BTS(C) – VI – 11 – 013 – M

* Fatigue
* Creep,
* Resilience

B. Tech Degree VI Semester Examination April 2011

ME 603 MACHINE DESIGN I
(*2006 Scheme*)

Time : 3 Hours

Maximum Marks : 100

(Use of approved design data hand book is permitted)

PART – A
(Answer **ALL** questions)

(8 x 5 = 40)

I. (a) Define machine design. What are the steps involved in design of machine element.

(b) Explain the following:
  (i) Factor of safety
  (ii) Thermal stress

(c) What is self locking of power screw? What is the condition of self locking?

(d) (i) Explain the significance of pre-loading of bolts.
  (ii) How is the slipping of a cotter avoided?

(e) (i) What are the various modes in which a riveted joint may fail?
  (ii) Name the various assumptions taken in design of riveted joint.

(f) What is spring index? Explain nipping in springs.

(g) What are the different types of welded joints? Why reinforcement is normally required in welded joints?

(h) Explain critical speed of shafts.

PART – B

(4 x 15 = 60)

II. A cylindrical shaft made of steel of yield strength 700MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using two different theories of failure and assuming a factor of safety of 2.
Take E = 210 GPa and Poisson's ratio = 0.25.

(15)

OR

III. A pulley is keyed to a shaft midway between two anti-friction bearings. The bending moment at the pulley varies from -170 N-m to 510 N-m and the torsional moment in the shaft varies from 55 N-m to 165 N-m. The frequency of the variation of the loads is the same as the shaft speed. The shaft is made of cold drawn steel having an ultimate strength of 540 MN/m^2 and a yield strength of 400 MN/m^2. Determine the required diameter for an indefinite life. The stress concentration factor for the key way in bending and torsion may be taken as 1.6 and 1.3 respectively. The factor of safety is 1.5. (15)
Take size factor = 0.85 and surface finish factor = 0.88.

IV. In a steam engine the maximum steam pressure is 1.0 N/mm^2 absolute and the back pressure is 0.014 N/mm^2 absolute. The cylinder diameter is 0.3m. The contact surfaces of the head and cylinder are ground together so that no packing is necessary. What must be the diameter of the bolt, so that the maximum stress in the bolt necessary to ensure a steam tight joint will not exceed 55.0 N/mm^2. Assume number of bolts used = 8. If steel studs are used and rubber gasket 3mm thick be placed between the contact surfaces, what must be diameter of the studs?

(15)

OR

(P.T.O)

V. It is required to design a split muff coupling to transmit 50KW power at 120 rpm. The shafts, key and clamping bolts are made of plain carbon steel 30C8. (Sy_t = 400 N/mm^2). The yield strength in compression is 15% of tensile yield strength. The factor of safety for shafts, key and bolts is 5. The number of clamping bolt is 8. The coefficient of friction between sleeve halves and the shaft is 0.3.

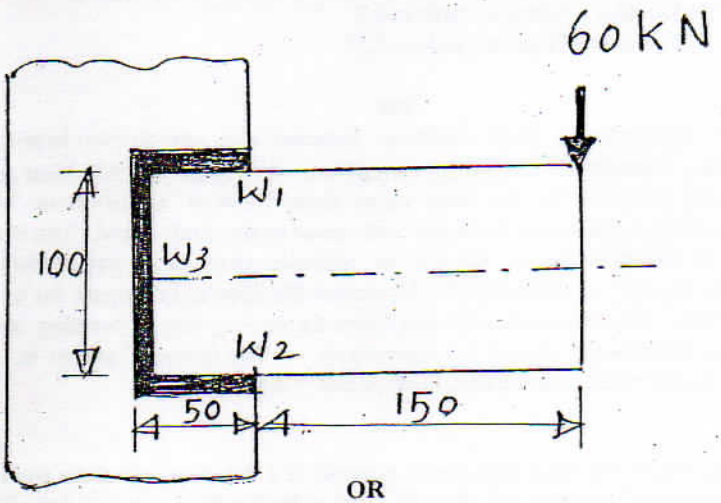
(i) Calculate the diameter of input and output shafts.
(ii) Specify length and outer diameter of sleeve halves
(iii) Find out the diameter of clamping bolts assuming that the power is transmitted by friction.
(iv) Specify bolt diameter using standard empirical relations.
(v) Specify the size of key and check the dimensions for shear and compression criteria. (15)

VI. Design a triple riveted longitudinal double strap butt joint with unequal straps for a boiler. The inside diameter of the longest course of the drum is 1.3 meters. The joint is to be designed for a steam pressure of 2.4 N/mm^2. The working stresses 77 N/mm^2 in tension, 62 N/mm^2 in shear and 120N/mm^2 in compression shall be selected. Assume the efficiency of the joint as 81%. (15)

OR

VII. Design a helical spring for a spring loaded safety valve (R2ms-bottom safety valve) for the following conditions: -
Diameter of valve seat = 65mm
Operating pressure = 0.7 N/mm^2
Maximum pressure when the valve blows off freely = 0.75 N/mm^2
Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 = 3.5mm
Maximum allowable stress = 550 N/mm^2
Modulus of rigidity = 84 x 10^3 N/mm^2
Spring index = 6
• Draw a neat sketch of the free spring showing the main dimensions. (15)

VIII. A welded connection as shown in the figure is subjected to an eccentric force of 60 kN in the plane of the welds. Determine the size of the welds, if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions.



(15)

OR

IX. A hollow shaft of 0.5m outside diameter and 0.3m inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearings 6m apart and it transmits 5600KW at 150 rpm. The maximum axial propeller thrust is 500 kN and the shaft weighs 70 kN.
Determine - (i) the maximum shear stress developed in the shaft and
(ii) the angular twist between the bearings. (15)

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