

**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

( Choose the correct option )

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- (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.

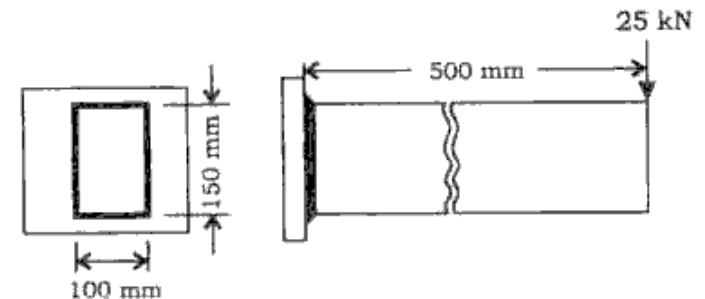
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2. Design a cotter joint, made of 30C8 steel, to support a load of 50 kN which is subjected to slow reversals of direction. 14

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  $80 \text{ N/mm}^2$ ,  $120 \text{ N/mm}^2$  and  $65 \text{ N/mm}^2$  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  $75 \text{ N/mm}^2$ . 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  $1^\circ$  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.

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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/mm<sup>2</sup>. [Take  $C = 82$  GPa]

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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/mm<sup>2</sup>, determine the width of the belt. [Take the mass density of the belt material as 1000 kg/m<sup>3</sup>]

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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<sup>2</sup>. 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.

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