**UNIVERSITY QUESTION PAPERS:**

Code : 021615

B.Tech 6th Semester Exam., 2014

DESIGN OF MACHINE ELEMENTS

Time : 3 hours                               Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.

(v) Use of data books is permitted. Select data, if missing, suitably.

1. Answer any *seven* of the following as directed :                                       2×7=14

   (a) Give two examples of bearing pressure and crushing stress in the design consideration of machine elements.

   (b) A hollow shaft and a solid shaft are of equal weight. The hollow shaft has

      (i) lower strength but greater stiffness

      (ii) lower strength and lower stiffness

      (iii) greater strength but lower stiffness

      (iv) greater strength and also greater stiffness

   (c) If a helical coil spring of stiffness $K$ is cut into two identical half coil springs, the stiffness of each of these half spring will be ——.
           ( Fill in the blank )

   (d) Cast iron is widely used for machine frames. Give two reasons.

   (e) Give the composition of $25Cr_4Mo_2$.

   (f) The resistance of fatigue of a material is measured by

      (i) elastic limit

      (ii) proportionate limit

      (iii) endurance limit

      (iv) ultimate strength limit
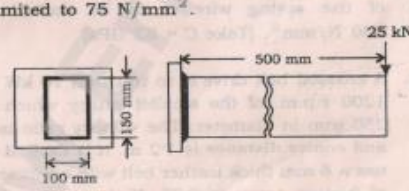
          ( Choose the correct option )

   (g) What is the minimum efficiency required for the circumferential boiler joint?

   (h) Why are multiple threaded screws not recommended in screw jack?

   (i) Suggest suitable coupling for shafts with parallel misalignment.

   (j) Name the three stresses induced in belt due to power transmission.

2. Design a cotter joint, made of 30C8 steel, to support a load of 50 kN which is subjected to slow reversals of direction.                    14

3. Determine the main dimensions of the longitudinal joints of a boiler whose inner diameter is 1·7 m and pressure of steam is 20 bar. The allowable tensile, crushing and shear stresses of mild steel rivet are 80 N/mm², 120 N/mm² and 65 N/mm² respectively. Assume quadruple rivetted, zig-zag butt joint with unequal cover plates.          14

4. Determine the size of the welds to support by means of fillet welds of a beam of rectangular cross-section as shown in the figure below if the permissible shear stress in the weld is limited to 75 N/mm².                    14



5. A mild steel shaft has to transmit 70 kW at 240 r.p.m. The allowable shear stress in the shaft material is limited to 45 MPa and the angle of twist is not to exceed 1° in a length of 20 times the shaft diameter. Determine the shaft diameter and design a cast iron flange coupling of protected type for the shaft. The shear stress in the coupling bolts is to be limited to 30 MPa.                    14

6. Design a screw jack for lifting a load of 20 kN through a distance of 200 mm.          14

7. A safety valve of 60 mm diameter is to blow off at a pressure of 12 bar. It is held on its seat by a close-coiled helical spring. The maximum lift of the valve is 10 mm. Determine main dimensions of a compression spring of spring index 5. Take initial compression of the spring as 35 mm. The maximum shear stress in the material of the spring wire is to be limited to 500 N/mm². [Take C = 82 GPa]          14

8. A crossed belt drive is to transmit 10 kW at 1200 r.p.m. of the smaller pulley which is 250 mm in diameter. The velocity ratio is 2 and centre distance is 1·2 m. It is desired to use a 6 mm thick leather belt with coefficient of friction equal to 0·25. If the permissible stress for the belt material is 2 N/mm², determine the width of the belt. [Take the mass density of the belt material as 1000 kg/m³]          14

9. A single-disc clutch is required to resist a maximum torque 500 N-m. The outer radius of the friction lining is 30% more than the inner radius. The permissible intensity of pressure between the contact surfaces is 0·08 N/mm$^2$. The coefficient of friction is 0·25. Eight helical compression springs are used to provide axial force necessary to engage the clutch. If the stiffness of each spring is 36 N/mm, determine the size of the friction lining and initial compression in the spring. **14**

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**B.Tech 6th Semester Exam., 2018**

DESIGN OF MACHINE ELEMENTS

'Time : 3 hours   akubihar.com   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.

1. Choose the correct option (any *seven*) : 2×7=14

   (a) Steels used for automobile bodies and hoods are

       (i) medium carbon steel

       (ii) mild steel

       (iii) high carbon steel

       (iv) alloy steel

   (b) Material used for self-lubricated bearing is

       (i) acetal

       (ii) polyurethane

       (iii) polytetrafluoroethylene (Teflon)

       (iv) Any one of the above

   (f) A stress that varies in sinusoidal manner with respect to time from tensile to compressive (or vice-versa) and with zero mean is called

       (i) reversed stress

       (ii) fluctuating stress

       (iii) repeated stress

       (iv) varying stress

   (g) In order to find the endurance limit, the rotating beam specimen is subjected to

       (i) repeated stresses

       (ii) reversed stresses

       (iii) fluctuating stresses

       (iv) maximum stress

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   (h) In design of screw jack from buckling considerations, the end conditions are assumed as

       (i) both ends are hinged

       (ii) both ends are fixed

       (iii) one end fixed and other hinged

       (iv) one end fixed and other free

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   (c) In forged components

       (i) fiber lines are arranged in a predetermined way

       (ii) fiber lines of rolled stock are broken

       (iii) there are no fiber lines

       (iv) fiber lines are scattered

   (d) When a circular shaft is subjected to torque, the torsional shear stress is

       (i) maximum at the axis of rotation and zero at the outer surface

       (ii) uniform from axis of rotation to the outer surface

       (iii) zero at the axis of rotation and maximum at the outer surface

       (iv) zero at the axis of rotation and zero at the outer surface and maximum at the mean radius

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   (e) The thermal stresses are caused due to

       (i) variation in temperature

       (ii) high temperature

       (iii) specific heat

       (iv) latent heat

   (i) In the running condition, the net force acting on the drum of centrifugal clutch is equal to

       (i) the centrifugal force on shoe

       (ii) the centrifugal force on shoe minus spring force

       (iii) the centrifugal force on shoe plus spring force

       (iv) the spring force

   (j) The maximum shear stress in spring wire is induced at

       (i) inner surface of the coil

       (ii) outer surface of the coil

       (iii) central surface of the coil

       (iv) end coils   akubihar.com

2. (a) What are the factors to be considered for selection of engineering materials for a machine component? Discuss the important manufacturing considerations in machine design.   7

   (b) How will you select direction of fiber lines in forged components?   7

3. The force acting on a bolt consists of two components—an axial pull of 12 kN and a transverse shear force of 6 kN. The bolt is made of steel having $S_{yt} = 310 \text{ N/mm}^2$ and factor of safety is 2·5. Determine the . diameter of the bolt using the maximum shear stress theory of failure. akubihar.com 14

4. A rotating bar made of steel having $S_{ut} = 620 \text{ N/mm}^2$ is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is $310 \text{ N/mm}^2$. Calculate the fatigue strength of the bar for a life of 1,00,000 cycles.   14

5. A forged steel bar of 55 mm diameter is subjected to a reversed bending stress of $260 \text{ N/mm}^2$. The bar is made of 40C8 steel $(S_{ut} = 610 \text{ N/mm}^2)$. Calculate the life of the bar for a reliability of 90%.   14

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6. A transmission shaft carries a pulley midway between the two bearings. The bending moment at the pulley varies from 200 N-m to 600 N-m, as the torsional moment in the shaft varies from 70 N-m to 200 N-m. The frequencies of variation of bending and torsional moments of steel FeE 400 $(S_{yt} = 400 \text{ N/mm}^2$ and $S_{ut} = 540 \text{ N/mm}^2)$. The corrected endurance limit of the shaft is $210 \text{ N/mm}^2$. Determine the diameter of the shaft using a factor of safety of 2·5.   14

7. The layout of a wall crane and the pin-joint connecting the tie-rod to the crane post is shown in the figures (a) and (b) respectively. The tension in the tie-rod is maximum, when the load is at a distance of 2 m from the wall. The tie-rod and the pin are made of steel having $S_{yt} = 250 \text{ N/mm}^2$ and factor of safety is 3·0. Determine the diameter of the tie-rod and the pin.   14



(a)  W = 50 kN   (b) Crane post