Code No: 153BZ

R18

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, April/May - 2023
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.

PART – A

(25 Marks)

1.a)	Summarize the characteristics of boundary.	[2]
b)	What is meant by intensive properties of system? Give some examples.	[3]
c)	Tell the significance of third law of thermodynamics.	[2]
d)	Illustrate the functions of heat pump.	[3]
e)	List the advantages of mollier chart.	[2]
f)	Summarize the characteristics of pure substances.	[3]
g)	What is meant by real gas?	[2]
h)	Explain the importance of compressibility chart.	[3]
i)	List out the advantages of dual cycle.	[2]
j)	Explain the importance of Brayton cycle.	[3]

PART – B

(50 Marks)

2.a) Distinguish the (i) Reversible process and Irreversible process (ii) Heat and work.
b) Examine the characteristics of quasi static process and thermodynamic equilibrium of the system. [5+5]

OR

3.a) Discuss the concepts of continuum and energy in state and energy in transition.
b) In a two part process with an expansion from 0.1 to 0.2 m^3 at a constant pressure of 150 kPa is followed by an expansion from 0.2 to 0.4 m^3 with a linearly rising of pressure from 150 kPa ending at 300 KPa. By showing the process on P-V diagram calculate the boundary work. [5+5]

4.a) Establish an equation for first law of thermodynamics applied to a closed system operating in a cycle with the help of Joule's experiment.
b) A Closed system of mass 2 kg undergoes a process in which there is heat transfer of 25 kJ from the system to the surroundings. The amount of work done on the system is 100 kJ. The specific internal energy decreased by 15 kJ/kg and the elevation of the system increased by 1000 m. The acceleration due to gravity is 9.6 m/s^2. Determine the change in kinetic energy of the system. [5+5]

OR

5.a) Deduce the expression for the thermal efficiency of the hat engine.

b) Conclude "All reversible engines have same thermal efficiency working under the same temperature limits". [5+5]

6.a) Explain p-V-T surface with a neat sketch.

b) Water at 40 ^{0} C is continuously sprayed into a pipe line carrying 5 tonnes of steam at 5 bar, 30^{0}C per hour. At a section downstream where the pressure is 3 bar, the quality is to be 95%. Find the rate of spray in kg/h. [5+5]

OR

7.a) Draw and explain the T-v diagram for the formation of compressed liquid water to superheated steam.

b) Enumerate the importance of free expansion process with some examples. [5+5]

8. Deduce the expression of Vander Waals equation of state for the real gases and also state the assumptions in its derivation. [10]

OR

9. An insulated rigid tank is divided into two compartments by a partition. One compartment contains 7 kg of oxygen gas at 40 ^{0} C and 100 kPa, and the other compartment contains 4 kg of nitrogen gas at 20 ^{0} C and 150 kPa. Now the partition is removed, and the two gases are allowed to mix. Determine a) the mixture temperature b) the mixture pressure after equilibrium has been established. [10]

10.a) With a neat sketch, explain the working of Brayton cycle and derive the expression for thermal efficiency.

b) List out the assumptions in the air standard cycles for derivation of thermal efficiency. [5+5]

OR

11. At the beginning of compression in an air standard Otto cycle engine cylinder the temperature is 37 ^{0}C, the pressure is 1 bar and volume is 0.000707 m ^{3}. At the end of compression the pressure is 10 bar. The heat supplied to the cycle is 1.5 kJ. Calculate (a) Compression ratio (b) the net work per cycle (c) the mean effective Pressure. [10]

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