Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech

CPME 6303

Fifth Semester (Special) Examination – 2013

MACHINE DESIGN – I

BRANCH : MECH

QUESTION CODE : D 306

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **four** from the rest.*
The figures in the right-hand margin indicate marks.
Draw neat sketches wherever necessary. Assume any missing data suitably.
Use of only Specified Design Data Book is permitted inside the examination hall.

1. Answer the following questions : 2×10

   (a) What are the different stages for designing a machine component ?

   (b) What do you mean by the terms Standardization and Interchangeability?

   (c) Where the designers use diamond riveting ?

   (d) What are the differences between parallel and transverse weld?

   (e) Which theories of failure are applicable for shaft design ? Justify your answer.

   (f) What is a gib ? What is its function in a gib and cotter joint ?

   (g) What is lever ? Explain the principle on which it works.

   (h) What do you understand by surge in a spring ? How can it be prevented ?

   (i) Why is the nut of a power screw made of a soft material ?

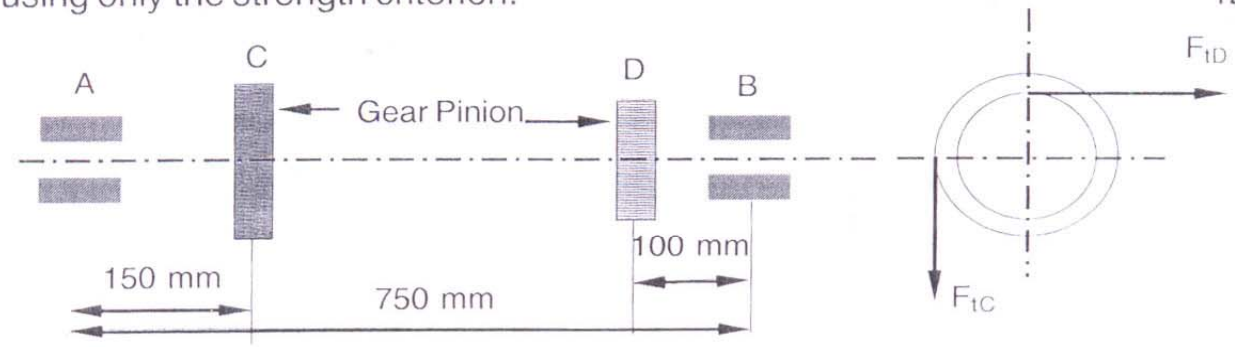
   (j) What types of stresses are induced in key ?

2. Design a riveted joint (Consider both longitudinal and circumferential seams) of a boiler having 1.3 meter diameter to withstand maximum pressure of 2.25 N/mm^2. The longitudinal joint is triple-riveted, double-cover plate butt joint with straps of

unequal width and the circumferential joint is double-riveted lap joint. Material for the boiler plate and rivets are C20 having allowable limits of tensile, shear and crushing strengths are 90 N/mm^2, 60 N/mm^2 and 120 N/mm^2. Efficiency of the longitudinal joint is 85%. Corrosion allowance is 1.5 mm. 12.5

3. Design a knuckle joint to connect two rods of equal diameter. Each rod is subjected to an axial tensile force of 20 kN. The rods are made of mild steel having allowable limits of tensile, shear and crushing strengths are 75 N/mm^2, 50 N/mm^2 and 120 N/mm^2. 12.5

4 A steel solid shaft transmitting 15 kW at 300 r.p.m. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Both the pinion and gear profile is corresponding to 20° full depth system. The shaft is made of plain carbon steel having yield shear strength 250 N/mm^2 and Young's modulus 0.2 $\times 10^6$ N/mm^2. The shock and fatigue factor for bending and torsion as 2 and 1.5 respectively. Design the shaft using only the strength criterion. 12.5



5 A bushed-pin type flexible coupling is used to connect the output shaft of an electric motor to the shaft of a compressor. The electric motor delivers transmitting 20 kW power at 500 rpm. The overload capacity is 1.25 times the average torque. Design the bushed-pin type flexible coupling. The shaft, keys and pins are made of plain carbon steel C40 having yield tensile strength 340 N/mm^2. The flange is made of Grey cast iron FG200 (Ultimate tensile strength is 200 N/mm^2). 12.5

6 A semi-elliptical laminated spring is to carry a load of 10 kN. It consists of 10 leaves 50 mm wide, 2 of the leaves being of full length. The spring is to be 1 meter between the eyes and is held at the center by a 53 mm wide clamp. The spring is initially stressed so as to induce an equal stress of 500 MPa when fully loaded. Design the spring system and determine the dimensions of the spring such as :

(a) Thickness of leaves

(b) Eye diameter

(c) Length of leaves

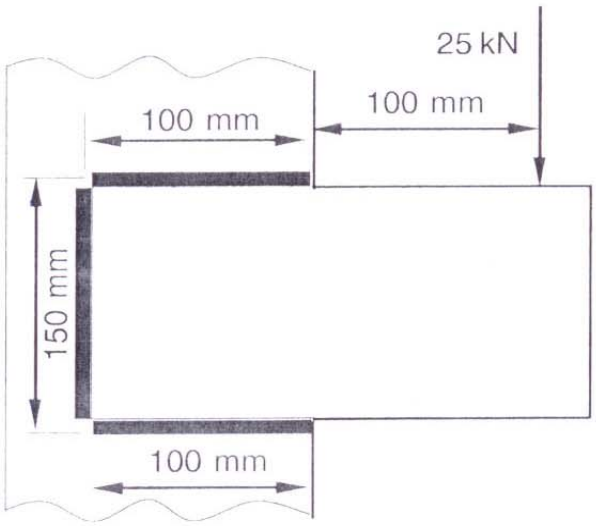
(d) Maximum deflection and camber

(e) Size of center bolt required (Material of the bolt is made of MS having allowable tensile strength of 100 N/mm^2)

Take bearing pressure as 10 MPa and tensile yield stress of the pin material (40 C8) 328.6 MPa. The modulus of elasticity of the material is 207000 N/mm^2. 12.5

7. (a) Design a simple lever of a safety valve for a boiler having a gauge pressure of 2.5 MN/m^2. The valve diameter is 90 mm. The lever is 1 meter long and the distance between the fulcrum and the valve point is 125 mm. The cross section of the lever is rectangular having width to height ratio is 4 : 1. The lever is made of C20 steel having allowable strength of 90 N/mm^2. The bearing pressure at the pin is 20 N/mm^2. 6.5

(b) A bracket carrying a load of 25 kN is to be welded as shown in the figure. Calculate the size of the weld if the permissible shear stress is not to exceed 60 N/mm^2. 6



8. Answer the following :

(a) How is strength of a shaft affected by the keyway ? 3

(b) What are the various types of misalignments, which normally occur between two shafts ? 3.5

(c) Give the standard proportions for industrial practice of a rectangular key. 3

(d) Differentiate between first, second and third class levers ? Why third-class is not recommended by the designer for use ? 3