B.E./B.Tech SEMESTER ARREAR EXAMINATIONS, NOV/DEC 2013

MECHANICAL ENGINEERING

5TH SEMESTER – (R-2008)

ME 9305 – DESIGN OF MACHINE ELEMENTS

(Use of PSG design data book is permitted)

Time : 3 Hrs Maximum marks: 100

Answer all Questions

PART – A (10 x 2 = 20)

1. State the advantages and disadvantages of Fibre Reinforced Plastic materials, as engineering materials for structural components.
2. Why hole based systems are preferred than shaft based system in fits and tolerances?
3. What is nip and express its importance in leaf springs.
4. How will you find whether the given helical spring is a compression spring or tension spring?
5. Why I- section is preferred in connecting rods?
6. Define equivalent dynamic load of bearings.
7. What is the effect of key way cut into the shaft?
8. Shafts are always of uniform circular cross section. True or false. Justify your answer.
9. Differentiate bolt, nut, stud and screw.
10. Why riveted joints are preferred over welded joints in aircraft body?

PART - B

11. (i) The C – frame of a 100 kN capacity press is shown in fig. 11(i)(a) &(b). The material of the frame is grey cast iron FG 200 and the factor of safety is 3. Determine the dimensions of the frame. (10 marks)

    (ii) The surface of a steel machine member is subjected to principal stresses of 200 N/mm^2 and 100 N/mm^2. What tensile yield strength is required to provide a safety factor of 2 with respect to initial yielding, according to maximum shear stress theory? (4 marks)

    (iii) A steel member is subjected to a variable bending stress of 40 N/mm^2 to – 50 N/mm^2. The yield strength of the material is 350 N/mm^2. If the ultimate strength is 550 N/mm^2, find the factor of safety. (2 marks)

12. (a) A transmission shaft, supporting two pulleys A and B and mounted between two bearings as shown in fig. 12(a). Power is transmitted from pulley A to B. The shaft is made of plain carbon steel 45C8 (σ_{ut} = 600 N/mm^2 and σ_{yt} = 480 N/mm^2). The pulleys are keyed to the shaft. Determine the shaft diameter using **ASME** code if k_b = 1.5 and k_t = 1. Also determine the shaft diameter on the basis of torsional rigidity, if the permissible angle of twist between the pulleys is 5° and G = 79300 N/mm^2. (16 marks)

    (OR)

12. (b) (i) A rigid coupling is used to transmit 20kW power at 720 rpm. There are 4 bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that bolts are finger tight in reamed and ground holes. (6 marks)

    (ii) Design an overhung crank shaft for the following data: Maximum load on the crank pin for maximum torque position = 50 kN, crank radius = 200 mm, distance between crank pin centre and nearby bearing centre = 300mm. Allowable stresses in bending = 70 MPa, shear = 50 MPa and bearing = 7 MPa. (10 marks)

13. (a) A concentric spring for an aircraft engine valve is to carry a maximum load of 5000N, under an axial deflection of 40 mm, both these springs have same free length, same solid length and are subjected to equal maximum shear stress of 850 N/mm^2. If the spring index for both the springs is 6, determine (i) the load shared by each spring (ii) spring wire diameter, mean coil diameter and number of coils for both the springs. Take G = 80,000 N/mm^2 and diametral clearance to be equal to the difference of wire diameters between outer and inner springs. (16 marks)

(OR)

13. (b) A semi elliptic leaf spring is used for the suspension of automobile application. The center to center distance is 1.2 m. It has been 2 full length leaves and 10 graduated leaves. (σ_{ys} = 1000 N/mm^2, E = 2.11 x10^5 N/mm^2 and FOS 2.5. The maximum force is 10 kN. Ratio of width to thickness is 10:1. Calculate width, thickness and nip. (16 marks)

14. (a) A bracket carrying a load of 20kN is to be welded as shown in fig 14(a). Calculate the size of the weld if the working shear stress is not to exceed 70 N/mm^2. (16 marks)

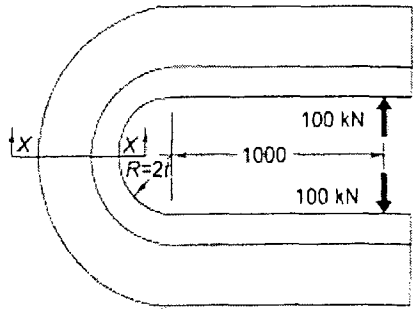
(OR)

14. (b) An offset bracket is fixed to a steel column, as shown in fig 14(b), by means of four bolts. The bracket is subjected to an inclined pull of 12 kN. Determine the diameter of the bolt if the allowable strength of the bolt material is 120 N/mm^2. (16 marks)

15. (a) A 100 mm dia semi journal bearing supports a radial load of 5000N. The bearing is 100 mm long and operates at 400 rpm. Permissible minimum film thickness is 25 and diametral clearance is 125 microns. Find (i) suitable oil and its Viscosity (ii) friction co efficient (iii) heat generation rate (iv) amount of oil pumped through bearing (v) amount of end leakage (vi) rise in temperature of oil. Assume operating temperature of the oil as 87 ^{0}C. (16 marks)

(OR)

15. (b) A four stroke diesel engine has following specifications. Diameter of piston = 75 mm, stroke = 100 mm, speed = 750 rpm, length of connecting rod = 225 mm. Maximum gas pressure = 7 N/mm^2, mass of reciprocating parts = 1.5 kg. Assume C60 steel as material for connecting rod. Find (i) load due to gas pressure (ii) axial load on connecting rod (iii) dimensions of the connecting rod and (iv) check the induced stresses are within the design stresses. (16 marks)



(a)

(b) Section at XX

fig. 11(i)

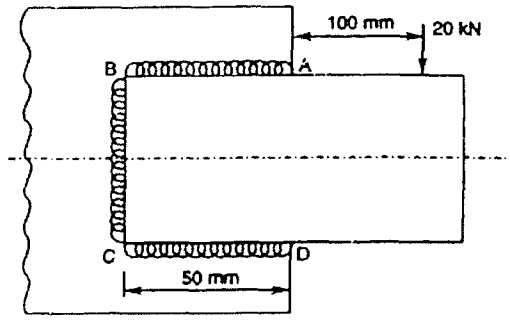
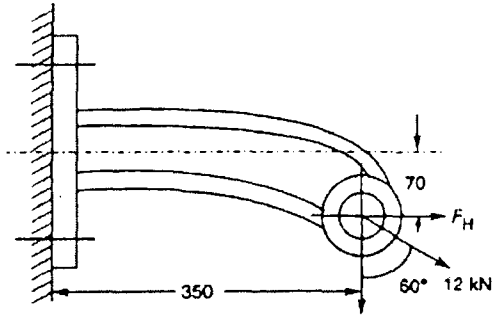


fig. 14(a)



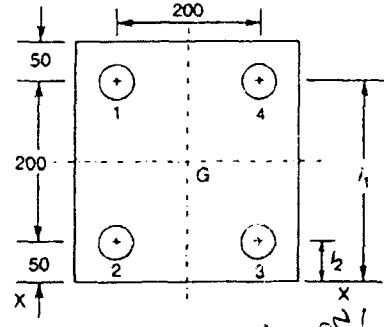


fig. 14(b)

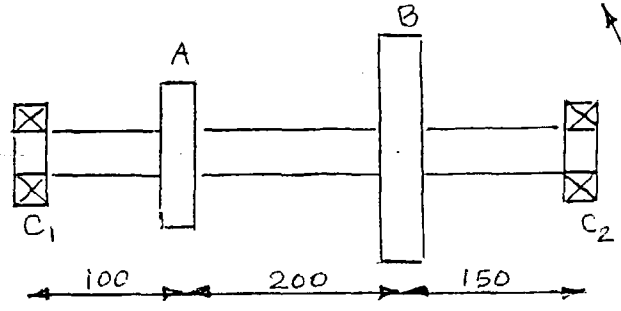


fig. 12(a)