B.E. Mechanical Engineering Fifth Semester

ME501 - Design of Machine Elements

P. Pages : 2 **GUG/W/18/1646**

Time : Three Hours * 1 2 9 5 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Answer Q. No. 1 OR Q. 2, Q.3 OR Q.4, Q. 5 OR Q. 6, Q. 7 OR Q. 8
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. I.S.I. Hand Book for structural steel section, I.S. Code 8000/1962 or 1964, I.S. 456 (Revised), I.S. 875 may be consulted.
7. Use of design Data book is permitted.

1. a) Describe the general procedure in machine Design with a block diagram. **5**

b) Design and draw a cotter joint to support a load varying from 30kN in compression to 30kN in tension. The material used in carbon steel for which the following allowable stresses may be used. The load is applied statically. The design stresses are 50MPa in tension and compression, 35 MPa in shear and 90MPa in crushing. **15**

OR

2. a) What do you mean by stress concentration? Explain various methods used to reduce its effect. **5**

b) What do you mean by working stress and define factor of safety for both ductile and brittle material. **5**

c) A shaft made of SAE 1030 is subject to maximum torque (T) of $12\,kN\cdot m$ and Maximum moment of $6\,kN\cdot m$. Find the diameter of shaft (II) using **10**

i) Maximum principal stress theory and ii) Maximum shear stress theory

Assume F.S. = 1.2

Assume that the shaft is also subject to an axial tensile load of 2kN.

3. a) Two plates of 10mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter, rivet pitch, strap thickness, and efficiency of the joint. Take the working stresses in tension and shearing as 80MPa and 60MPa respectively. **10**

b) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P as shown in fig. (3-b). **10**

Determine the weld size if shear stress in the same is not to exceed 140MPa.

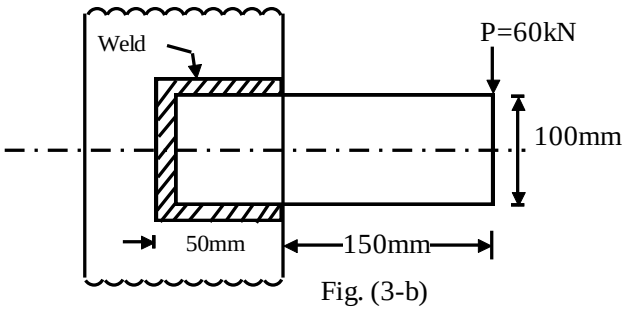

Fig. (3-b)

OR

4. a) State and explain various stresses induced in screw fastening due to static loading. **5**

b) What are the different stresses induced in helical compression spring when it carries axial load. **5**

c) A steam engine cylinder has an effective diameter of 350mm and the maximum steam pressure acting on the cylinder cover is $1{\cdot}25\,N/mm^2$. Calculate the number and size of studs required to fix the cylinder cover, assuming the permissible stress in studs as 33MPa. **10**

5. a) State and explain types of screw threads used for power screws with neat sketch. **5**

b) A screw jack is to lift a load of 80kN through a height of 400mm. The elastic strength of screw material in tension and compression is 200MPa and in shear 120MPa. The material for nut is phosphor-broze for which the elastic limit may be taken as 100MPa in tension, 90MPa in compression and 80MPa in shear. The bearing pressure between the nut and the screw is not to exceed $18N/mm^2$. Design and Draw the screw jack. **15**

The Design should include the design of 1. screw 2. Nut assume F.S. = 2.

OR

6. a) Design a helical compression spring for a maximum load of 1000N for a deflection of 25mm using the value of spring index as 5. **10**

The maximum permissible shear stress for spring wire is 420MPa & modulus of rigidity is 84 kN/mm^2. Take Wahl's factor, $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where C = Spring Index.

b) Design a Leaf spring for the following specifications: **10**
Total load = 140kN; Number of springs supporting the load = 4; Maximum number of leaves = 10; Span of the spring = 1000mm; Permissible deflection = 80mm. Take young's Modulus, E = $200kN/mm^2$ and allowable stress in spring material as 600MPa.

7. A pressure vessel made up of SAE1050 with internal diameter of 250mm to sustain internal pressure of 2MPa. **20**

Design

1) Wall thickness (tb)
2) Size and No. of bolts required
3) Material for bolt
4) Gasket Material for leak proof joint.
5) Bottom and Top cover plate made up of hemispherical and flat circular bolted respectively.

OR

8. A steel shaft transmitting 15kW at 200 rpm. is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30teeth of 5mm module is located 100mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100teeth of 5mm module is located 150mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54MPa in shear, determine the diameter of the shaft. **20**

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