Code No: 123AB **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, February - 2024
THERMODYNAMICS
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.
iv) **Use of steam tables, Mollier chart and psychrometric chart is permitted.**

PART - A

(25 Marks)

1.a)	With example differentiate intensive and extensive properties.	[2]
b)	Write the steady flow energy equation and reduce it for a nozzle and a turbine.	[3]
c)	List any two limitations of first law of thermodynamics.	[2]
d)	Determine the efficiency of a Carnot engine and the COP of a Carnot refrigerator, when both are working between the same temperature limits of 150K and 300K.	[3]
e)	Relate gas constant and universal gas constant and hence find the value of gas constant for CO_2.	[2]
f)	Write a brief note on critical point and triple point of water.	[3]
g)	State Dalton's law of partial pressure.	[2]
h)	A sling psychrometer reads 40° C dry bulb temperature and 36° C wet bulb temperature. Find the humidity ratio and relative humidity.	[3]
i)	Represent Otto cycle on P-V and T-S coordinates.	[2]
j)	What is refrigeration effect? Define a tonne of refrigeration.	[3]

PART - B

(50 Marks)

2.a)	Derive an expression for the work done in a non-flow reversible isothermal process.	
b)	A mixture of gases expands at constant pressure from 1 MPa, 0.03 m^3 to 0.06 m^3 with 84 kJ of positive heat transfer. There is no work other than that done on a piston. Find the change in stored energy for the mixture. If the same mixture expands through the same state path, while a stirring device does 21 kJ of work on the system, find the work and heat transfer for the process.	[4+6]

OR

3.a)	Compare and contrast work and heat. Also provide sign convention for them.	
b)	A blower handles1 kg/s of air at 20^0C and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/s and 150 m/s respectively. Find the exit air temperature, assuming adiabatic conditions. Take C_p for air as 1.005 kJ/kgK.	[4+6]

4.a) Prove the equivalence of Kelvin Planck and Clausius statements of second law of thermodynamics.

b) Define: entropy, availability, irreversibility. [6+4]

OR

5.a) What is Clausius inequality? Highlight its significance.

b) A domestic food freezer maintains a temperature of -12° C, the ambient temperature is 35° C. If heat leaks into the freezer at the rate of 2 kJ/s, determine the least power necessary to pump this heat out continuously. Also find the COP of this system and the COP if the system works as a heat pump, between the same temperature limits. [3+7]

6. A cylinder contains 1 m^3 of air at 100 kPa and 100° C. This air is compressed to a volume of 0.25 m^3, the final pressure being 600 kPa. Determine: mass of the gas, polytropic index 'n' for the compression, work transfer, heat transfer and change in internal energy. [10]

OR

7.a) Write short note on steam turbines and Mollier chart.

b) Draw and explain P-T diagram for water. [4+6]

8. Atmospheric air is a mixture of 6 kg of O_2 and 9 kg of N_2, existing at 300 kPa pressure and temperature of 25° C. Determine for the mixture: (a) the mole fraction of each constituent, (b) the equivalent molecular weight, (c) the equivalent gas constant, (d) the values of C_p and C_v. If the mixture is heated at constant volume to 40° C, find the changes in internal energy, enthalpy and entropy of the mixture. Take γ for O_2 and N_2 to be 1.286 and 1.4 respectively. [10]

OR

9.a) Write a brief note on psychrometric chart and its use.

b) A sling psychrometer reads 40 ^{0}C DBT and 35 ^{0}C WBT. Find the humidity ratio, relative humidity, dew point temperature, specific volume and enthalpy of air. [3+7]

10. Derive an expression for the efficiency of air standard Otto cycle. [10]

OR

11.a) With a simple layout explain the Bell-Colleman refrigeration cycle.

b) Write a brief note on the commonly used refrigerants and the essential properties of a good refrigerant. [6+4]

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