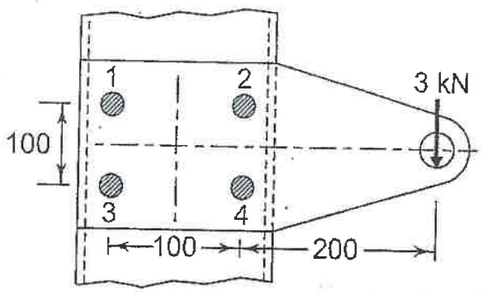
b. A steel plate subjected to a force of 3 kN and fixed to a vertical channel by means of four identical bolts is shown in figure. The bolts are made of plain carbon steel C45 and factor of safety is 2. Determine the diameter of the rivet shank. | 10 | 3 | 3 | 3



All Dimensions are in mm

29. a. A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Take $\sigma_t = 70\,MPa$, $\tau = 50\,MPa$ and $\sigma_c = 100\,MPa$. State how the joint will fail and find the efficiency of the joint. | 10 | 4 | 4 | 3

(OR)

b. A plate of 200 mm width and 600 mm long is welded to a vertical plate to form a cantilever with projecting length of 480 mm and over lap between the plates as 120 mm. Fillet weld is done on all the three sides. A vertical load 40 kN is applied at the free end of the cantilever plate parallel to its width of 200 mm. If the allowable weld stress is 120 MPa. Determine the weld size. | 10 | 3 | 4 | 2

30. a. Design a cranked lever for the following dimensions. | 10 | 3 | 5 | 3
Length of the handle = 320 mm
Length of the lever arm = 450 mm
Over gang of the journal = 120 mm
The lever is operated by a single person exerting a maximum force of 400 N at a distance of 1/3rd length of the handle from its free end. The permissible stresses may be taken as 50 MPa for lever material and 40 MPa for the shaft material.

(OR)

b. 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 4mm and the spring material has a maximum allowable shear stress of 180 MPa and modulus of rigidity of 81GPa. Determine the | 10 | 3 | 5 | 2
(i) Mean coil diameter of the spring
(ii) Diametrical clearance between the spring and the rod
(iii) Number of coils in the spring
(iv) Solid length of the spring

* * * * *

Reg. No.														

B.Tech. DEGREE EXAMINATION, MAY 2022
Sixth Semester

18MEC208T – MECHANICAL ENGINEERING DESIGN
(For the candidates admitted from the academic year 2018-2019 to 2019-2020)
(Approved Design Data Book may be 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) | Marks | BL | CO | PO
Answer **ALL** Questions

1. When the hole of diameter 'd' is punched in a metal of thickness 't', then the force required to punch a hole is equal to | 1 | 1 | 1 | 1
(A) $d \times t \times \tau$ (B) $\pi \times d \times t \times \tau$
(C) $\frac{\pi}{4} \times d^2 \times \tau$ (D) $\frac{\pi}{4} \times d \times t \times \tau$

2. Cast iron is used for machine beds because of its high_____ | 1 | 1 | 1 | 1
(A) Tensile strength (B) Endurance strength
(C) Damping capacity (D) Compressive strength

3. Safe area of stress diagram for maximum energy of distortion theory is represented by | 1 | 1 | 1 | 1
(A) Square of sides equal to $2\sigma_y$ (B) An ellipse with major axis $2\sqrt{2}\ \sigma_y$
(C) A rectangle (D) A circle

4. The maximum bending stress in a curved beam having symmetrical section always occur at the _____ | 1 | 1 | 1 | 1
(A) Centroidal axis (B) Neutral axis
(C) Inside fiber (D) Outside fiber

5. _____is an example of transition fit. | 1 | 2 | 1 | 1
(A) Running fit (B) Expansion fit
(C) Shrinkage fit (D) Wringing fit

6. Endurance limit or fatigue limit is the maximum stress that a member can with stand for an infinite number of load applications without failure when subjected to | 1 | 1 | 2 | 1
(A) Static loading (B) Dynamic loading
(C) Combined static and dynamic loading (D) Completely reversed loading

7. A transmission shaft subjected to bending loads must be designed on the basis of | 1 | 1 | 2 | 1
(A) Maximum normal stress theory (B) Maximum shear stress theory
(C) Maximum normal and maximum shear stress theories (D) Fatigue strength

8. The relationship between notch sensitivity factor 'q', theoretical stress concentration factor k_t and form stress factor K_f is given by | 1 | 1 | 2 | 1
(A) $q = K_f / K_t$ (B) $q = (K_f - 1)/(K_t - 1)$
(C) $q = (K_f + 1)/(K_t + 1)$ (D) $q = (K_t - 1)/(K_f - 1)$

9. A key capable of tilting in a recess milled out in a shaft is known as — 1 1 2 1
   (A) Gib head key (B) Feather key
   (C) Flat saddle key (D) Wood ruff key

10. A piston rod and a cross head are connected by _____ — 1 1 2 1
   (A) Cotter joint (B) Universal joint
   (C) Oldhams coupling (D) Muff coupling

11. The square threads are usually found on — 1 2 3 1
   (A) Spindles of bench vices (B) Railway carriage couplings
   (C) Feed mechanism of machine tools (D) Screw cutting lathes

12. The length of cotter in a sleeve and cotter joint, is taken as _____ — 1 1 3 1
   (A) 1.5 d (B) 2.5 d
   (C) 3 d (D) 4 d

13. The split pin is used in _____ — 1 1 3 1
   (A) Cotter joint (B) Knuckle joint
   (C) Universal coupling (D) Flange coupling

14. A cotter joint is used, when no relative motion is permitted between the rods joined by the cotter. It is capable of transmitting_____ — 1 2 3 1
   (A) The twisting moment (B) An axial tensile as well as compressive load
   (C) The bending moment (D) Only compressive axial load

15. To ensure self-locking in a screw jack, it is essential that helix angle is — 1 2 3 1
   (A) Larger than friction angle (B) Smaller than friction angle
   (C) Equal to friction angle (D) Such as to give maximum efficiency in lifting

16. In a riveted lap joint, which one is not a failure mode? — 1 1 4 1
   (A) Tearing failure of plate (B) Bearing failure of rivet
   (C) Shearing failure of rivet (D) Tensile failure of rivet

17. The most efficient riveted joint possible is one which would be as in tension, shear and crushing as the original plates to be joined. But this can never achieve because — 1 2 4 1
   (A) Rivets can be made with the same material (B) Rivets are weak in compression
   (C) There should be atleast one hole in the plate reducing its strength (D) Clearance is present between the plate and the rivet

18. The thickness of the boiler shell is determined on the basis of — 1 2 4 1
   (A) Circumferential stress in the shell (B) Longitudinal stress in the shell
   (C) Circumferential stress in the shell and assumed efficiency (D) Longitudinal stress in the shell and assumed efficiency

19. In a fillet weld, the weakest area of the weld is — 1 1 4 1
   (A) Toe (B) Root
   (C) Face (D) Throat

20. Parallel fillet weld joint is designed based on _____ — 1 1 4 1
   (A) Tensile strength (B) Compressive strength
   (C) Bending strength (D) Shear strength

21. All the types of levers are subjected to — 1 2 5 1
   (A) Twisting moment (B) Bending momcnt
   (C) Direct axial load (D) Combined twisting and bending moment

22. An 'I' section is more suitable for a — 1 2 5 1
   (A) Lever loaded safety valve (B) Rocker arm
   (C) Foot lever (D) Cranked lever

23. The initial gap between two turns of a close coiled helical tension spring should be — 1 2 5 1
   (A) Based on wire diameter (B) Based on number of turns
   (C) Based on maximum deflection (D) Zero

24. Which of the spring is used in a mechanical wrist watch? — 1 1 5 1
   (A) Helical compression spring (B) Spiral spring
   (C) Torsion spring (D) Belleville spring

25. Due to addition of extra full length leaves, the deflection of a semi-elliptic spring — 1 2 5 1
   (A) Increases (B) Decreases
   (C) Is doubled (D) Does not change

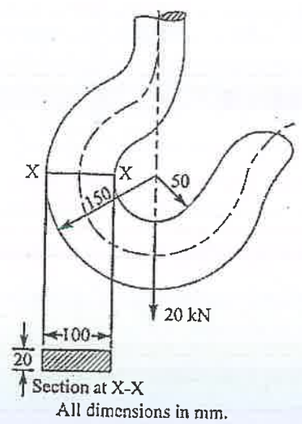
PART – B (5 × 10 = 50 Marks) — Marks | BL | CO | PO

Answer **ALL** Questions

26. a. A cylindrical shaft made of steel (yield strength = 700 MPa) is subjected to static loads consisting of bending moment of 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using — 10 3 1 2
   i. Maximum shear theory
   ii. Maximum strain energy theory
   Assuming a factor of safety of 2. Take E = 210 GPa and Poisson's ratio = 0.25.

(OR)

   b. The crane look carries a load of 20 kN as shown in figure. The section at X.X is rectangular whose horizontal side is 100 mm. Find the stresses in the inner and outer fibres at the given section. — 10 3 1 2



All dimensions in mm.

27. a. A shaft is to transmit 50 KW at 1200 rpm. It is also subjected to a bending moment of 275 N-m. Allowable shear stress is 60 N/mm^2. The shaft is not to twist more than 2° in a length of 2m. Take G=80×10^3 N/mm^2. Design the shaft. — 10 4 2 3

(OR)

   b. The shafts 100 mm diameter are to be connected by means of two cast iron couplings. The allowable shear stress of the bolt material is 45 N/mm^2, while that of shaft material is 55 N/mm^2. Find the size of the bolts to be used and check the flange for the induced Crushing stress. — 10 3 2 3

28. a. Design a sleeve and cotter joint subjected to a load of 30 kN. The permissible stresses for the steel in tension, crushing and shear are 50 N/mm^2, 70 N/mm^2 and 35 N/mm^2 respectively. — 10 4 3 3

(OR)