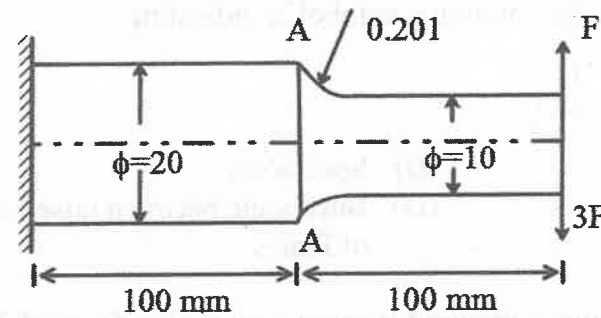


- 7.a. i. A Cantilever beam shown in Figure. Made of C40 steel of circular cross section is subjected to a load that varies from  $F$  (compressive) to  $3F$  (Tensile). Determine the value of  $F$  that the beam can withstand. Assume  $FoS = 2.1$ , Stress concentration Factor = 1.42, Notch sensitivity Factor = 0.3. Surface finish Factor = 0.85, Size Factor = 0.86.



- ii. Comment on the statement "In curved beams maximum stress always occur at the inner fibre".
- b. In compressive yield stress and tensile yield stress are equivalent, then region of safety from maximum principal stress theory is of which shape?
- (A) Rectangle (B) Square  
(C) Circle (D) Ellipse
- c. Calculate the shaft diameter on rigidity basis. If torsional moment is 196000 N-mm. Length of the shaft is 1000 mm. Permissible angle of twist per meter is  $0.5^\circ$  and take  $G = 79300 \text{ N/mm}^2$ .
- (A) 100mm (B) 41.2mm  
(C) 35.8mm (D) 38.8mm

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Reg. No.

B.Tech. DEGREE EXAMINATION, MAY 2023

OPEN BOOK EXAMINATION

Sixth Semester

18MEC208T – MECHANICAL ENGINEERING DESIGN

(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

(PSG design data book permitted)

- Specific approved THREE text books (Printed or photocopy) recommended for the course
- Handwritten class notes (certified by the faculty handling the course / head of the department)

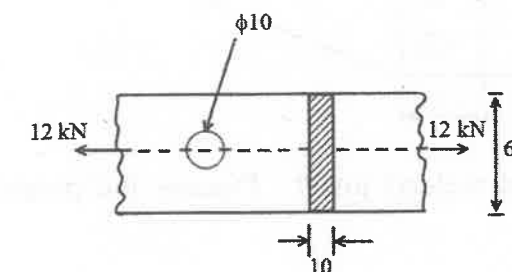
Time: 3 Hours

Max. Marks: 100

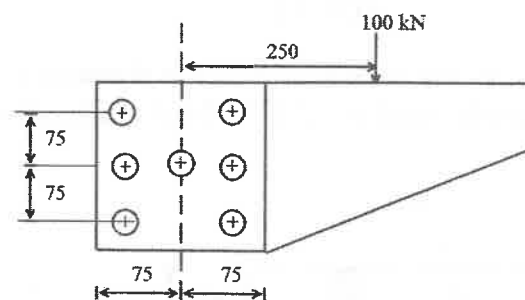
Answer FIVE questions

(Question No 1 is compulsory)

- |   | Marks | BL | CO | PO  |
|---|-------|----|----|-----|
| 1.a.i. If the body is subjected to stress in xy plane with stresses of $60 \text{ N/mm}^2$ and $80 \text{ N/mm}^2$ acting along x and y are respectively. Also shear stress acting is $20 \text{ N/mm}^2$ . Find the maximum amount of shear stress to which the body is subjected. | 3     | 2  | 1  | 2,3 |
| ii. A bolt is subjected to a tensile load of 30kN and a shear load of 10kN. Determine the diameter of the bolt according to   | 15    | 4  | 1  | 2,3 |
| i. Maximum Principal Stress Theory  |       |    |    |     |
| ii. Maximum Principal Strain Theory   |       |    |    |     |
| iii. Maximum Shear Stress Theory  |       |    |    |     |
| Assume the factor of safety as 2.5, yield point stress in simple tension = $300 \text{ N/mm}^2$ , Poisson's ratio = 0.25, also calculate standard diameter as per the BIS. Justify the best suitable diameter from the above theories.  |       |    |    |     |
| b. If compressive yield stress and tensile yield stress are equivalent, then region of safety from maximum principal stress theory is of which shape  | 1     | 1  | 1  | 2   |
| (A) Rectangle (B) Square<br>(C) Circle (D) Ellipse  |       |    |    |     |
| c. If the body is subjected to stresses in xy plane with stresses of $60 \text{ N/mm}^2$ acting along x and y axes respectively. Also as shear stress acting is $10 \text{ N/mm}^2$ . Find the inclination of the plane in which shear stress is minimal.                           | 1     | 2  | 1  | 2   |
| (A) $45^\circ$ (B) $30^\circ$<br>(C) $60^\circ$ (D) $15^\circ$  |       |    |    |     |
| 2.a. i. A rectangular plate 60mm × 10mm with a hole 10mm diameter is as shown below and subjected to a tensile load of 12 kN. Find the maximum stress induced.  | 8     | 3  | 2  | 2   |



- ii. The bending stress in a machine part fluctuates between a tensile stress of  $280 \text{ N/mm}^2$  and a compressive stress of  $180 \text{ N/mm}^2$ . What should be minimum ultimate tensile strength of this part to be carry their fluctuation indefinitely according to (i) Goodman's Formula (ii) Soderberg formula. Factor of Safety = 1.5. Assumes that the yield point is never likely to be less than 55% of ultimate tensile strength or Greater than 93% of it. 10 4 2 3
- b. Which of the following straight line joints endurance limit on the stress amplitude axis and yield strength on the mean stress axis? 1 1 2 2  
 (A) Soderberg equation (B) Modified Goodman Line  
 (C) Gerber Line (D) Goodman Line
- c. A steel bar having diameter 14mm is subjected to a fluctuating load of 50kN in tension and 10kN in compression. Find the mean stress of the steel bar. 1 2 2 2  
 (A) 52 Pa (B) 130 Pa  
 (C) 505 Pa (D) 5151 Pa
- 3.a. i. Two mild steel rods 40 mm diameter are to be connected by a cotter joint. The thickness of the cotter is 12 mm. Calculate the dimension of the joint, if the maximum permissible stresses are 45 MPa in tension: 35 MPa in shear and 70 MPa in crushing. 14 3 3 3
- ii. Distinguish between Cotter Joint and Knuckle Joint. 4 2 3 2
- b. If Knuckle joint is to fail by crushing failure of pin in Fork, then determine the diameter of Knuckle Pin when 50 kN axial tensile force act on rods. Given maximum allowable compressive stress =  $25 \text{ N/mm}^2$ . Thickness of each eye of fork = 25mm 1 2 3 2  
 (A) 40mm (B) 50mm  
 (C) 60mm (D) 70mm
- c. If core diameter of the bolt is 18.8mm. Find the nominal diameter? 1 2 3 3  
 (A) 17.27 mm (B) 15.34 mm  
 (C) 14.67 mm (D) 16.37mm
- 4.a. i. A bracket is riveted to column by 6 rivets of equal size as shown in the following figure. It carries a load of 100 kN at a distance of 250mm from the column. If the maximum shear stress in the rivet is limited to 63 MPa. Find the diameter of the rivet. 13 3 4 3

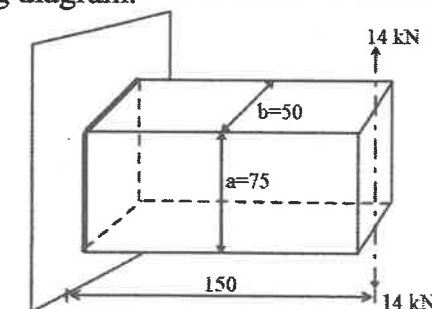


- ii. What is an eccentric loaded welded joint? Discuss the procedure for designing such a joint. 5 3 4 2

- b. A rivet is specified as 20mm rivet, what does it mean? 1 2 4 2  
 (A) Thread is 20mm (B) Shank diameter is 20mm  
 (C) Head diameter 20mm (D) Head and Shank diameter 20 mm
- c. Find the type of weld joint the following symbol is indicating. 1 2 4 2



- (A) Fillet Weld (B) Spot Weld  
 (C) Single U butt weld (D) But a weld between raised edges of Plates
- 5.a. i. A compression helical spring is required to exert a minimum force of 250N and maximum force of 600N and the deflection for this change in load is to be 15mm. The spring must fit in a hole of 30mm diameter. The load is static. Ultimate tensile stress is 1393 MPa and shear stress is 606 MPa. 14 3 5 2,3
- ii. What is lever? Explain the principle on which it works. 4 3 5 2
- b. A bottle opener belongs to which class of the levers. 1 2 5 2  
 (A) Effort in the middle (B) Fulcrum in the middle  
 (C) Resistance in the middle (D) Pulley effect
- c. If spring index = 2.5. What can be concluded about stresses in the wire? 1 2 5 2  
 (A) They are High (B) They are Negligible  
 (C) They are Moderate (D) Cannot be Determined
- 6.a. i. A rectangular beam is to be welded in a plate. The maximum load of 14 kN is applied repetitiously. Determine the size of weld required for 10,000,000 cycles. Assume the shear load is distributed uniformly over the entire weld. Refer The following diagram. 13 4 4 3



- ii. A circular bar of 50 mm diameter and 200 mm long is welded to a steel plate. It supports a vertical downward load of 10 kN at its free end. Determine the weld size assuming the strength of the weld to be 94 MPa. 5 2 4 2
- b. In \_\_\_\_\_ welding heavy current (50,000 A) is passed through the joint which gets melt and welding is under external pressure. 1 1 4 2  
 (A) Arc Welding (B) Gas Welding  
 (C) Forge Welding (D) Spot Welding
- c. Couplings used in marine propeller shaft are 1 2 4 2  
 (A) Solid Flanged Coupling (B) Half – leg muff Coupling  
 (C) Butt muff Coupling (D) Cone Coupling