**20ME502**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION** | | | |
| **December, 2023** | **Mechanical Engineering** | | |
| **Fifth Semester** | **Design of Machine Elements** | | |
| **Time:** Three Hours | | **Maximum:** 70 Marks | |
| ***Answer question 1 compulsory.*** | | | **(14X1 = 14Marks)** |
| ***Answer one question from each unit.*** | | | **(4X14=56 Marks)** |
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|  |  |  | CO | BL | M |
| 1 | a) | What is design synthesis? | CO1 | L1 | 1M |
|  | b) | Define equivalent torsional moment. | CO1 | L1 | 1M |
|  | c) | State maximum shear stress theory of failure. | CO1 | L1 | 1M |
|  | d) | Differentiate low cycle fatigue and high cycle fatigue. | CO3 | L2 | 1M |
|  | e) | Write the examples component’s subjected to fatigue failure. | CO3 | L2 | 1M |
|  | f) | What is bolt of uniform strength? | CO3 | L1 | 1M |
|  | g) | Name the materials used for threaded fasteners. | CO2 | L1 | 1M |
|  | h) | Write the expression for efficiency of a riveted joint. | CO3 | L1 | 1M |
|  | i) | State the reasons of replacing riveted joint by welded joint in modern equipment. | CO3 | L2 | 1M |
|  | j) | How is rivet specified? | CO3 | L1 | 1M |
|  | k) | What is meant by power screw? | CO4 | L1 | 1M |
|  | l) | Why square threads are preferred over V-threads for power transmission? | CO4 | L1 | 1M |
|  | m) | Define spring index. | CO4 | L1 | 1M |
|  | n) | Which spring is used for safety valve applications? | CO4 | L2 | 1M |
| **Unit-I** | | | | | |
| 2 | a) | What are the steps involved in the design of machine elements? Explain. | CO1 | L2 | 8M |
|  | b) | Briefly explain about preferred numbers and their significance. | CO1 | L2 | 6M |
| **(OR)** | | | | | |
| 3 | a) | Why factor of safety is necessary in the design of mechanical components? Discuss the important factors influencing the selection of factor of safety. | CO1 | L2 | 6M |
|  | b) | The stresses induced at a critical point in a machine component made of steel 45C8 (σyt = 380 N/mm2) are as follows:  σx = 100 N/mm2  σy = 40 N/mm2  τxy = 80 N/mm2  Calculate the factor of safety using i) the maximum principal stress theory and ii) the maximum shear stress theory. | CO3 | L3 | 8M |
| **Unit-II** | | | | | |
| 4 |  | A cantilever beam made of cold drawn steel 40C8 (σut = 600 N/mm2 and σyt = 380 N/mm2) is shown in figure. The force P acting at the free end varies from -50 N to +150 N. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter ‘d’ of the beam at the fillet cross section.  2D524D2A | CO3 | L3 | 14M |
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| **(OR)** | | | | | |
| 5 | a) | What are the different types of the stresses induced in bolts? Explain the procedure of designing a bolt subjected to direct tensile load. | CO3 | L2 | 6M |
|  | b) | Two shafts are connected by means of a flange coupling to transmit torque of 25 N-m. The flange of the coupling is fastened by four bolts of the same material at a radius of 30 mm. Find the size of the bolts if the allowable shear stress for the bolt material is 30 MPa. | CO3 | L3 | 8M |
| **Unit-III** | | | | | |
| 6 | a) | What is an eccentric loaded welded joint? Discuss the procedure for designing such a joint. | CO3 | L2 | 7M |
|  | b) | A plate 100 mm wide and 10 mm thick is to be welded with another plate by means of transverse fillet welds at the ends. If the plates are subjected to a load of 70 kN, find the size of weld for static as well as fatigue load. The permissible tensile stress for the weld metal should not exceed 70 MPa. | CO3 | L3 | 7M |
| **(OR)** | | | | | |
| 7 | a) | Classify different types of riveted joints with neat sketches and mention their applications. | CO3 | L2 | 6M |
|  | b) | A riveted joint, consisting of four identical rivets, is subjected to an eccentric load of 5 kN as shown in figure. Determine the diameter of rivets, if the permissible shear stress is 60 N/mm2. | CO3 | L3 | 8M |
| **Unit-IV** | | | | | |
| 8 |  | A double-threaded power screw, with ISO metric trapezoidal threads (θ = 150) is used to raise a load of 300 kN. The nominal diameter is 100 mm and the pitch is 12 mm. The coefficient of friction at the screw threads is 0.15. Neglecting collar friction, calculate i) torque required to raise the load ii) torque required to lower the load and iii) efficiency of the screw. | CO4 | L3 | 14M |
| **(OR)** | | | | | |
| 9 |  | A safety value, 60 mm in diameter is to blow off at a pressure of 1.2 N/mm2. It is held on its seat by means of a helical compression spring with initial compression of 35 mm. The maximum lift of the valve is 10 mm. The spring index is 5. The maximum shear stress in the material of the wire is limited to 500 MPa and modulus of rigidity of the spring material is 80 GPa. Calculate wire diameter, mean coil diameter and number of active coils. | CO4 | L3 | 14M |

