

337511(37)

B. E. (Fifth Semester) Examination, April-May 2020

(Old Scheme)

(Mech. Mechatronics Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : All questions are compulsory. Assume suitable data if necessary. PSG Data Book and ISI codes are permitted for the necessary reference.

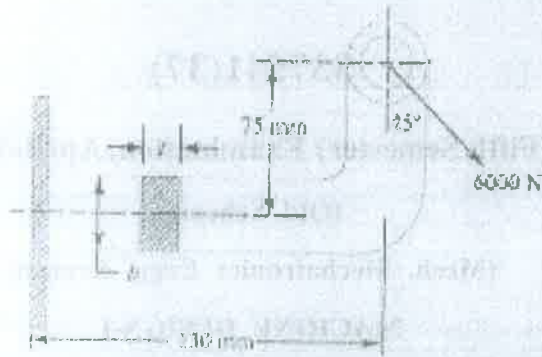
Unit-I

1. (a) Define the fatigue stress concentration factor. 2

Note : Attempt any two.

- (b) A mild steel bracket as shown in figure, is subjected to a pull of 6000 N acting at 45° to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross-sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa. 7

[2]



(c) A bar of circular cross-section is subjected to alternating tensile forces varying from a minimum of 200 kN to a maximum of 500 kN. It is to be manufactured of a material with an ultimate tensile strength of 900 MPa and an endurance limit of 700 MPa. Determine the diameter of bar using safety factors 3.5 related to ultimate tensile strength and 4 related to endurance limit and a stress concentration factor of 1.65 for fatigue load. Use Goodman straight line as basis for design. 7

(d) Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 r.p.m., the compressor speed being 350 r.p.m. The minimum center distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides. 7

337511(37)

[3]

Unit-II

2. (a) What is the effect of keyway cut into the shaft? 2

Note : Attempt any one.

(b) Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses :

$$\sigma_t = 60 \text{ MPa}; \tau = 70 \text{ MPa}; \sigma_c = 125 \text{ MPa} \quad 14$$

(c) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. 14

Unit-III

3. (a) What is self-locking property of threads and where it is necessary? 2

Note : Attempt any one.

(b) For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in figure. The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile

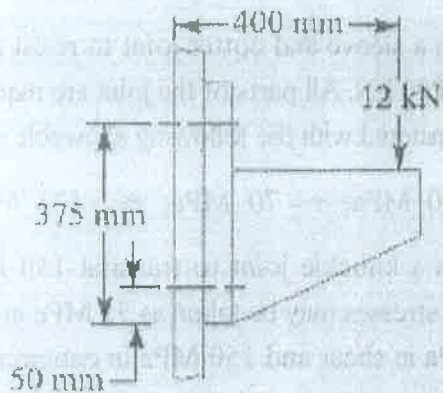
337511(37)

PTO

[4]

stress for the bolt material is 84 MPa. Also find the cross-section of the arm of the bracket which is rectangular:

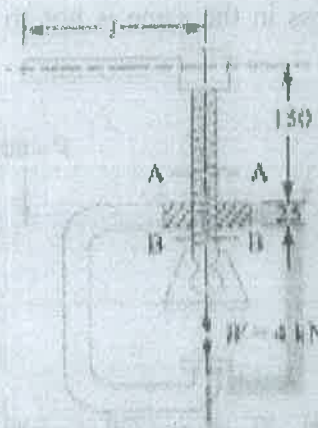
14



- (c) A C-clamp, as shown figure, has trapezoidal threads of 12 mm outside diameter and 2 mm pitch. The coefficient of friction for screw threads is 0.12 and for the collar is 0.25. the mean radius of the collar is 6 mm. If the force exerted by the operator at the end of the handle is 80 N, find : 1. The length of handle; 2. the maximum shear stress in the body of the screw and where does the exist; and 3. The bearing pressure on the threads.

14

[5]



Unit-IV

4. (a) What is the difference between caulking and fullering? Explain with the help of neat sketches.

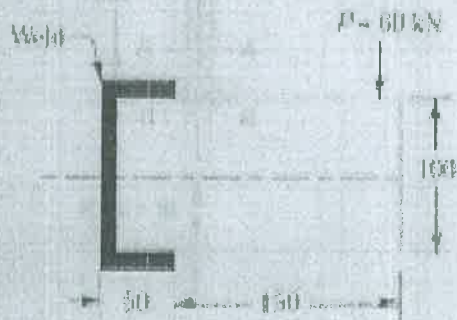
Note : Attempt any one.

- (b) A steam boiler is to be designed for a working pressure of 2.5 N/mm² with its inside diameter 1.6 m. Give the design calculations for the longitudinal joints for the following working stress for steel plates and rivets : In tension = 75 MPa, In shear = 60 MPa, In crushing = 125 MPa. Draw the joints to a suitable scale.
- (c) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in figure. Determine the weld size

[6]

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

10



Unit-V

5. (a) How does the working of a clamp coupling differ from that of a muff coupling? Explain.

6

Note : Attempt any one.

- (b) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left-hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right-hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for the both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter

337511(37)

[7]

for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.

10

- (c) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows :

- The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
- The allowable shear stress for cast iron is 15 MPa.
- The allowable bearing pressure for rubber bush is 0.8 N/mm^2 .
- The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling.

10

100]

337511(37)