K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:III
Class:SY	Program:B.Tech
Branch Code:MEC	Pattern:2023
Name of Course:Engineering Thermodynamics	Course Code:2305202
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 02 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Steam tables, psychrometric chart and p-h chart will be provided. It should not be attached to the answer sheet.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

		Marks	**CO**
Question No. 1			
1a)	Apply first law of thermodynamics and write an energy balance equation (SFEE) for steam generator and steam turbine. If steam generated is at 100 bar 350^0C and water enters at 70^0C find the heat added in the boiler.	(6)	01
Question No. 2			
2a)	State the principle of increase of entropy. Explain available energy, unavailable energy and dead state concepts. If heat supplied is 100 kJ at 1000 K find its available energy.	(6)	01
Question No. 3			
3a)	In a boiler the steam generated is at 100 bar and 70 percent dry. Using steam tables, find the saturation temperature, specific enthalpy, specific volume and specific entropy. If this steam is superheated by 50^0C find its specific volume, specific enthalpy and specific entropy Represent this process on T-S diagram.	(8)	01, 3
	OR		
3b)	If the steam is 95 percent dry and at 150 bar find its specific volume, specific enthalpy and specific entropy. If it is heated at constant pressure and becomes dry saturated find specific volume, specific enthalpy and specific entropy How much is the temperature, pressure and latent heat of vaporization at critical point.	(8)	01, 3
3c)	A coal-based Steam power plant operates on Rankine cycle. Represent the cycle on temperature entropy diagram. The condition of steam at inlet to turbine is 110 bar, 350 degree Celsius. The condenser pressure is 0.01 bar. Find the specific enthalpy values at the inlet and outlet of boiler. Find pump work and heat added in boiler. Also find dryness fraction at turbine exit.	(8)	01, 2, 3
	OR		
3d)	A Steam power plant operates on Rankine cycle. Represent the cycle on temperature entropy diagram.	(8)	01, 2, 3

The condition of steam at inlet to turbine is 110 bar, 350 degree Celsius. The condenser pressure is 1 bar. Find pump work and heat added in boiler. Discuss methods of improving efficiency of power plant.

Question No. 4

4a)	Draw psychrometric chart and represent sensible cooling process. If the initial conditions are 30 ^{o}C DBT and 27 ^{o}C WBT find the initial psychrometric properties like specific humidity, RH and specific enthalpy. What would be the dew point temperature at this condition and coil surface temperature. If the air is sensibly cooled to 26^{0}C find the final specific humidity, relative humidity and specific enthalpy	(8)	01, 3, 4

OR

4b)	You must have visited malls and theatres. Explain the central AC system (chiller) with block diagram clearly showing chilled water circuit, air circuit, refrigerant circuit, and condenser coolant circuit. If the initial conditions are 35 ^{o}C DBT and 50% RH what would be the dew point temperature at this condition and coil surface temperature.	(8)	01, 3, 4
4c)	Explain the thermodynamic cycle of a domestic refrigerator using the vapor-compression refrigeration system. Discuss each process on the pressure-enthalpy (p-h) diagram and temperature-entropy (T-s) diagram. Find the COP with R134a as refrigerant assuming temperature in the evaporator as -10^{o}C and that in condenser as 40^{o}Cassuming saturation cycle. Find the new COP change with 5 degrees of suction superheat and 3 degrees of liquid sub cooling.	(8)	01, 3, 4

OR

4d)	Explain in detail the construction and working of a refrigeration system used in an ice factory using ammonia and brine as a refrigerant. How will you calculate specific refrigerating effect if water at 25^{o}C is cooled to -5^{o}C ice? Support your answer with a neat schematic and thermodynamic cycle on a p−h diagram.	(8)	01, 3, 4

Question No. 5

5a)	How are the steam generators used in power plants different from those in process industries. Explain with neat diagram any high-pressure steam generator used in power plant.	(8)	01, 5

OR

5b)	Suggest boiler accessories that would improve its efficiency and explain two of those using neat diagrams.	(8)	01, 5
5c)	A single stage reciprocating air compressor has a swept volume of 2000 cc at speed of 800 rpm. Assume pressure ratio of 8 and clearance ratio of 0.05. Assume inlet at 1 bar 15 degree Celsius. If polytropic index is 1.25 find indicated power, volumetric efficiency, isothermal efficiency and FAD.	(8)	01, 5

OR

5d)	Derive the expression for volumetric efficiency of compressor in terms of clearance and pressure ratio. How is clearance related to volumetric efficiency. Explain with pressure volume diagram. How was volumetric efficiency calculated in your experimental set up.	(8)	01, 5

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