MECHANICAL ENGINEERING

Time Allowed : 3 hours   Full Marks : 100

All questions carry equal marks of 10 each.

Answer any <u>10 (ten)</u> questions
taking <u>5 (five)</u> questions from each section.

Assume any missing data.

<u>SECTION - A</u>

1. What is the importance of T.T.T. diagram? Explain the various steps involved in constructing a T.T.T. diagram.

2. Explain the following:

   (a) Fibre Reinforced Composites

   (b) Metal Matrix Composites (MMC)

3. What do you mean by non-traditional machining methods? How are they classified? Explain with the help of a neat diagram the principle of Electrical Discharge Machining (EDM).

4. Define the term "production, planning & control". Briefly describe the functions of production, planning & control.

5. Explain the concept of value analysis. State the objectives of value analysis.

6. A 5kg cylinder is suspended from a spring of constant 325N/m and is acted upon by a vertical periodic force of magnitude $F = F_n \sin \omega t$, where $F_n = 15\text{N}$. Determine the amplitude of the motion of the cylinder if –
   (i) w = 8 rad/sec
   (ii) w = 12 rad/sec

7. A cylindrical bar is 30mm in diameter and 1200mm long. During a tensile test it is found that the longitudinal strain is four times the lateral strain. Calculate the modulus of rigidity and bulk modulus if its elastic modulus is $1 \times 10^5 \text{N/mm}^2$. Find the change in volume when the bar is subjected to a hydrostatic pressure of 100N/mm^2.

8. Write notes on:
   (a) High level languages
   (b) Data processing

SECTION - B

9. A plane wall (k=W/mK), 10cm thick, generated at a uniform rate of $8 \times 10^6 \text{W/m}^3$. The two sides of the wall are maintained at 180°C and 120°C. Neglecting the end effect, determine
   (a) Temperature distribution across the plate
   (b) Position and magnitude of maximum temperature

10. A refrigeration plate using CO_2 as refrigerant works between 25°C and -5°C. The dryness of CO_2 is 0.6 at the entry of the compressor. Find the ice formed per day, if the ice is formed at 0°C from the water at 10°C. Quantity of CO_2 circulated = 10 kg/min. Take relative efficiency = 0.6, C_p(water) = 4.2KJ/Kg, latent heat of ice = 335KJ/Kg.

Properties of CO_2:

Temperature (°C)	Liquid heat (KJ/Kg)	Latent heat (KJ/Kg)	Entropy of liquid (KJ/KgK)
25	81.25	121.6	0.2513
-5	-7.53	245.8	-0.0419

11. (a) Define the following:
   (i) Internal energy
   (ii) Enthalpy

(b) Prove that a system, which satisfies Kelvin Plank statement, cannot violate Clausius statement or vice versa.

12. (a) Differentiate between a Petrol engine and Diesel engine by mentioning three salient points.

(b) What do you mean by scavenging? What are the different types of scavenging?

13. A power station has the installed capacity of 180MW. The following data are supplied pertaining to power station.
Capital cost = Rs.300×10^6
Rate of interest and depreciation = 18%
Annual cost of fuel oil, salaries and taxation = Rs.36×10^6
Load factor = 0.4
Calculate

   (a) The cost of generation

   (b) The saving in cost per KWh, if the annual load factor is raised to 0.5

14.   (a) Explain the working principle of a centrifugal compressor.

   (b) What do you mean by slip factor of a centrifugal compressor?

15. Explain what you mean by

   (a) Fanno line flows

   (b) Rayleigh line flows

16. Write notes on (any two):

   (a) Buckingham's p – theorem

   (b) Octane number

   (c) Four stroke engine

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