

**ANURAG Engineering College**  
(An Autonomous Institution)

III B.Tech I Semester Regular/Supplementary Examinations, Dec-2023/Jan-2024

**DESIGN OF MACHINE MEMBERS – I**  
(MECHANICAL ENGINEERING)

Time: 3 Hours

Max.Marks:75

**Section – A (Short Answer type questions)**

(25 Marks)

Answer All Questions

	Course Outcome	B.T Level	Marks
1. Define factor of safety?	CO1	L1	2M
2. List out at least 6-important mechanical properties of engineering materials.	CO1	L1	3M
3. Define endurance strength.	CO2	L1	2M
4. Explain fatigue stress concentration factor and notch sensitivity.	CO2	L2	3M
5. What are locking devices in bolted joints?	CO3	L1	2M
6. Write the applications of welded joints.	CO3	L1	3M
7. What is a Key? Mention various functions of the keys.	CO4	L1	2M
8. Where do you use a Knuckle joint? Give practical examples.	CO4	L2	3M
9. List out the various types of stresses induced in shafts.	CO5	L1	2M
10. Distinguish between rigid and flexible couplings.	CO5	L2	3M

**Section B (Essay Questions)**

Answer all questions, each question carries equal marks.

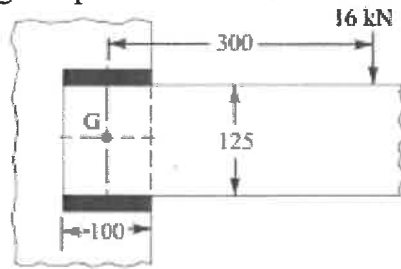
(5 x 10M = 50M)

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|--|-----|----|-----|
| 11. A) A machine element is loaded so that $\sigma_1 = 120$ MPa, $\sigma_2 = 70$ MPa, $\sigma_3 = -90$ MPa the material has a maximum yield strength in tension and compression of 360 MPa. Find the factor of safety for each of the following theories. i) Maximum Normal stress theory ii) Maximum Shear stress theory iii) Distribution energy theory.   | CO1 | L3 | 10M |
| <b>OR</b>  |     |    |     |
| B) An unknown weight falls through a height of 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 25 mm diameter. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take $E = 200$ kN/mm <sup>2</sup> .  | CO1 | L3 | 10M |
| 12. A) A simply supported beam has a concentrated load at the centre, which fluctuates from a value of P to 4P. The span of the beam is 0.5 m and its cross-section is circular with a diameter of 0.06 m. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum value of P. Take a size factor of 0.85 and a surface finish factor of 0.9. | CO2 | L3 | 10M |
| <b>OR</b>  |     |    |     |
| B) An automobile leaf spring is subjected to cyclic stress such that the average stress is 150 MPa, variable stress is 350 MPa; the material properties are; ultimate strength = 400 Mpa; yield strength = 350 MPa; endurance limit = 270 MPa; estimate the factor of safety using Goodman method and Soderberg method?  | CO2 | L3 | 10M |

13. A) A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch which will rupture the joint. If the above joint is subjected to a load such that the factor of safety is two, find out the actual stresses developed in the plates and the rivets.

**OR**

- B) A  $125 \times 95 \times 10$  mm angle is welded to a frame by two 10 mm fillet welds, as shown in Fig. A load of 16 kN is applied normal to the gravity axis at a distance of 300 mm from the centre of gravity of welds. Find maximum shear stress in the welds, assuming each weld to be 100 mm long and parallel to the axis of the angle.



All dimensions in mm.

14. A) Design and draw a sleeve and cotter joint to connect two rods to transmit maximum tensile load of 82 kN. Assume sleeve cotter and rods are made of same material and design stresses in the material are 65 MPa in tension; 130 MPa in crushing and 50 MPa in shear.

**OR**

- B) Design a cotter joint to withstand an axial load varying from 45 kN in tension to 45 kN in compression. The allowable for the steel used in the joint are 60 MPa in tension; 70 MPa in crushing; 45 MPa in shear.

15. A) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length.

**OR**

- B) Design a solid muff coupling made of cast iron to connect two shafts transmitting 35 kW at 150 rpm with a capability of 25% maximum torque greater than the mean torque. The shaft and key are made of mild steel for which permissible shear and crushing stress are  $30 \text{ MN/m}^2$  and  $80 \text{ MN/m}^2$  respectively. Permissible shear stress in CI is  $15 \text{ MN/m}^2$ .