

Reg. No.															
----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

B.Tech. DEGREE EXAMINATION, DECEMBER 2022
Sixth and Seventh Semester

18MEC208T – MECHANICAL ENGINEERING DESIGN
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)
(Use of PSG data book is permitted)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- (ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours

Max. Marks: 75

PART – A (25 × 1 = 25 Marks)

Answer ALL Questions

Marks BL CO PO

- | | | | | |
|---|---|---|---|---|
| 1. In bilateral system for tolerances | 1 | 1 | 1 | 2 |
| (A) Tolerances are given on both positive and negative sides of basic size | | | | |
| (B) One tolerance is zero and other tolerance is given only on higher side of basic size | | | | |
| (C) One tolerance is zero and other tolerance is given on any one side of basic size | | | | |
| (D) One tolerance is zero and other tolerance is given only on lower side of basic size | | | | |
| 2. When a circular shaft is subjected to torque, the torsional shear stress is | 1 | 1 | 1 | 2 |
| (A) Directly proportional to the distance from the axis | | | | |
| (B) Inversely proportional to the distance from the axis | | | | |
| (C) Proportional to the square of the distance from the axis | | | | |
| (D) Constant through out the cross-section | | | | |
| 3. When a shaft of diameter d and length l is subjected to torsional moment M_t , then the angle of twist θ in degrees is given by | 1 | 1 | 1 | 3 |
| (A) $\frac{584M_t l}{Gd^4}$ | | | | |
| (B) $\frac{M_t l}{\pi d^4}$ | | | | |
| (C) $\frac{584M_t l}{Gd^3}$ | | | | |
| (D) $\frac{M_t G}{d^4 l}$ | | | | |
| 4. Rankine's theory of failure is applicable to | 1 | 1 | 1 | 2 |
| (A) Ductile materials | | | | |
| (B) Elastic materials | | | | |
| (C) Brittle materials | | | | |
| (D) Plastic materials | | | | |
| 5. For maximum principal stress theory, the shape of the region of safety on σ_1, σ_2 co-ordinate system is | 1 | 1 | 1 | 2 |
| (A) Square | | | | |
| (B) Hexagon | | | | |
| (C) Ellipse | | | | |
| (D) Circle | | | | |

6. The maximum stress concentration factor for a rectangular plate with a transverse hole loaded in tension (or) compression 1 1 2 2
 (A) 2 (B) 3
 (C) 2.5 (D) 1
7. A stress that varies in sinusoidal manner with respect to time from tensile to compressive and with zero mean is called 1 1 2 2
 (A) Reversed stress (B) Fluctuating stress
 (C) Repeated stress (D) Varying stress
8. The surface finish factor for a highly polished component is 1 1 2 2
 (A) 0.89 (B) 1
 (C) 0.85 (D) 0
9. A transmission shaft subjected to pure bending moment should be designed on the basis of 1 1 2 2
 (A) Maximum principal stress theory (B) Maximum shear stress theory
 (C) Distortion energy theory (D) Goodman or soderberg diagrams
10. A transmission shaft is subjected to bending moment (M_b) and torsional moment (M_t). The equivalent bending moment is given by 1 1 2 2
 (A) $\sqrt{(M_b) + (M_t)}$ (B) $\sqrt{(M_b)^2 + (M_t)^2}$
 (C) $[M_b + M_t]$ (D) $M_b + \sqrt{(M_b)^2 + (M_t)^2}$
11. The taper in cottor is usually 1 1 3 2
 (A) 1 in 24 (B) 1 in 8
 (C) 1 in 100 (D) 1 in 48
12. A knuckle joint is used to transmit 1 1 3 2
 (A) Axial tensile force only (B) Axial tensile or compressive force
 (C) Axial compressive force only (D) Combined bending and torsional moment
13. Machine bolts are 1 1 3 2
 (A) Through bolts with rough shank and used with nut (B) Are used to prevent relative motion between two parts
 (C) Similar to stud (D) Turned into a threaded hole in one of the parts
14. A stud is 1 1 3 2
 (A) Screw with long threads (B) Screw with circular head
 (C) Screw with hexagonal head (D) Headless screw with threads on both sides

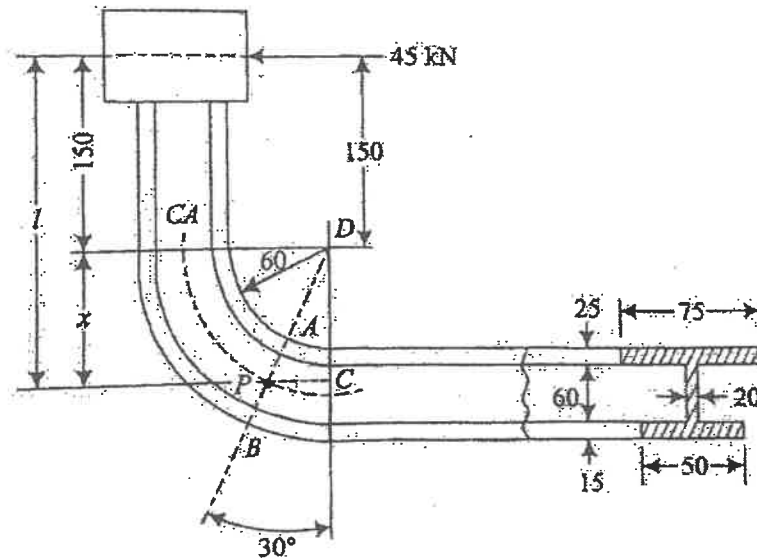
15. The shock absorbing capacity of a bolt can be increased by 1 1 3 2
 (A) Increasing shank diameter (B) Making shank diameter equal to core diameter of threads
 (C) Using castle nut in place of ordinary hexagonal nut (D) Using a washer
16. The size of a fillet weld is given by 1 1 4 2
 (A) Throat of fillet (B) Smaller side of triangle
 (C) Hypotenuse of triangle (D) Bigger side of triangle
17. The parallel fillet welds are designed for 1 1 4 2
 (A) Tensile strength (B) Bending strength
 (C) Shear strength (D) Compressive strength
18. In fillet welded joint, the throat of weld as compared to the size of weld is 1 1 4 2
 (A) About 0.5 times (B) About 0.707 times
 (C) About same size (D) About $\sqrt{2}$ times
19. The diameter of the rivet hole is 1 1 4 2
 (A) Equal to nominal diameter of rivet (B) Slightly less than nominal diameter or rivet
 (C) Slightly more than nominal diameter or rivet (D) Independent of nominal diameter of rivet
20. Rivets are usually made of 1 1 4 2
 (A) High carbon steel (B) Alloy steel
 (C) Cast iron (D) Mild steel
21. In lever terminology, 'Mechanical Advantage' is the ratio of 1 1 5 2
 (A) Load to effort (B) Effort to load
 (C) Load arm to effort arm (D) Effort arm to load arm
22. The type of spring use in door hinges is 1 1 5 2
 (A) Helical extension spring (B) Multi leaf spring
 (C) Spiral spring (D) Helical torsion spring
23. When the helical extension spring is subjected to axial tensile force, the type of stress induced in the spring wire is 1 1 5 2
 (A) Tensile stress (B) Compressive stress
 (C) Bending stress (D) Torsional stress
24. The stiffness of spring is 1 1 5 2
 (A) Deflection per unit of axial force (B) Force per unit cross-sectional area of spring
 (C) Ratio of mean coil diameter to wire diameter (D) Force required to produce unit deflection
25. The ratio of the length to the diameter of the fulcrum and roller pin in rocker arm is taken as 1 1 5 2
 (A) 1.25 (B) 0.25
 (C) 1.75 (D) 1

PART – B (5 × 10 = 50 Marks)

Marks BL CO PO

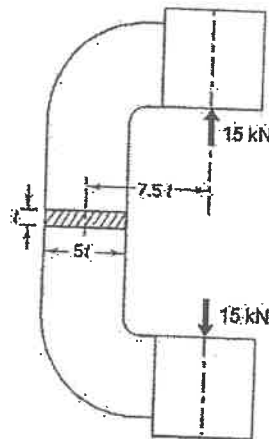
Answer ALL Questions

26. a. The frame of a punch press has dimensions in mm as shown below. Analyze along AB and determine the stresses at A and B. Take curvature into account. 10 4 1 3



(OR)

- b. A C-frame is made by gray cast iron, $S_{ut} = 300 \text{ N/mm}^2$ and the factor of safety is 2.5. Determine the dimensions of the cross-section. 10 4 1 3



27. a. A steel rod of circular section is subjected to an axial load, varying from 20 kN to 50 kN. As the bending moment varies from 500 N-m to 1000 N-m. Determine the diameter of the rod, using the following. $FOS = 2.25$, $\sigma_u = 560 \text{ MPa}$, $\sigma_y = 320 \text{ MPa}$, $\sigma_{-1} = 280 \text{ MPa}$, $B = 0.8$, $C = 0.85$, $K_f = 1.4$, $A = 0.7$, for axial loading, $A = 1.0$ for bending moment. 10 3 2 3

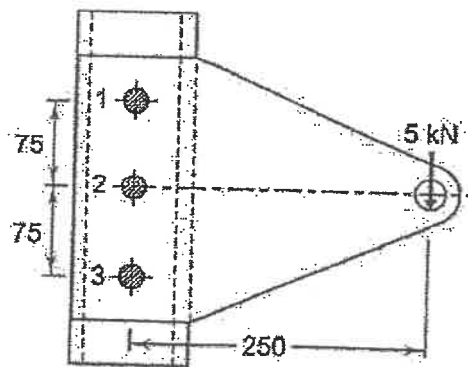
(OR)

- b. A propeller shaft is made up by joining together number of solid shafts. The joint is made by forging the ends of the shaft in the form of a flange, and bolting flanges together by means of 8 bolts. Determine the size of the shaft, the diameter and thickness of the flange and the diameter of the bolt. Take $P = 60 \text{ kN}$ at 120 r.p.m. permissible stresses are $\tau = 35 \text{ MPa}$, and $\sigma_c = 45 \text{ MPa}$. 10 3 2 3

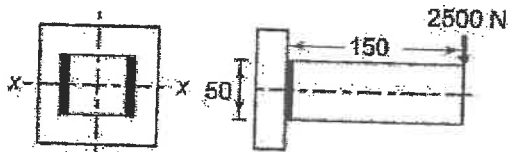
28. a. Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The width of the center is five times of thickness. Take $S_{yt} = 400 \text{ N/mm}^2$ and FOS = 4. Calculate, width and thickness of the cotter on the basis of
- Shear failure and
 - Bending failure

(OR)

- b. A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts. Determine the diameter of the shank by taking FOS= 3, $S_{yt} = 40 \text{ N/mm}^2$



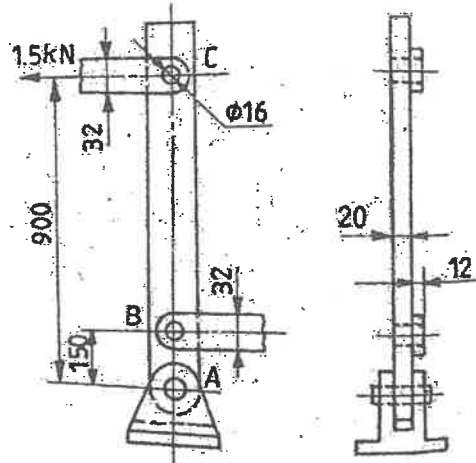
29. a. A welded joint as shown below is subjected to an eccentric load of 2500 N. find the size of the weld, if the maximum shear stress in the weld is not to exceed 50 N/mm^2 .



(OR)

- b. A cylindrical pressure vessel with in inner diameter is subjected to internal steam pressure of 1.5 MPa. The permissible stresses for the cylinder plate and the rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. The efficiency of longitudinal joint can be taken as 80% for the purpose of calculating the plate the thickness. The efficiency of circumferential lap joint should be at least 62%. Design the circumferential lap joint and calculate
- Thickness of the plate
 - Number of rivets
 - Diameter of rivets
 - Pitch of rivets
 - Number of rows of rivets
 - Overlap of the plate

30. a. Figure shows a vertical lever. ABC of 200 mm thickness, which is attached to a fulcrum pin at A and to a horizontal tie rod at B. A 1.5 kN force is applied to the lever at C through another horizontal tie rod. Determine
- The reactions at A and B
 - Maximum tensile stress in the tie rods of 32×12 mm size.
 - Shear stress in the 16 mm diameter pins at A, B and C
 - Maximum bearing pressure intensity at B.



(OR)

- b. A helical compression spring made from 6.3 mm dia steel wire has an outside dia of 57.3 mm with squared and ground ends with 12 coils. The maximum shear stress in the spring when compressed fully is 820 MPa. Determine
- The spring rate
 - Free length of spring
 - Critical frequency of vibration
- When one end is fixed. Take density of the spring material as 7000 kg/m^3 and $G = 80 \text{ GPa}$.

* * * * *