## VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD
*Accredited by NAAC with A++ Grade*
### B.E. (Mech. Engg.) V-Semester Main & Backlog Examinations, Jan./Feb.-2024
### Design of Machine Elements

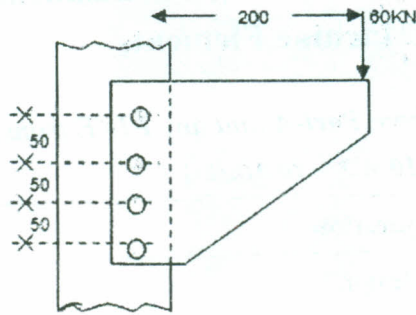Time: **3 hours**                                                                 Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

### Part-A (10 × 2 = 20 Marks)

| Q. No. | Stem of the question | M | L | CO | PO |
|---|---|---|---|---|---|
| 1. | What are the preferred numbers in shaft design? | 2 | 2 | 1 | 1 |
| 2. | List the mechanical properties to be considered for design of mechanical component. | 2 | 1 | 1 | 1 |
| 3. | How does stress concentration lead to failure? | 2 | 2 | 2 | 1 |
| 4. | Sketch the fluctuating stress and reversed stress with respect to time. | 2 | 1 | 2 | 1 |
| 5. | State the advantages of rigid coupling | 2 | 1 | 3 | 2 |
| 6. | Mention types of failures of key. | 2 | 1 | 3 | 2 |
| 7. | Sketch the through bolt and stud. | 2 | 1 | 4 | 1 |
| 8. | What is the importance of locking devices? Draw any one locking device. | 2 | 2 | 4 | 2 |
| 9. | What is overhauling of screw jack? | 2 | 3 | 5 | 1 |
| 10. | Define pitch, back-pitch and margin about riveted joints. | 2 | 1 | 5 | 1 |

### Part-B (5 × 8 = 40 Marks)

| Q. No. | | Stem of the question | M | L | CO | PO |
|---|---|---|---|---|---|---|
| 11. | a) | How do you designate carbon steels and cast iron? | 2 | 1 | 1 | 1 |
| | b) | A critical section in a shaft is subjected to a twisting moment of 20 KN m and bending moment of 16 KN m. The yield strength of shaft material is 700 MPa. Determine the diameter of the shaft according to any three theories of failure. Assume factor of safety is 3, E=210 GPa and μ=0.33. | 6 | 2 | 1 | 3 |
| 12. | a) | List out the factors affecting endurance limit of a component. | 2 | 2 | 2 | 1 |
| | b) | A pulley is keyed to the shaft, midway between two bearings. The bending moment at the pulley varies from − 150N-m to +450N-m The shaft material has $S_{ut}$ =540 N/mm² and $S_{yt}$= 400N/mm². Calculate the required diameter of the shaft at the key-slot. Size factor = 0.88, Surface finish factor = 0.85. Factor of safety = 1.8 | 6 | 3 | 2 | 3 |
| 13. | a) | List the types of keys used in industry and draw the jib headed key. | 2 | 1 | 3 | 2 |
| | b) | Shaft supported in two bearings 800 mm apart is running at 720 rpm. It carries two pulleys at A and B 300mm and 600 mm respectively from LH bearing. Pulley A, 400 mm in diameter is drive pulley with 10 kW input, and pulley B is the output pulley 300 mm in diameter. Both are vertical belt driven with ratio of tensions 2.3. Allowable shear stress for the shaft material as 75 N/mm² Determine the shaft diameter. | 6 | 3 | 3 | 3 |
| 14. | a) | Sketch a bolt of uniform strength and write down the relevant equations. | 2 | 2 | 4 | 1 |

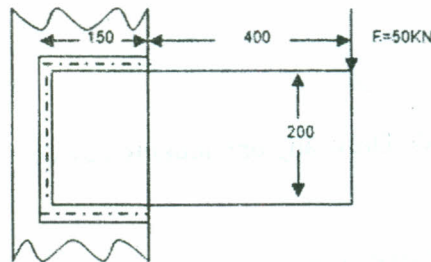| | | | M | L | CO | PO |
|---|---|---|---|---|---|---|
| | b) | A bracket is supported by means of 4 bolts of same size as shown in fig. Determine the standard size of the bolt if the shear stress is limited to 100N/mm². All dimensions are in mm. | 6 | 4 | 4 | 2 |



| | | | M | L | CO | PO |
|---|---|---|---|---|---|---|
| 15. | a) | A triple riveted lap joint with zig-zag riveting is used to connect two plates of 12 mm thickness. Design the joint and show how it will fail. Take $\sigma t$ = 120MPa, $\tau$ =100 MPa and $\sigma c$ = 150 MPa. | 4 | 2 | 5 | 1 |
| | b) | The following sketch shows an eccentrically loaded welded joint. Determine the weld size if shear stress in the same is not to exceed 80MPa | 4 | 4 | 5 | 2 |



| | | | M | L | CO | PO |
|---|---|---|---|---|---|---|
| 16. | a) | An unknown weight falls through 15 mm on a collar rigidly attached to the lower end of a vertical bar 3.2 m long and 6 cm² in section. If the maximum instantaneous extension is known to be 2.1 mm. what is the corresponding stress and the value of unknown weight? Given E=200 GPa. | 4 | 3 | 1 | 2 |
| | b) | The working cycle of a mechanical component ( $S_u$ = 660MPa Corrected $S_e$ = 280MPa ), subjected to completely reversed bending stresses consists of the following 3 elements. ±550MPa for 75% of time, ±400MPa for 15% of time ±500MPa for 10% of time Determine the life of the component. | 4 | 3 | 2 | 2 |
| 17. | | Answer any *two* of the following: | | | | |
| | a) | Design and sketch muff coupling to transmit 15KW at 900 rpm from an electric motor to a compressor. The following permissible stresses may be assumed: Shear stress for shaft and key is 40MPa, Crushing stress for key is 80MPa, Shear stress for CI = 8MPa. | 4 | 2 | 3 | 2 |
| | b) | Explain: a) leg length and b) throat thickness of weld section with a neat sketch. | 4 | 1 | 4 | 1 |
| | c) | Draw the sketches of a differential and compound screw and explain their working principle. | 4 | 1 | 5 | 1 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

| | | |
|---|---|---|
| i) | Blooms Taxonomy Level – 1 | 20% |
| ii) | Blooms Taxonomy Level – 2 | 30% |
| iii) | Blooms Taxonomy Level – 3 & 4 | 50% |

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