of the combination is raised by 50°C, Take E_s=210GN/m^2, E_c=105GN/m^2, α_s=11.5X10^{-6}/°C & α_c=17X10^{-6}/°C (12)

OR

12 (b) A mild steel shaft of 80mm diameter is subjected to a bending moment of 2000N-m and a torque T. If the yield point of the steel in tension is 200MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum principal stress 2.The maximum shear stress and 3. The maximum distortion strain-energy theory of yielding? (16)

13 (a) Design a protective type of cast iron flange coupling for a steel shaft transmitting 15KW at 200 rpm and having an allowable shear stress of 40MPa. The working stress in the bolts should not exceed 30MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The max torque is 25% greater than the full load torque. The shear stress for cast iron is 14MPa. The no of bolts is four. (16)

OR

13 (b) (i) A steel spindle transmits 4KW at 800rpm. The angular deflection should not exceed 0.25°/m of the spindle. If the modulus of rigidity for the material of the spindle is 84GPa. Find the diameter of the spindle and the shear stress induced in the spindle (6)

(ii) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length (10)

14 (a) A mild steel cover plate is to be designed for an inspection hole in the shell of a pressure vessel. The hole is 120mm in diameter and the pressure inside the vessel is 6 N/mm^2. Design the cover plate along with the bolts. Assume allowable tensile stress for mild steel as 60MPa and for bolt material as 40MPa and the thickness of the cylinder wall is 10mm. (16)

OR

14 (b) Design a cotter joint to support a load varying from 35KN in compression to 30KN in tension. The Material used is carbon steel for which the following allowable stress may be used. The load is applied statically. Tensile stress=Compressive stress=50MPa, Shear Stress=35MPa and Crushing Stress=90MPa (16)

15 (a) Design a valve spring of a petrol engine for the following operating conditions:
Spring Load when the valve is open=400N, Spring Load when the valve is closed=250N, Maximum inside diameter of spring=25mm, Length of the spring when the valve is open=40mm, Length of the spring when the valve is closed=50mm, Maximum permissible shear stress=400MPa. Assume necessary data for the problem (16)

OR

15 (b) Design a cast iron flywheel used for a four stroke I.C. Engine developing 180KW at 240rpm. The hoop or centrifugal stress developed in the flywheel is 5.2MPa, the total fluctuation of speed is limited to 3% of the mean speed the work done during the power stroke is 1/3 more than the average work done during the whole cycle. The maximum torque on the shaft is twice the mean torque. The density of cast iron is 7220 Kg/m^3 ; τ=40MPa, Minor Axis=0.5 major axis; no of arms is 6; σ_b=15MPa (16)