USN [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]   **15AU53**

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Design of Machine Elements – I

Time: 3 hrs.   Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing
ONE full question from each module.
2. Use of machine design data hand book is permitted.
3. Missing data, if any, may be suitably assumed.

Module-1

1   a.   What are the factors in the selection of factor of safety?   **(04 Marks)**
    b.   Determine the maximum stress induced in the bracket shown in the Fig.Q1(b).   **(12 Marks)**
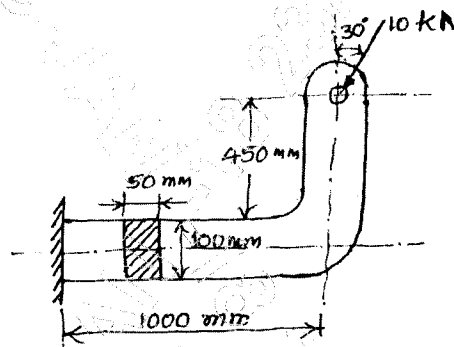

Fig.Q1(b)

OR

2   a.   A radial load of 1.8kN is acted on a journal bearing and length of journal to diameter of shaft ratio is 2. Determine the dimensions of the bearing if the allowable bearing pressure is limited to 0.3MPa.   **(04 Marks)**
    b.   A circular rod of diameter 60mm and lengths 200mm is fixed at one end. The free end is subjected to an axial tensile load of 10kN transverse load of 6kN and a twisting moment of 400N-m. Determine the stresses at the critical points.   **(12 Marks)**

Module-2

3   a.   A filleted plate with a circular hole subjected to a tensile force of 5kN is shown in the Fig.Q3(a). The ultimate strength of the plate material is 200MPa. Determine the thickness of the plate. Take the factor of safety as 2.5.   **(10 Marks)**
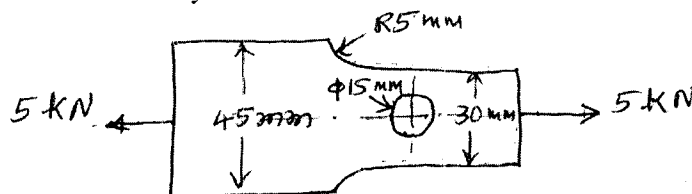

Fig.Q3(a)

    b.   A power hammer weighing 4kN strikes the midpoint of a beam simply supported at its ends 4m apart. The beam has a depth of 200mm and width 100mm. Determine the height through which the hammer weight can be allowed to fall if the maximum stress in the beam is limited to 120MPa. Take the modulus of elasticity of beam material as 206.8 GPa. **(06 Marks)**

OR

4   A hot rolled steel shaft is subjected to a torsional moment that varies from 300N-m clockwise to 100N-m counter clockwise as the bending moment at the critical section varies from 400N-m to –200N-m. Neglecting the stress concentration effect, determine the required shaft diameter. The material has an ultimate strength of 550MPa and yield strength of 410MPa. Take the endurance limit as half the ultimate strength and factor of safety as (16 Marks)

Module-3

5   a.   A flange coupling is used to connect two co-axial shafts of diameter 50mm. The allowable shear stress in the steel shaft is 40MPa. Determine :
     i)   shear stress induced in the key
     ii)   shear stress induced in the four M16 × 1.5 bolts located on the bolt circle diameter of 150mm and
     iii) shear stress induced in the cast iron flange of 20mm thick and the hub diameter of 100mm. (08 Marks)
    b.   Design a knuckle joint to connect two mild steel rods to sustain an axial pull of 150kN. The pin and the rods are mode of some material. Assume the working stresses in the material as 80MPa in tension, 40MPa in shear and 120MPa in crushing. (08 Marks)

OR

6   A section of steel shaft of 2m long supported between bearings running at 1000rpm carries a 20° involute spur gear of pitch diameter 200mm at its mid point. The gear delivers 20kw power to its mating gear located directly above the shaft. If the shaft material selected has an allowable shear stress of 40MPa, determine the diameter of the shaft. Assume the loads are steady. (16 Marks)

Module-4

7   Two lengths of a flat tie bar of 15mm thick are connected by a butt joint with equal cover plates on either side. If a load of 500 kN is acting on the bar, design the joint such that the section of the bar is not reduced by more than one rivet hole. The working stresses for the material of the bar is 120MPa in tension, and for the material of the rivet are 70MPa in shear and 140MPa in crushing. (16 Marks)

OR

8   a.   A plate of 100mm wide and 10mm thick is to be welded with another plate by means of transverse welds with another plate by means of transverse welds at the ends. Determine the length of weld if the maximum tensile stress in not to exceed 90MPa. (06 Marks)
    b.   A solid circular bar of diameter 60mm is to be welded to a vertical plate by an all round fillet weld. It carries a load of 10kN at a distance of 200mm from the vertical plate. Determine the size of the weld, if the maximum permissible stress is 100N/mm². (10 Marks)

Module-5

9   a. A cylinder head of a steam engine is subjected to a steam pressure of 0.8MPa. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak proof. The bore diameter of the cylinder is 250mm. Find the size of bolts so that the stress in bolts is not to exceed 110MPa.   (08 Marks)

   b. A bracket is bolted to a vertical support by seven bolts of equal size as shown in the Fig.Q9(b). Determine the size of the bolt if the allowable stress in the bolt material is 40MPa.   (08 Marks)
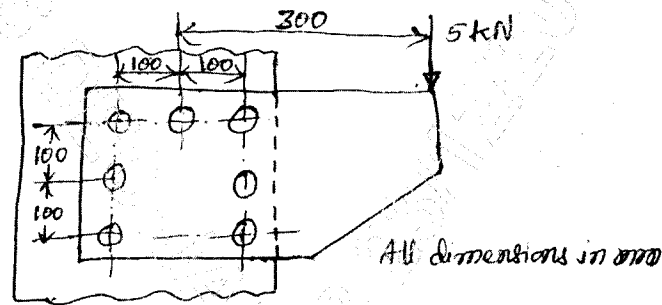

Fig.Q9(b)

OR

10 a. The lead screw of a lathe has single start ISO trapezoidal threads of 30mm outside diameter and 6mm pitch. It drives a tool carriage and exerts an axial load of 1.5kN on a thrust collar of 30mm inside diameter and 50mm outside diameter. If the lead screw rotates at 40rpm, find the power required to drive the screw. Take the coefficient of friction for power screw as 0.14 and for collar as 0.09.   (08 Marks)

   b. A slice gate weighing 8kN is attached to a nut and is raised by means of a single start square threaded screw. The friction force due to water pressure resisting the opening of the gate is 2kN. The outside diameter of the screw is 40mm and the pitch is 7mm. The head of the screw rests on a supporting collar of 42mm inside diameter and 70mm outside diameter. Assuming the coefficient of friction for threads as 0.11 and for collar as 0.15, determine :
      i) Maximum force to be exerted at the end of a lever of 0.6m length for raising the gate
      ii) Efficiency of the screw and the collar mechanism
      iii) Height of the nut for an allowable bearing pressure of 6MPa.   (08 Marks)

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