**PVP 20**

Code: 20ME3503

**III B.Tech - I Semester – Regular / Supplementary Examinations**
**NOVEMBER 2023**

# DESIGN OF MACHINE ELEMENTS
## (MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level CO – Course Outcome

*** Use of Approved Design data book is permitted ***

| | | | BL | CO | Max. Marks |
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| | | **UNIT-I** | | | |
| 1 | a) | Explain about general procedure in machine design. | L2 | CO1 | 7M |
| | b) | What are the factors to be considered while selecting the material in machine design? | L2 | CO1 | 7M |
| | | **OR** | | | |
| 2 | a) | A manufacture is interested in starting a business with five different models of tractors ranging from 7.5 to 75 kW Capacities. Specify power capacities of the models. There is an expansion plan to further increase the number of models from five to nine to fulfill the requirement of farmers. Specify the power capacities of the additional models. | L2 | CO1 | 7 M |
| | b) | Explain the essential mechanical properties of engineering materials. | L2 | CO1 | 7M |
| | | **UNIT-II** | | | |
| 3 | a) | A machine element is loaded so that $\sigma_1 = 120$ MPa, $\sigma_2 = 70$MPa, $\sigma_3 = -90$MPa. The material has maximum yield strength in tension and compression of 360 MPa. | L3 | CO2 | 4 M |

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| | | Find the factor of safety using maximum shear stress theory. | | | |
| | b) | A simply supported beam has a concentrated load at the center, which fluctuates from a value of P to 4 P. 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. | L3 | CO2 | 10M |
| **OR** | | | | | |
| 4 | a) | Explain various methods of reducing stress concentration in machine elements. | L2 | CO1 | 4M |
| | b) | A cylindrical shaft made of steel yield strength 800 MPa is subjected to static loads bending moment 20 kN-m and twisting moment 30 N-m. Calculate the diameter of the shaft using Normal stress theory and Von Mises theory. Assume factor of safety is 2. | L3 | CO2 | 10M |
| **UNIT-III** | | | | | |
| 5 | a) | Find the efficiency of the following riveted joints:<br>i) Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm.<br>ii) Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm.<br>Assume; Permissible tensile stress in plate = 120 MPa, Permissible shearing stress in rivets = 90 MPa, Permissible crushing stress in Rivets = 180 MPa. | L3 | CO3 | 10M |

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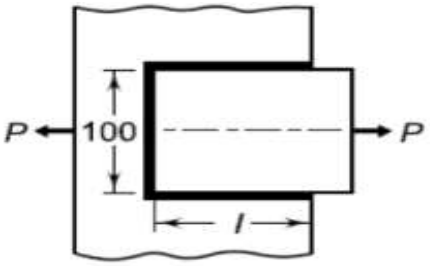
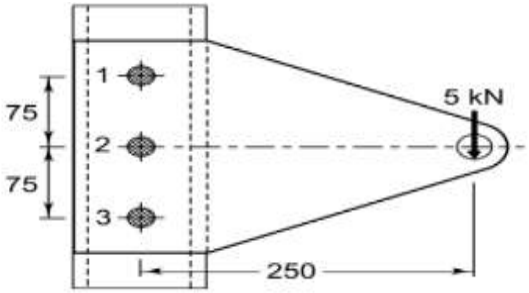
| | b) | Write the advantages of riveted and welded joints. | L2 | CO1 | 4M |
| **OR** | | | | | |
| 6 | a) | Classify riveted and welded joints? | L2 | CO1 | 4M |
| | b) | A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Fig. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plates are 70 and 50 N/mm$^2$ respectively. Find the length of each parallel fillet weld Assume the tensile force acting on the plates as static.   | L3 | CO3 | 10M |
| **UNIT-IV** | | | | | |
| 7 | a) | What is meant by bolt of uniform strength? | L2 | CO1 | 4 M |
| | b) | A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in Fig. The bolts are made of plain carbon steel 30C8 ($\sigma_{yt}$ = 400 N/mm$^2$) and the factor of safety is 3. Determine the diameter of the bolts.   | L3 | CO3 | 10M |
| **OR** | | | | | |
| 8 | a) | What are the different stresses induced in bolts due to initial tightening? | L2 | CO1 | 4M |

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| | b) | Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses: $\sigma_t$= 60 MPa; $\tau$ =70 MPa; and $\sigma_c$= 125 MPa. | L3 | CO3 | 10M |
| **UNIT-V** | | | | | |
| 9 | a) | Write the design procedure for leaf spring. | L2 | CO1 | 7M |
| | b) | A close coiled helical compression spring of 16 active coils has a spring stiffness of 10 N/mm. It is cut into two springs having 7 and 9 turns. Determine the spring stiffness of resulting springs. | L3 | CO4 | 7M |
| **OR** | | | | | |
| 10 | | A helical compression spring, made of circular wire, is subjected to an axial force, which varies from 2.5 kN to 3.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. The spring is made of patented and cold-drawn steel wire with ultimate tensile strength of 1050 N/mm$^2$ and modulus of rigidity of 81370 N/mm$^2$. The permissible shear stress for the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) total number of coils; (v) solid length of the spring; (vi) free length of the spring; (vii) required spring rate; and (viii) actual spring rate. | L3 | CO4 | 14M |