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

Total number of printed pages – 4

B. Tech

PCME 4303

Fifth Semester Regular Examination – 2014

DESIGN OF MACHINE ELEMENTS

BRANCH : MECH

QUESTION CODE : H 169

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 BPUT 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 machine elements ?

(b) Explain the following terms :

(i) Standardization

(ii) Tolerances.

(c) What do you mean by the term Interchangeability ? What is its importance in the design of machine elements ?

(d) What do you understand by diamond riveting and where should the designer use it ?

(e) Explain the bending failure of knuckle pin in knuckle joint.

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

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

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

(i) What do you mean by buckling of a spring ? How it can be prevented ?

(j) What types of stresses are produced in a belt used for power transmission ?

2. (a) Differentiate between parallel and transverse weld. What do you mean by throat and leg of a weld ? 2.5

(b) Design a boiler joint by using riveted joints at the seams of a boiler having 1.825 meter diameter to withstand maximum pressure of 1.83 N/mm^2. Material for the boiler plate and rivets are C15 having allowable limits of tensile, shear and crushing strengths are 80 N/mm^2, 50 N/mm^2 and 125 N/mm^2. Efficiency of the longitudinal joint is 85%. Corrosion allowance is 2.0 mm. The longitudinal joint is triple-riveted, double-cover plate butt joint with straps of unequal width having zig-zag arrangement. The circumferential joint is double-riveted lap joint with zig-zag arrangement. 10

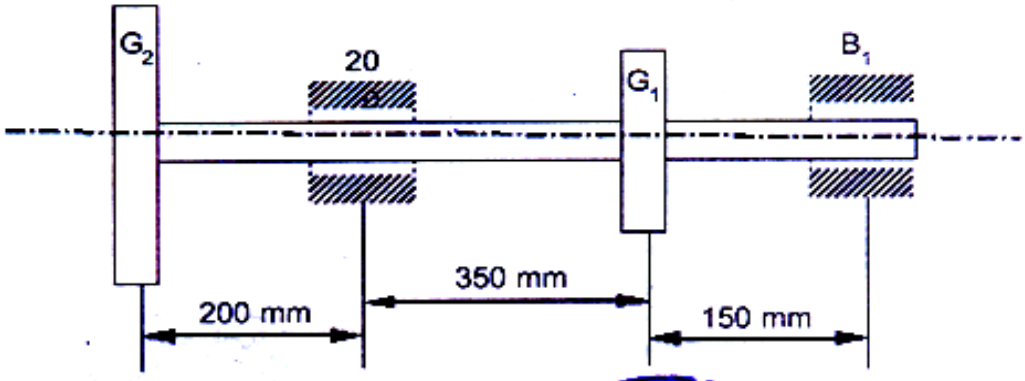
3. (a) Explain the bending failure of cotter in socket and spigot cotter joint. 2.5

(b) Design a socket and spigot cotter 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 50 N/mm^2, 45 N/mm^2 and 90 N/mm^2. 10

4. (a) How is strength of a shaft affected by the keyway ? 2.5

(b) A solid shaft transmitting 22.5 kW at 220 rpm from gear G_1 through gear G_2 Both the gears are mounted on two bearings B_1 and B_2 as shown in the figure 4.1. Pitch circle diameter of gears G_1 and G_2 are 350 mm and 700 mm respectively. The gears are having 20^0 pressure angle and 5 module. The gear G_1 rotates in anticlockwise direction when viewed from the right hand side and it receives power from top. Shaft material is plain carbon steel having yield shear strength of 250 N/mm^2. The combined shock and

fatigue factors for tension and bending may be taken as 1.2 and 1.5 respectively. Design the Shaft using the strength criterion. 10



(Figure 4.1)

5. (a) Discuss the various types of misalignments, which normally occur between two shafts. 2.5

(b) A protected type of rigid flange coupling is used to connect to shafts of equal diameters and transmit 18.5 KW power at 425 rpm. The overload capacity is 1.5 times the average torque. Design the coupling.

The shaft, keys and bolts are made of plain carbon steel C40 having yield tensile strength 320 N/mm^2.

The flange is made of gray cast iron FG200 having ultimate tensile strength is 200 N/mm^2. 10

6. (a) What is nipping in leaf spring ? Discuss its role in spring design. 2.5

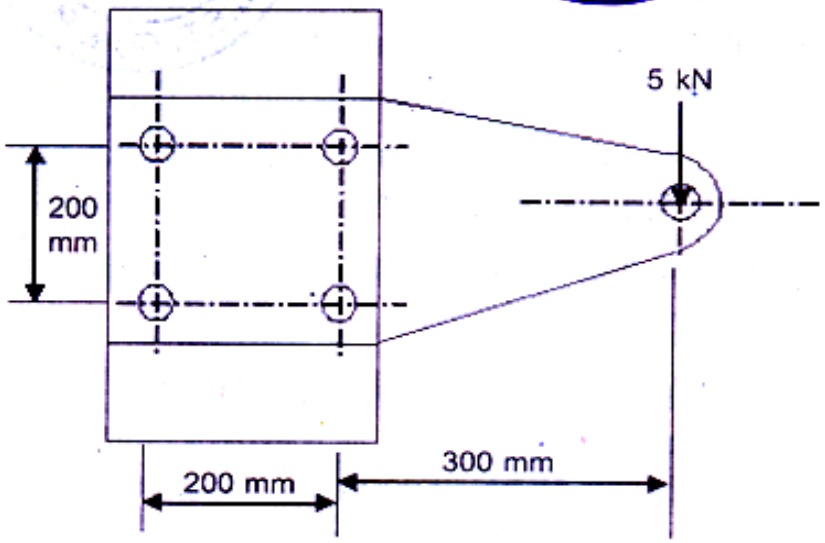
(b) Design a leaf spring for the rear axle of a college bus. The load on the rear axle of the bus is 15 kN. It consists of twelve leaves out of which two of the leaves are main leaves and the remaining graduated leaves. The spring span is to be 1200 mm between the eyes and is held at the center by a 100 mm wide clamp. The spring width is 55 mm. The material of the spring is chrome-vanadium steel having allowable tensile strength is 300 N/mm^2. The modulus of elasticity is 207000 N/mm^2. The bearing pressure at the pin is 10 N/mm^2 and allowable tensile yield stress of the pin material is 120 MPa. Material of the bolt is made of mild steel having allowable tensile strength of 100 MPa. 10

7. (a) Differentiate between first, second and third class levers. Why third-class is not recommended by the designer for use ? 2.5

(b) Design a flat belt drive along with pulleys to transmit 12.5 kW at 650 rpm to a driven two stage air-compressor operating at 350 rpm. Consider belt material as chrome-tanned leather having design stress 2.2 N/mm^2, density is 10×10^3 N/m^3, service factor is 2.0. The pulleys are made of grey cast iron FG200 having ultimate tensile strength is 200 N/mm^2. Coefficient of friction between chrome-tanned leather and CI pulley is 0.4. Consider the belt as double ply with thickness is 10 mm. The shaft is made of plane carbon steel C20 having allowable shear strength is 75 N/mm^2. The over-hang of the shaft is 200mm. The cross-section of the arm of the pulley is elliptical. The combined shock and fatigue factors for tension and bending may be taken as 1.0 and 1.5 respectively. 10

8. (a) Why is the nut of a power screw made of a soft material? 2.5

(b) A steel plate is subjected to a force of 5 kN and fixed to a vertical channel by means of four identical bolts. Determine the diameter of the shank. 5



(c) 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 100 mm. The lever is 100 cm long and the distance between the fulcrum and the valve point is 150 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 100 N/mm^2. The bearing pressure at the pin is 20 N/mm^2. 5