[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
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16122(D) - 0 DEC 2016

B. Tech 5th Semester Examination

Machine Design-I (NS)

ME-314

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

SECTION - A

Answer any ONE question from the group

1. (a) What is the difference between failure due to static loading and fatigue loading? (3)
   (b) Briefly explain importance of ergonomic and aesthetic consideration in machine design. (5)
   (c) What are the factors to be considered for selection of material for a machine element? (4)
   (d) Analysis reveals that the principal stresses at a critical point on the free surface of a steel machine member are 150 MPa and 200 MPa. A designer wants to provide a minimum factor of safety of 3.5 for the point. Calculate a suitable value for the yield strength of the steel material that the designer may select for the machine member. (8)
2. (a) What is endurance limit? What are the factors that affect endurance limit of a machine components? (4)
   (b) What is S-N Curve? (2)
   (c) What is fatigue stress concentration factor? What are the causes of stress concentration? (4)
   (d) Mention few practical examples of low cycle fatigue failure and high cycle fatigue failure. (3)
   (e) What is notch sensitivity and notch sensitivity factor? (3)
   (f) What is fatigue life? (2)
   (g) What is the difference between clearance fit and interference fit? (2)

SECTION - B

Answer any ONE question from the group

3. (a) What is the function of transmission shafts? (1)
   (b) Which theories of failure are applicable for shafts and why? (2)
   (c) When should splines be used in place of a key. (2)
   (d) A line shaft is supported between two bearings 850 mm apart. A pulley (D) of 450 mm diameter and of mass 30 kg is keyed to the shaft and is

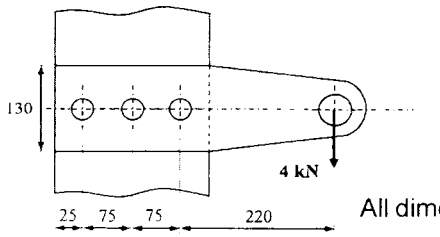
located at a distance 425 mm to the right of the left hand bearing. The power is supplied to the shaft by means of a vertical belt on this pulley (D), which is then transmitted to another pulley (E) of 250 mm diameter and 18 kg mass "carrying a horizontal belt with maximum tension of 2.7 kN. The pulley (E) is keyed to overhung portion of the shaft at 200 mm to the right of right hand bearing. The ratio of belt tensions on tight and slack sides is 3:1 in each belt. The power is transmitted from the pulley to a coupling just outside the right hand bearing. The shaft is made of plain carbon steel 45C8. Determine the shaft diameter using the ASME code. The combined shock and fatigue factors for bending and torsion are assumed as 1.5 and 1.0, respectively. (15)

4. (a) With freehand sketch, explain different types of keyways for flat key. (4)
   (b) What is the critical speed of the shaft? (2)
   (c) The standard rectangular cross section for parallel sunk key for fixing a gear on a 50 mm diameter shaft is 14 mm×9 mm. The shaft is transmitting 12kW power at 720 RPM to the gear. The key is made of steel 50C4 (Yield strength= 460MPa) and factor of safety is 3. The drive is subjected to minor shocks for which a service factor of 1.3 is to be considered. Determine the effective length of the key. (5)
   (d) A hollow transmission shaft, having inside diameter 0.7 times the outside diameter, is made of plain carbon steel 40C8. A pulley of 900 mm in diameter is mounted on the shaft which overhangs the left bearing by 250 mm. The belt is vertical and transmit power to the machine shaft below the pulley. The tension on the tight and slack sides of the belt are 3 kN and 1 kN respectively. The angle of wrap of the belt on the pulley is 180°. Use factor of safety 3. Estimate the outside and inside diameters of the shaft. (9)

SECTION - C

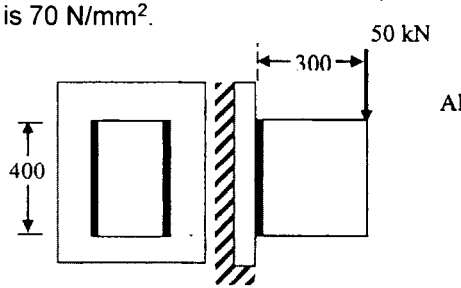
Answer any ONE question from the group

5. (a) What is the main objective of fullering? (2)
   (b) With suitable sketch show the following types of welded joint and indicate the standard notations: (a) double V- butt joint, (b) fillet joint. (4)
   (c) A steel plate subjected to a force of 4 kN and fixed to another plate by means of three identical screws is shown in Fig. The screws are made from plain carbon steel 45C8 (Min. Yield strength= 380MPa) and the factor of safety is 2.5. Specify the size of screws. (7)



All dimensions are in mm

(d) A bracket is welded to the vertical plate by means of two fillet welds as shown in Fig. The bracket is subjected to an eccentric static force of 50 kN. Determine the size of weld if permissible shear stress for the weld is 70 N/mm^2. (7)



All dimensions are in **mm**

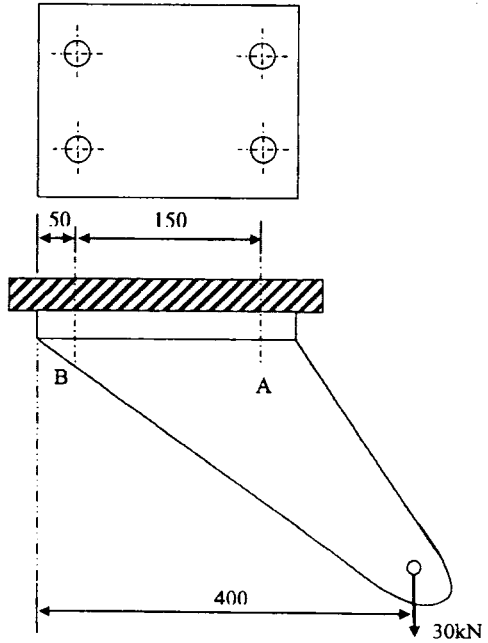
6. (a) What are the advantages and disadvantages of square threads over trapezoidal threads? (3)

(b) What is throat of a weldment? Explain with suitable diagram. (3)

(c) What do you understand by efficiency of riveted joints? (2)

(d) What is pretension of a bolt and why it is necessary? (3)

(e) A steel bracket is attached to a steel beam by means of four identical bolts, in two rows (two bolts in each row A & B) as shown in Fig. Left row of bolts are at a distance of 50 mm from the left edge of the bracket and two rows are 150 mm distance apart. A 30 kN load acting vertically at a distance of 400 mm from the left edge of the bracket. The bolts are made of plain carbon steel 30C8 and factor of safety is 4. Determine the size of the bolts. (9)



All dimensions are in **mm**

SECTION - D

Answer any ONE question from the group

7. (a) Briefly explain the different types of pipe joints. (5)

(b) With neat sketch, discuss the various modes of failure in spigot end of rod in cotter 5 joint. (5)

(c) Find out the dimensions of an oval flanged cast iron coupling to join the cast iron pipes of 200 mm diameter for carrying steam at a pressure of 3 MPa. (10)

8. (a) Design a spigot-socket type cotter joint to carry a load of 25 kN. The permissible stresses for the material used in tension, shear and crushing are 60 MPa, 48 MPa and 100 MPa, respectively. (10)

(b) Draw load diagram and bending moment diagram for the knuckle pin. Derive the expression of maximum bending moment and maximum stress due to bending. Find the diameter of the knuckle pin of a knuckle joint to connect two circular rods of 30 mm diameter that will carry an axial tensile load of 60 kN. The rods and knuckle pin made of plain C-steel (30C8). Assume factor of safety of 5 and standard proportion for knuckle joint. (10)

SECTION - E

Answer ALL the questions

9. (i) What is stress concentration and stress concentration factor?

(ii) What is the difference between low cycle fatigue and high cycle fatigue?

(iii) Where do you use Miner's equation?

(iv) What are the advantages of hollow shaft over solid shaft?

(v) Why is transmission shaft stepped?

(vi) What are the main advantages of taper sunk key over parallel sunk key?

(vii) What is flexible shaft and where do you use it?

(viii) Mention two main advantages each for coarse series thread and fine series thread.

(ix) What is the main objective of caulking?

(x) What do you mean by tensile stress area of a screw in bolted joint? (2×10=20)