

JT (Design)-Level 2**Part A: Answer any 10 Questions: 3 marks each (3 x 10 =30 marks)**

- 1) From a circular sheet of paper of radius 15 cm, a sector of 10% area is removed. If the remaining part is used to make a conical surface, Calculate the ratio of the radius and height of the cone.
- 2) Mr. Rahul works as a technician in a workshop. _____ has a passion for automobiles and wants to participate _____ the automobile design competition scheduled _____ 10th January 2024. He _____ (correct form of verb 'could') participate in the previous year's competition as his design was not complete. This year he _____ (correct form of verb 'plan') not only to complete the design well ahead of time _____ (and/or/but/however) also improve the esthetics of it.
- 3) The time taken for various jobs on a lathe are given below. Find their mean, median and mode time for jobs done in a workshop.

Job	Time (s)
A	20
B	25
C	15
D	30
E	12
F	20
G	18
H	24
I	20

- 4) Draw a stress strain graph for mild steel and mark Yield stress and Ultimate stress.

5) Two linear springs having spring constants 10 N/mm and 20 N/mm are connected in series and hung vertically down from a fixed surface. Calculate the deflection in springs when 1kg mass is attached to the other end.

6) A band brake having band-width of 80 mm, drum diameter of 250 mm, coefficient of friction of 0.25 and angle of wrap of 270° is required to exert a friction torque of 1000 N-m. Calculate the maximum tension (in kN) developed in the band.

7) Explain the difference between Welding, Brazing and Soldering briefly.

8) In an axial tensile test on 15 mm diameter bar of gauge length 200 mm, the load at proportionality limit is 25 kN and the corresponding changes in length and diameter are 0.25 mm and 0.0065 mm, respectively. Calculate the modulus of elasticity and the Poisson's ratio of the material.

9) What is the effect of the following alloying elements in steel?

- a. Chromium (Cr)
- b. Nickel (Ni)
- c. Phosphorous (P)
- d. Titanium (Ti)
- e. Vanadium (V)
- f. Tungsten (W)

10) In a machining operation cutting speed is reduced by 25% Assuming $n = 0.5$ and $C = 300$ in Taylor's equation, calculate the increase in tool life.

11) Explain the working principle of the following briefly.

- a. Electro Discharge Machining (EDM)
- b. Water Jet Machining
- c. Ultrasonic Machining

- 12) In a limit system, the following limits are specified to give a clearance fit between shaft and hole

$$\text{Shaft } 50 \begin{matrix} -0.006 \\ -0.020 \end{matrix} \text{ mm}$$

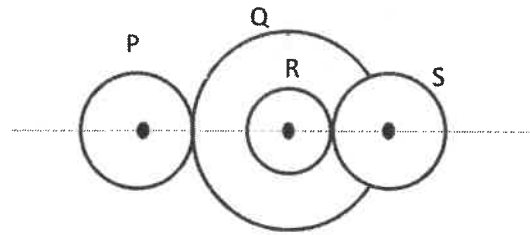
$$\text{Hole } 50 \begin{matrix} +0.30 \\ -0.00 \end{matrix} \text{ mm}$$

Determine—

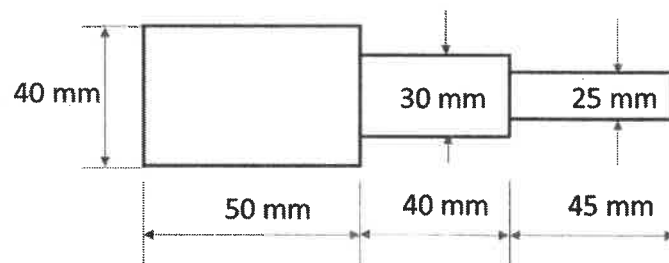
- (A) basic size
 - (B) shaft and hole tolerances
 - (C) Minimum clearance
- 13) Two 2 mm thick steel sheets are being spot welded at a current of 5000 A and current flow time is 0.15 s. The diameter of electrodes is 5 mm while the effective resistance is $250 \mu\Omega$. The density of metal is 7800 kg/m^3 , while specific energy for melting is 1.4 MJ/kg . Calculate the amount of heat generated and the percentage of heat dissipated.
- 14) A sphere-shaped casting solidifies in 10 min. What will be the solidification time in minutes for another sphere of the same material, which is 8 times heavier than the original casting?
- 15) What are the common defects occurring in the welding process?

Part B: Answer any 6 Questions : 5 marks each (5 x 6 =30 marks)

- 1) A compound gear train with gears P, Q, R and S has number of teeth 20, 40, 15 and 20, respectively. Gears Q and R are mounted on the same shaft as shown in the figure below. The diameter of the gear Q is twice that of the gear R. If the module of the gear R is 2 mm, the center distance in mm between gears P and S is



- 2) Explain the following briefly.
- Strain hardening
 - Annealing
 - Normalizing
 - Case hardening
- 3) Name any 5 defects occurs in casting process and explain them briefly.
- 4) A sheet metal operation is performed on 2 mm thick steel sheet to produce circular discs of 24 mm diameter. The shear strength of the work material is 312 MPa. Determine the size of punch for the blanking operation, and the size of die for the piercing operation.
- 5) A 40 mm diameter and 135 mm long shaft is to be converted to a stepped shaft of dimensions as shown in the figure by turning.



The depth of cut should not exceed 2.5 mm. Cutting speed is to be 25 m/min and feed to be 0.25 mm/rev for each cut. Estimate the machining time.

- 6) Balls of diameter 25 mm and 10 mm were used to measure the taper of a ring gauge. During inspection, the ball of 25 mm diameter was protruding by 2.0 mm above the top surface of the ring. This surface was located at a height of 40 mm from the top of the 10 mm diameter ball. What is the taper angle?
- 7) The worktable of a positioning system is driven by a lead screw having pitch 8 mm. The lead screw is connected to the output shaft of a stepper motor through a gear box whose ratio is 6:1. The stepper motor has 48 step angles. Determine the number of pulses and the speed of stepper motor required to move the table a distance of 220 mm from its present position at a linear velocity of 440 mm/min.
- 8) Explain Clearance, interference and transition fits with suitable examples.
- 9) Draw perspective, top view and side views of a cube of side (S) with hemispherical depression of diameter (D). The diameter of the depression is half of the side of cube ($D = 0.5 \times S$).