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

Question Paper Code : 50882

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fifth/Seventh Semester

Mechanical Engineering

ME 8595 — THERMAL ENGINEERING — II

(Common to Mechanical Engineering (Sandwich)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Steam Tables, Psychrometric Tables/chart, Refrigeration Tables are permitted

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define nozzle efficiency.
2. Distinguish between convergent nozzle and divergent nozzle.
3. How the steam generators are classified?
4. What are the functions of boiler accessories?
5. Define degree of reaction.
6. What are the limitations of velocity compounding?
7. List the advantages of co-generation.
8. Distinguish between bleeding and extraction of steam.
9. What is the effect of increased discharge pressure of refrigerant in vapour compression refrigeration system?
10. Define sensible heat factor (SHF).

PART B — (5 × 13 = 65 marks)

11. (a) Derive an expression for the condition of maximum discharge through steam nozzle.

Or

(b) Discuss the supersaturated flow of steam in nozzle.

12. (a) Draw a schematic flow diagram of a modern steam generator, Discuss the installation of convection and radiation super heaters and their exit temperature response with varying steam flow rates.

Or

(b) A boiler generates 8.5 kg of steam per kg of coal burned at a pressure of 13.5 bar from feed water having absolute temperature of 350 K. The boiler efficiency is 70% and factor of evaporation is 1.17. Taking specific heat of steam at constant pressure to be 2.1 kJ/kg K, calculate

(i) the degree of superheat and temperature of steam generated,

(ii) the calorific value of coal, and

(iii) the equivalent evaporation.

13. (a) In a 50% reaction turbine stage running at 50 rps, the exit angles are 30° and the inlet angles are 50°. The mean diameter is 1 m. The steam flow rate is 104kg/min and the stage efficiency is 85%, calculate (i) the power output of the stage, (ii) the specific enthalpy drop in the stage, and (iii) the percentage increase in the relative velocity of steam when it flows over the moving blades.

Or

(b) Steam with a velocity of 800 m/s enters an impulse turbine ring and drives the rotor at 3000 rpm. The jet angle is 20° and the mean drum diameter is 1.4 m. Assuming that inlet and exit angles of the moving blades are equal and a blade velocity coefficient of 0.85, find (i) the blade angles (ii) diagram efficiency (iii) power developed per kg per second of steam flow (iv) stage efficiency, if the nozzle efficiency is 95%.

14. (a) Distinguish between recuperative and regenerative heat exchangers.

Or

(b) Explain the various sources of residual heat and methods for utilizing the same.

15. (a) Explain the working principle of vapour absorption refrigeration system.

Or

(b) Explain the concept of cooling towers and its types.

PART C — (1 × 15 = 15 marks)

16. (a) A 20 tonnes vapour compression refrigeration system using Freon-12 operates between an evaporator pressure of 1.004 bar and a condenser pressure of 13.663 bar. The system uses 10°C superheating. Calculate the mass flow rate, COP, degree of sub cooling and power input. The refrigerant leaving the condenser is saturated liquid and when leaving the evaporator it is dry saturated vapour. The compression is isentropic. The properties of Freon -12 are shown in the table.

Pressure	Temp °C	h_f	h_{fg}	S_f	S_g	$C_{p.f}$	$C_{p.v}$
bar		*kJ/kg*	*kJ/kg*	*kJ/kg.K*		*kJ/kg.K*	
1.004	–30	8.854	174.076	0.371	0.7165	–	0.579
13.663	55	90.201	207.766	0.3194	0.6777	1.074	–

Or

(b) The following data relates to a conference room having a seating capacity of 80 persons

Inside design conditions	22°C DBT 55% RH
Outside design conditions	38°C DBT 28°C WBT
Sensible and latent heat loads per person	75W and 45W respectively
Lights and fan loads	12000 W
Sensible heat gain through glass, walls, ceiling etc.	12000 W
Air infiltration	18 m^3/min
Fresh air supply	80 m^3/min
By pass factors of the coils	0.1

If two third of recirculated room air and one third of fresh air are mixed before entering the cooling coils, determine

(i) apparatus dew point (5)

(ii) grand total heat load (5)

(iii) effective room sensible heat factor (5)