

B.Tech DEGREE EXAMINATION, DECEMBER 2023

Sixth Semester

18MEC208T - MECHANICAL ENGINEERING DESIGN

(For the candidates admitted during the academic year 2018-19 to 2021-22)

OPEN BOOK EXAMINATION (PSG design data book to be provided)

Note:

- i. Specific approved THREE text books (Printed or photocopy) recommended for the course.
- ii. Handwritten class notes (certified by the faculty handling the course / Head of the Department).

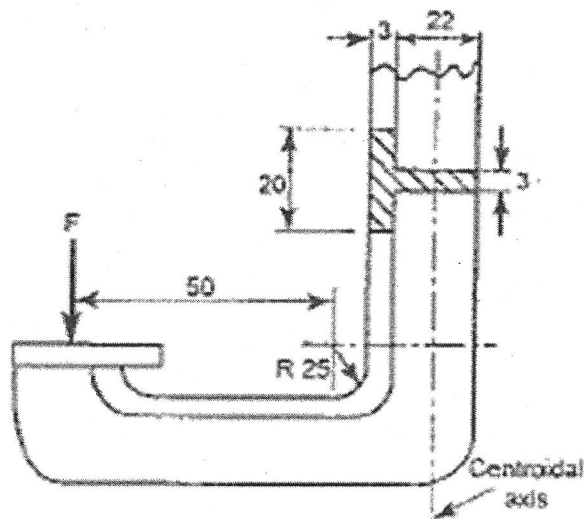
Time: 3 Hours

Max. Marks: 100

Answer **FIVE** Questions
(Question No. 1 is compulsory)

Marks BL CO

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| <p>1 i. A C-clamp is to bear the force 'F' applied onto it. It has a T- Section as shown in the figure (all dimensions are in mm). If the maximum tensile stress in the clamp is limited to 130 MPa, find 'F.'</p> | 18 | 3 | 1 |
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| <p>ii. The trunnion of a mixing machine has an effective length of 30 cm, and the weight comes on each trunnion is 12500 N, what should be the diameter of the trunnion if the fibre stress is not to exceed 35 N/mm².</p> | 1 | 2 | 1 |
|---|---|---|---|

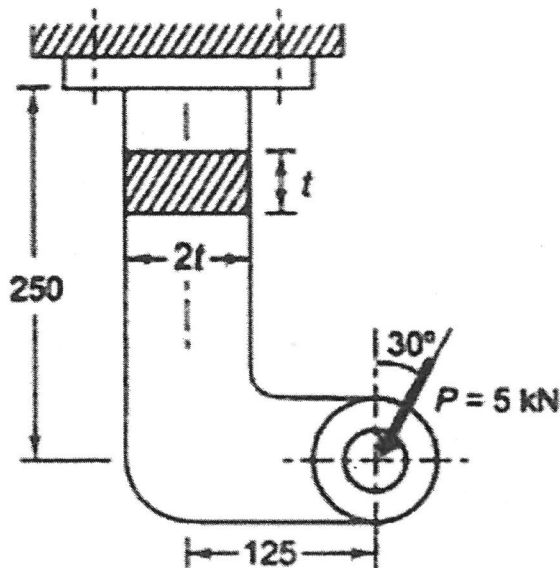
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|------------|------------|
| (A) 101 mm | (B) 102 mm |
| (C) 103 mm | (D) 100 mm |

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| <p>iii. Find the maximum principal stress in MPa for the machine member subjected to the following stresses.</p> | 1 | 2 | 1 |
|--|---|---|---|

$\sigma_x = 20 \text{ MPa}$, $\sigma_y = 7 \text{ MPa}$ and $\tau_{xy} = 4 \text{ MPa}$

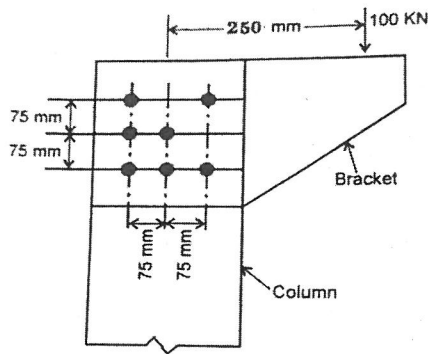
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|---------------|---------------|
| (A) 20.13 MPa | (B) 21.13 MPa |
| (C) 22.13 MPa | (D) 23.13 MPa |

- 2 i. A bracket, made of steel (Yield stress of 200 N/mm^2) and subjected to a force of 5 kN acting downwards at an angle of 30° to the vertical, is shown in figure (all dimensions are in mm). The factor of safety is 4. Determine the dimensions of cross section of the bracket. 18 3 1

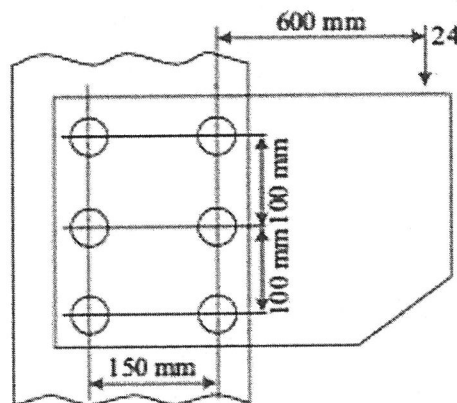


- ii. The state of stress at a point, for a body in plane stress, is given as follows: $\sigma_x = 100 \text{ kPa}$, $\tau_{xy} = 50 \text{ kPa}$. If the minimum principal stress is 10 kPa , then the normal stress σ_y (in kPa) is 1 2 1
- (A) 37.78 (B) 39.78
(C) 41.78 (D) 43.78
- iii. In a metal forming operation, when the materials just started yielding the principal stresses are $\sigma_1 = +180 \text{ MPa}$, $\sigma_2 = -100 \text{ MPa}$, $\sigma_3 = 0$. Following Von Mises Criterion, the Yield Stress is _____ MPa 1 2 1
- (A) 245.76 (B) 249.76
(C) 254.76 (D) 259.76
- 3 i. An overhung shaft carries a 90 cm diameter pulley whose centre is 25 cm from the centre of the nearest bearing. The weight of the pulley is 0.6 kN and the angle of the lap is 180° . The pulley is driven by a motor vertically below it. If the permissible tension in the belt is 2600 N and if the coefficient of friction between the belt and pulley surface is 0.3 estimate the diameter of the shaft when the internal diameter is 0.6 times the external diameter. Neglect centrifugal tension and assume permissible shear and tensile stresses as 64 and 84 N/mm^2 respectively 18 3 2
- ii. In a structural member under fatigue loading, the minimum and maximum stresses developed at the critical point are 50 MPa and 150 MPa respectively. The endurance, yield, and ultimate strengths of the materials are 200 MPa , 300 MPa , and 400 MPa respectively. The factor of safety using the modified Goodman criterion is 1 2 2
- (A) 2 (B) 2.5
(C) 3 (D) 3.5
- iii. A static load is mounted at the centre of the shaft rotating at uniform angular velocity. The shaft will be designed for 1 1 2
- (A) The maximum compressive stress (static) (B) The maximum Tensile stress (static)
(C) The maximum Bending stress (static) (D) Fatigue Loading

- 4 i. The structural connection is subjected to an eccentric force of 100 kN, as shown in the figure. It is fastened by means of seven identical bolts. If the maximum shear stress in bolt material is limited to 63 N/mm^2 . Determine the size of the bolts

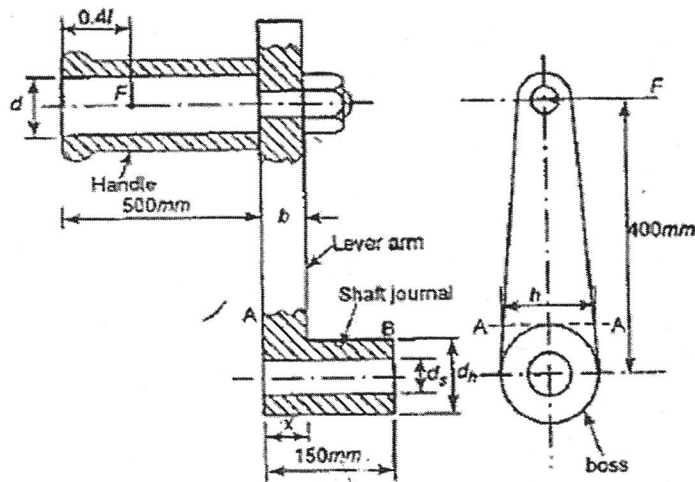


- ii. A Knuckle joint withstands a load of 100 kN. All the parts are made of the same material with ultimate tensile, crushing stress is 480 MPa and shear stress is 360 MPa. Use a factor of safety of 6 on ultimate strength. The diameter of the rod of a Knuckle joint is
 (A) 9.98 mm (B) 19.98 mm
 (C) 29.98 mm (D) 39.98 mm
- iii. An ordinary bolt of 25 mm diameter is converted to bolt of uniform strength by reducing the cross-sectional area of the shank by making a hole in the shank portion, The hole diameter in the shank is
 (A) 3.56 mm (B) 8.56 mm
 (C) 13.56 mm (D) 16.56 mm
- 5 i. Determine the diameter of the rivet for a joint subjected to 24 kN as eccentrically loaded, as shown in the figure. The allowable shear stress for the rivet material is 75 MPa.



- ii. Find the diameter of the rivet hole, if the plates of 13 mm thickness is fastened by double riveted zig-zag riveting.
 (A) 21 mm (B) 22 mm
 (C) 23 mm (D) 24 mm
- iii. If the thickness of the plate is 7 mm the minimum size of the weld required is
 (A) 3 mm (B) 5 mm
 (C) 7 mm (D) 9 mm
- 6 i. Design a close coiled compression spring has plain ends and is to fit over a 25 mm diameter rod. When a compressive force of 100 N is applied to the spring, it compresses by 50 mm. If the spring has a preferred wire diameter of 4 mm, and the spring material has a maximum allowable shear stress of 180 MPa and modulus of rigidity of 81 GPa,

- ii. A 60 mm long and 6 mm thick fillet weld carries a steady load of 15 kN along the weld. 1 3 4
The shear strength of the weld material is equal to 200 MPa. The factor of safety is
(A) 2.4 (B) 3.4
(C) 4.4 (D) 5.4
- iii. The spring constant of a helical compression spring does not depend on 1 1 5
(A) coil diameter (B) material strength
(C) number active turns (D) wire diameter
- 7 i. Design the cranked lever as shown in figure has the following dimensions: Length of the 18 3 5
handle = 500 mm; Length of the lever arm = 400 mm; Overhang of the journal = 150 mm. The lever is used for hoisting winch and operated by two persons exerting a maximum force of 600 N at a distance of 0.4 times the length of the handle from its free end. The permissible stresses in bending and shear are not to exceed 70 MPa and 50 MPa.



- ii. A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 1 3 5
mm. What is the mean diameter and spring index?
(A) 81 mm & 10.5 (B) 69 mm & 11.5
(C) 75 mm & 10.5 (D) 6 mm and 11.5
- iii. For a hand lever subjected to a torque of 8×10^5 N-mm with a shear stress of 70 MPa, 1 3 5
the suitable diameter of the shaft is
(A) 30 mm (B) 50 mm
(C) 40 mm (D) 60 mm

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