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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **ME301U - Machine Design-I**

Generated At : **18-04-2022 16:21:16**

Maximum Marks : **60**

Duration : **3 Hrs**

[Edit](#) [Print](#) [View Answer Key](#) [Close](#) **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. All questions are compulsory.
2. Illustrate your answer with suitable figures/sketches wherever necessary.
3. Assume suitable additional data; if required.
4. Use of logarithmic table, drawing instruments and non programmable calculators is allowed.
5. Figures to the right indicate full marks.

1) Attempt **All** from following Sub-Questions.

- a) Discuss the logical steps in procedure of designing machine elements. [06]
- b) Explain the 'maximum shear stress theory' and 'Von Mises and Hencky' theory. [06]

2) Attempt any **Two** from following Sub-Questions.

- a) For a key of square cross section which is equally strong in crushing and shearing, prove that $f_c = 2f_s$ [06]
- b) A shaft of uniform diameter is supported in two bearings spaced 1000 mm apart. It supports a belt pulley of 400 mm diameter located at 400 mm from left bearing. The weight of pulley is 300 N. The belt tension between belt and pulley is 0.25. The shaft transmits 8 kW at 400 r.p.m. The bearing pressure for the bearing material is 1 N / mm². Neglecting the mass of belt, find [06]
 - (i) The diameter of the shaft
 - (ii) The length of the bearing support.
- c) Write the strength equations for different possible failure considered in designing a Knuckle joint. [06]

3) Attempt any **Two** from following Sub-Questions.

- a) Explain the following each term in brief. [06]
 - (i) Solid Length
 - (ii) Free Length
 - (iii) Spring index
 - (iv) Stiffness of spring
 - (v) Pitch
 - (vi) Solid stress.
- b) A transverse fillet of 8 mm leg size is to be used to resist a tensile load. determine the allowable force per meter of weld, if the shear strength of weld is 79 N / mm². [06]
- c) The spring of spring balance, elongates by 150 mm when subjected to a load of 400 N. The spring index is 6. Take permissible shear stress for the wire material as 540 N / mm². Considering the effect of direct shear stress and wire curvature. Find [06]
 - (i) The wire diameter and coil diameter.
 - (ii) The number of active turns required. Take $G = 84 \times 10^3 \text{ N / mm}^2$.

4) Attempt any **Two** from following Sub-Questions.

- a) A flanged coupling is used to transmit 3.75 MW at 150 rpm. The allowable shear stress in the shaft and bolts may be taken as 50 N / mm². Determine the shaft diameter and diameter of bolts. Select no. of bolts from given table at the end. [06]

Shaft dia. in mm	35 to 55	56 to 150	151 to 230	231 to 390	Above 391
No. of bolts	4	6	8	10	12

- b) A plate made of plain carbon steel 20C8 ($S_{ut} = 440 \text{ N / mm}^2$) is shown in fig. no 4.b. The theoretical stress concentration factor and notch sensitivity are 2.50 and 0.8 respectively. The surface finish factor, size factor and reliability are 0.67, 0.85 and 0.897 respectively. The plate thickness is 30 mm. If the required factor of safety is 2.0, Determine the maximum completely reversed axial force can take for infinite life. Take $K_e = 1.0$ and axial force subjected on the plate at temperature 20°C. [06]

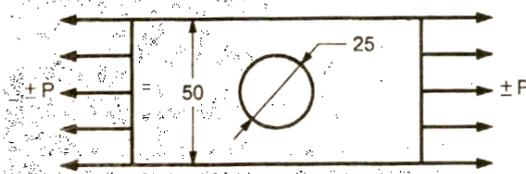


Fig. No. 4.b

- c) Explain the method of determining the size of bolts when the bracket carries an eccentric load perpendicular to the axis of bolts. [06]

5) Attempt **All** from following Sub-Questions.

- a) The safe compressive stress for a screw is 120 N / mm². The coefficient of friction between threads is 0.15. Force applied at the end of the handle is 300 N. The screw has single square threads of 4 mm pitch. the permissible bending stress for the handle is 90 N / mm². Neglect the frictional torque at the pad and the screw carries a compressive load of 30 KN. find [06]
 - (i) The diameter of the screw.
 - (ii) The diameter and length of the handle.
- b) What are the different methods to reduce stress concentration ? Illustrate it with two examples. [06]

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