Code: 13A03505 **R13**

B.Tech III Year I Semester (R13) Regular Examinations December 2015

DESIGN OF MACHINE MEMBERS – I

(Mechanical Engineering)

Use of Design data books is permitted in the examination hall

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) How is factor of safety defined for brittle and ductile materials?

(b) What are the various factors considered in the selection material for a machine element?

(c) Give one method of reducing stress concentration in key slots.

(d) Differentiate between Endurance limit and endurance strength.

(e) What are the advantages of preloading bolted joints?

(f) Differentiate with a neat sketch the fillet weld subjected to parallel loading and transverse loading.

(g) Differentiate between a cotter joint and a knuckle joint.

(h) List the shaft materials. State the reasons for their selection.

(i) Where are flexible couplings used?

(j) What are the materials used for flange coupling parts?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

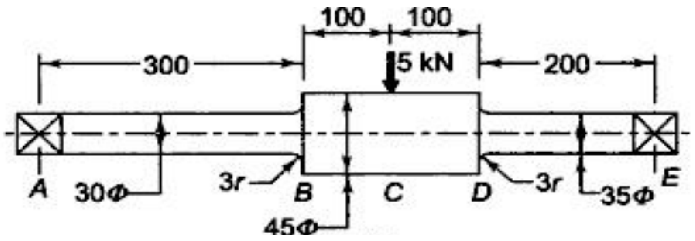
2 A hollow shaft is required to transmit 600 kW at 110 r.p.m, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 63 MPa and twist in a length of 3 meters not to exceed 1.4 degrees. Find the external diameter of the shaft, if the internal diameter to the external diameter is 3/8. Take modulus of rigidity as 84 GPa.

OR

3 A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m 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. (iii) The maximum distortion strain energy theory of yielding.

UNIT – II

4 A rotating shaft Subjected to a steady load of 5 kN and simply supported between to bearings A and E as shown in figure below. The shaft is machined from plain carbon steel 30C8 (Sut = 500 N/mm^2) and the expected reliability is 90%. The equivalent notch radius at the fillet section can be taken as 3 mm what is the life of the shaft.



OR

5 (a) Draw the SN curve for the ferrous and non ferrous materials and discuss their importance in design of components subjected variable loading.

(b) A machine component is subjected to a fluctuating stress that varies from 40 N to 100 N/mm^2. The corrected endurance limit of the machine component is 270 N/mm^2. The ultimate stress and yield point stress of the material are 600 and 400 N/mm^2 respectively. Find the factor of safety using: (i) Gerber formula. (ii) Solderberg line. (iii) Goodman line.

Contd. in page 2

UNIT – III

6 Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa; compressive stress 140 MPa; and shear stress in the rivet 56 MPa.

OR

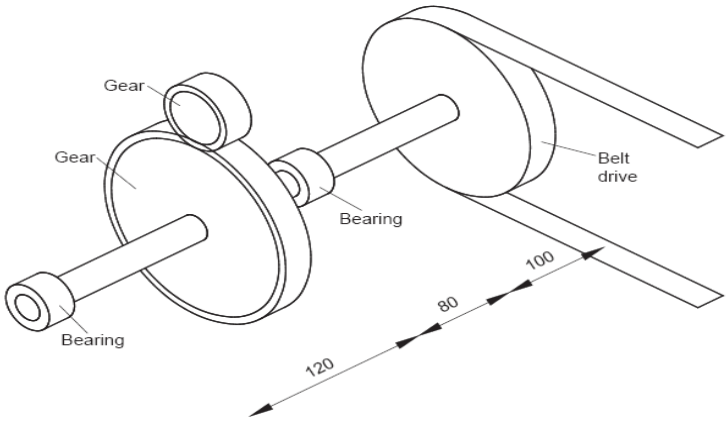
7 A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 N/mm^2. The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5.

UNIT – IV

8 Design a knuckle joint to connect two circular rods subjected to an axial force of 50 kN. The rods are coaxial and small amount of angular movement between their axis is permissible. Design the knuckle joint and specify the dimensions of its components.

OR

9 Using the ASME equation for the design of transmission shafting determine a sensible minimum nominal diameter for the drive shaft illustrated in figure given below, consisting of a mid mounted spur gear and overhung pulley wheel. The shaft is to be manufactured using 817M40 hot rolled alloy steel with σ_{uts}= 1000 MPa, σ_y= 770 MPa and Brinell Hardness approximately 220 BHN.The radius of the fillets at the gear and pulley shoulders is 3 mm. The power to be transmitted is 8 kW at 900 rpm. The pitch circle diameter of the 20° pressure angle spur gear is 192 mm and the pulley diameter is 250 mm. The masses of the gear and pulley are 8 and 10 kg respectively. The ratio of belt tensions should be taken as 2.5. Profiled keys are used to transmit torque through the gear and pulley. Take factors for stress concentration and fatigue for bending and twisting moments are as 2.0 and 1.5 respectively. Assume the shaft is of constant diameter for the calculation.



UNIT – V

10 Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used :
Shear stress for shaft, bolt and key material = 40 MPa
Crushing stress for bolt and key = 80 MPa
Shear stress for cast iron = 8 MPa

OR

11 The shaft and the flange of a marine engine are to be designed for flange coupling, in which the flange is forged on the end of the shaft. The following particulars are to be considered in the design :
Power of the engine = 3 MW
Speed of the engine = 100 r.p.m.
Permissible shear stress in bolts and shaft = 60 MPa
Number of bolts used = 8
Pitch circle diameter of bolts = 1.6 × Diameter of shaft
Find: (i) Diameter of shaft. (ii) Diameter of bolts. (iii) Thickness of flange. (iv) Diameter of flange.

*****