INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous) Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022

Regulation:UG20

DESIGN OF MACHINE ELEMENTS

Time: 3 Hours

(MECHANICAL ENGINEERING)

Max Marks: 70

Answer ALL questions in Module I and II Answer ONE out of two questions in Modules III, IV and V (NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V All Questions Carry Equal Marks All parts of the question must be answered in one place only

MODULE - I

1. (a) Illustrate how modified Goodman diagram is used for fluctuating bending stresses with suitable sketch. Distinguish between fluctuating stress, repeated stress, and reversed stress.

[BL: Understand| CO: 1|Marks: 7]

(b) A 50 mm diameter shaft is made from carbon steel having ultimate tensile strength of 600 MPa. It is subjected to a torque which fluctuates between 2000N-m to (- 900) N-m. Using Solderberg method, calculate the factor of safety [BL: Apply] CO: 1|Marks: 7]

$\mathbf{MODULE}-\mathbf{II}$

- 2. (a) Distinguish between leg of fillet weld and throat of fillet weld. What is the relationship between the leg and throat of fillet weld? [BL: Analyze] CO: 2|Marks: 7]
 - (b) A double riveted lap joint with chain riveting is made for joining two plates having thickness of 12 mm. If the allowable tensile stress, allowable shear stress, and allowable compressive stress are 65 MPa, 55MPa and 80MPa respectively, find the rivet diameter, pitch of rivets, distance between the rows of rivets, and efficiency of the joint. [BL: Apply] CO: 2|Marks: 7]

$\mathbf{MODULE}-\mathbf{III}$

3. (a) Describe briefly about cotter joint and discuss why cotter joint provided with taper.

[BL: Understand| CO: 3|Marks: 7]

- (b) A rectangular sunk key 14 mm wide, 10 mm thick and 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not, if the permissible shear stress and crushing stress are limited to 56 MPa and 168 MPa respectively. [BL: Apply] CO: 3[Marks: 7]
- 4. (a) Draw a neat labeled sketch of Knuckle joint and list its various elements and state their functions. [BL: Understand] CO: 4|Marks: 7]
 - (b) The cross-section of a flat key for a 40 mm diameter shaft is 22 mm × 14 mm. The power transmi tted by the shaft to the hub is 25 kW at 300 rpm. The key is made of steel $(S_{yc} = S_{yt} = 300N/mm^2)$ and the factor of safety is 2.8. Determine the length of the key. Assume $S_{yc} = 0.577S_{yt}$

[BL: Apply] CO: 4|Marks: 7]

$\mathbf{MODULE}-\mathbf{IV}$

- 5. (a) Enumerate various types of stresses that are induced in shafts. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight? [BL: Apply| CO: 5|Marks: 7]
 - (b) The diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5 [BL: Apply] CO: 5|Marks: 7]
- 6. (a) Describe any two types of shaft couplings, with sketches. Distinguish between shaft, axle and spindle. [BL: Understand| CO: 5|Marks: 7]
 - (b) Design a bushed-pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20% more than mean torque. material properties are as follows:

i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.

ii) The allowable shear stress for cast iron is 15 MPa.

iii) The allowable bearing pressure for rubber bush is 0.8 MPa.

The material of the pin is same as that of shaft and key.

[BL: Apply| CO: 5|Marks: 7]

$\mathbf{MODULE}-\mathbf{V}$

- 7. (a) Outline the various functions of a spring along the design procedure of helical compression springs under fatigue loading [BL: Understand| CO: 6|Marks: 7]
 - (b) It is required to design a helical compression spring with plain ends for carrying a pure static force of 1000N. The allowable shear stress and Modulus of rigidity for spring material are 400 N/mm^2 and $85GN/mm^2$. The spring rate is 48 N/mm. If spring index is 5, determine i) Wire diameter
 - ii) Total number of coils.
 - iii) Free length and pitch.
- 8. (a) Distinguish between the series and parallel types of spring connections. What are the remedial measures you will suggest to avoid the surging in springs? [BL: Analyze] CO: 6|Marks: 7]
 - (b) A torsional window shade spring is made from a music wire number 17. The mean diameter of helix is 22mm and number of coils are 400. Assume $S_{yt} = 0.6S_{ut}$ and factor of safety is 2 based on yield strength. Compute the stress on inside of helix taking into account of curvature effect. Find the torque that the spring can exert after unwinding 12 revolutions from the most highly stressed condition. For music wire number 17, d=1.37mm. $S_{ut} = 2076MPa$ and E=210 GPa.

[BL: Apply| CO: 6|Marks: 7]

[BL: Apply] CO: 6|Marks: 7]

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