Q. Code:362820

Reg. No. | | | | | | | | | | | | | |

B.E./B.TECH.DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

MN22402 – FLUID MECHANICS AND THERMAL SCIENCE

(Mechanical and Automation Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

(Use of approved thermodynamic tables, Mollier diagram and Heat and Mass Transfer Data Book are permitted)

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Acquire a basic knowledge of fluids in static, kinematic and dynamic equilibrium.	**3**
CO 2	Gain the knowledge of the applicability of physical laws in fluid flow through circular conduits.	**3**
CO 3	Analyze various energy transferring / transforming equipment using first law of thermodynamics	**3**
CO 4	Analyze various Energy Transferring / transforming equipment using Second law of thermodynamics and able to analyze the properties of steam with the help of steam table and charts.	**3**
CO 5	Gain the Knowledge of necessity of cooling of electronic components and heat transfer methods, Thermoelectric cooling principles, applications in electronics systems	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Draw the shear stress-velocity gradient profile for non-Newtonian fluids.	**1**	**3**
2.	Determine the specific gravity of a fluid having viscosity 0.07 poise and kinematic Viscosity is 0.042 stokes.	**1**	**3**
3.	Convert intensity of pressure of 2 MPa into equivalent pressure head of oil of specific gravity 0.8.	**1**	**3**
4.	Calculate the height of Capillary rise for water in a glass tube of diameter 1 mm.	**1**	**3**
5.	Write the expression for head loss due to friction.	**2**	**3**
6.	How does the velocity of fluid vary within the boundary layer zone.	**2**	**3**

7.	When a tube is said to be a hydraulically smooth?	**2**	**3**
8.	Hypothetically, under what conditions, minor losses will be higher than major loss.	**2**	**3**
9.	A closed system receives 500 kJ of heat and the internal energy increases by 360 kJ. Find the work done by the system.	**3**	**3**
10.	Sketch the isothermal expansion on p-V diagram and state the properties that remains constant.	**3**	**3**
11.	Should the automobile radiator be analyzed as a closed system or as an open system?	**3**	**3**
12.	Write down the steady flow energy equation for the Boiler and Turbine.	**3**	**3**
13.	Why does the entropy of actual universe always increase?	**4**	**3**
14.	When system is adiabatic, what can be said about the entropy change of the substance in the system?	**4**	**3**
15.	Is Iced water a pure substance? why?	**4**	**3**
16.	What is triple point? For a pure substance, how many degrees of freedom are there at triple point.	**4**	**3**
17.	How is the subject of heat transfer different from that of thermodynamics?	**5**	**3**
18.	What does conduction refer to? State Fourier's law of heat conduction. Why is the negative sign used?	**5**	**3**
19.	Why is the heat generation per unit volume in an electronic equipment often comparable to that in a nuclear reactor?	**5**	**3**
20.	When is a thick heat frame used in a PCB?	**5**	**3**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	A vertical gap 1.2 cm wide of infinite extent contains fluid of viscosity 1 Ns/m^2 and specific gravity 0.9.A metallic plate 1 m x 1m x 0.2 cm is lifted up with a constant velocity of 0.2 m/s through the gap. If the plate is at a	**(10)**	**1**	**3**

distance of 0.4 cm from one of the plane surfaces of the gap, find the vertical force required. Weight of the plate is 50 N.

(OR)

(b)	A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is in level with the centre of the pipe.	**(10)**	**1**	**3**
22. (a)	Derive Darcy-Weisbach expression for friction head loss in a pipe flow.	**(10)**	**2**	**3**

(OR)

(b)	Three pipes of lengths 800 m ,600 m and 300 m and of diameters 400 mm,300 mm and 200 mm respectively are connected in series. The ends of the compound pipe is connected to two tanks, whose water surface levels are maintained at a difference of 15 m. Determine the rate of flow water through pipes if f = 0.005.	**(10)**	**2**	**3**
23. (a)	A mass of air is initially at 260˚C and 700 kPa and occupies 0028 m^3. The air is expanded at constant pressure to 0.084 m^3 . A polytropic process with n = 1.5 is then carried out, followed by a constant temperature process. All the processes are reversible. Find (i)the heat transfer in the cycle(ii) the efficiency of the cycle.	**(10)**	**3**	**3**

(OR)

(b)	In a gas turbine installation, the gases enter the turbine at the rate of 5 kg/s with a velocity of 50 m/s and enthalpy of 900 kJ/kg and leave the turbine with 150 m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assume R = 0.285 kJ/kg K, C_p = 1.004 kJ/kg. K and inlet conditions to be at 100 kPa and 27˚C. Determine the work done and diameter of the inlet pipe.	**(10)**	**3**	**3**
24. (a)	In a Carnot cycle, the maximum pressure and temperature are limited to 18 bar and 410°C. The ratio of isentropic compression is 6 and isothermal expansion is 1.5. Assuming the volume of the air at the beginning of isothermal expansion as 0.18 m^3, determine (i) the pressure and temperature	**(10)**	**4**	**3**

at main points (ii) change in entropy during isothermal expansion (iii) mean thermal efficiency of the cycle (iv) mean effective pressure of the cycle and (v) the theoretical power if there are 210 working cycles per minute.

(OR)

(b)	Steam is generated at 8 bar from water at 32˚C.Determine the heat required to produce 1 kg of steam (a) when the dryness fraction is 0.85 (b) when steam is dry saturated and (c) when the steam is superheated to 305˚C. The specific heat of superheated steam may be taken as 2.093 kJ/kg.K	**(10)**	**4**	**3**

25. (a)	The wall in a furnace consists of 125 mm thick refractory bricks and 125 mm thick insulating firebricks separated by an air gap. A 12 mm thick plaster covers the outer wall. The inner surface of the wall is at 1100˚C and the ambient temperature is 25˚C. The heat transfer coefficient on the outside wall to the air is 17 W/m^2 K, and the resistance to heat flow of the air gap is 0.16 K/W. The thermal conductivities of refractory brick, insulating firebrick and plaster are 1.6,0.3, and 0.14 W/m K, respectively. Calculate the rate of heat loss per unit area of wall surface.	**(10)**	**5**	**3**

(OR)

(b)	Discuss the methods of selection of cooling techniques for electronic systems in various applications.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	The cross-section of a pipe carrying a given discharge is suddenly enlarged. What would be the ratio of the two diameters of the pipe if the magnitude of the loss of head at this change of section is same irrespective of the direction of flow? Assume $C_C = 0.64$.	**(10)**	**2**	**4**

****