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Machine Design - I
(1020)

P. Pages : 4

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

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory, solve **any two** bits of a, b, c in each question.
5. Draw neat sketches wherever necessary.
6. Use of non-programmable electronic calculator is allowed.
7. Use of PSG design data book is allowed.
8. Assume suitable data if necessary.

UNIT – I

1. a) Design a knuckle joint for a tie rod of a circular section to sustain a maximum pull of 70 kN. The ultimate strength of the material of the rod against tearing is 420 MPa. The ultimate tensile and shearing strength of the pin material are 510 MPa and 396 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 6. **10**

b) The load on a bolt consist of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of a bolt required according to – **10**
   i) Maximum principal stress theory.
   ii) Maximum shear stress theory.
   iii) Maximum principal strain theory.
   iv) Maximum strain energy theory.

c) i) Explain general procedure of machine Design. **5**

   ii) Selection of preferred size. **5**

UNIT – II

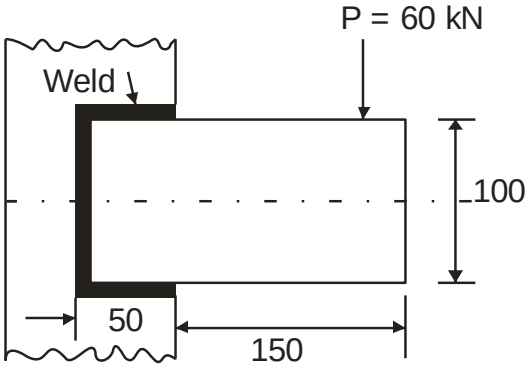
2. a) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weights 200 N and is located at 300 mm from the centre of bearings. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kw at 120 r.p.m. The angle of lap of the belt is 180º and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **10**

b) Design a cast iron protective type flange coupling to transmit 15 kw at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used. **10**
Shear stress for a shaft, bolt and key material = 40 MPa.
Crushing stress for bolt and key = 80 Mpa.
Shear stress for cast iron = 8 Mpa.
Draw a neat sketch of the coupling.

c) Explain :
i) Woodruff key. **5**
ii) ASME code for shaft design. **5**

UNIT – III

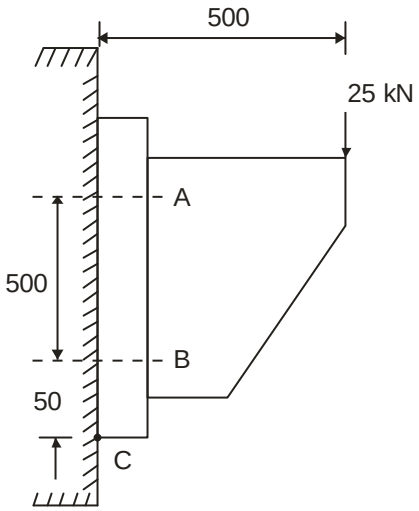
3. a) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in fig. **10**



All dimensions in mm.

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

b) A wall bracket is attached to a wall by means of four identical bolts, two at A and two at B, as shown in fig. Assuming that the bracket is held against the wall and prevented from tipping about point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2, determine the size of the bolts on the basis of maximum principal stress theory. **10**



c) i) Difference between fillet weld and butt weld joint. **5**

ii) Explain bolts of uniform strength. **5**

UNIT – IV

4. a) The mean diameter of the square threaded screw having pitch of 10 mm is 50 mm. A load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and the efficiency of the screw, when **10**

i) The load rotates with screw and,

ii) The load rests on the loose head which does not rotate with the screw.

The external and internal diameter of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw and the bearing surface may be taken as 0.08.

b) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25mm using the value of spring index as 5. **10**
The maximum permissible shear stress for spring wire is 420 MPa and 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.

c) Write short notes on : **10**

i) Shot peening.

ii) Self locking & overhouling of power screw.

UNIT – V

5. a) Explain : **10**

i) Notch sensitivity.

ii) Modified Goodman diagram.

b) Write short note on : **10**

i) Mechanical Reliability & factor of safety.

ii) Design and natural tolerances.

c) A machine component is subjected to two-diamensional stresses. The tensile stress in the X-direction varies from 40 to 100 N/mm^2 while the tensile stress in the Y-direction varies from 10 to 80 N/mm^2. The frequency of variation of these stresses is equal. The corrected endurance limit of the component is 270 N/mm^2. The ultimate tensile strength of the material of component is 660 N/mm^2. Determine the factor of safety used by the designer. **10**

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