Code No: 123AB

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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)	What is thermodynamic equilibrium?	[2]
b)	What is an irreversible process? Give examples.	[3]
c)	What is the contribution of Joule?	[2]
d)	What is meant by PMM1 and give one example?	[3]
e)	State Carnot's theorem and write its applications	[2]
f)	Write Clausius Clapeyron equation and its significance.	[3]
g)	What are saturation states?	[2]
h)	What is normal boiling point?	[3]
i)	State Gibb's-Dalton law.	[2]
j)	Give two examples of cyclic and non-cyclic heat engines.	[3]

PART - B

(50 Marks)

2.a) A Gas of volume 8000CC at a pressure of 200 kPa is compressed quasi statically according to $PV^2 =$ constant until the volume becomes 3000CC. Determine the final pressures and work transfer.

b) Explain Joules experiment and state the first law of thermodynamics applied to a closed system undergone by a cyclic process. [5+5]

OR

3.a) Explain about point function and path function ? Show that heat is a path function.

b) A single-cylinder, single-acting, 4 stroke engine of 0.15 m bore develops an indicated power of 5 kW when running at 220 rpm. Calculate the area of the indicator diagram that would be obtained with an indicator having a spring constant of 25×10^6 N/m^2. The length of the indicator diagram is 0.1 times the length of the stroke of the engine. [5+5]

4.a) A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, then the enthalpy of fluid passing is 4000 kJ/kg and velocity is 50 m/s. at the discharge end, the enthalpy is 2752 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.
i) Find the velocity at the exit from the nozzle.
ii) If the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate.

b) Show that Kelvin Planck statement and Clausius statement of second law thermodynamics are equivalent. [5+5]

OR

5.a) A cyclic heat engine operates between a source temperature of 800^{0}C and a sink temperature of 30^{0}C.What is the least rate of the heat rejection per kW net output of the engine?

b) Write down the general equation for steady flow systems and simplify when applied for the following systems:
i) Steam turbine.
ii) Steam nozzle.
iii) Centrifugal compressor.
iv) Condenser. [5+5]

6.a) Prove that entropy is a property of a system.

b) All spontaneous processes are irreversible. Explain.

c) What is absolute thermodynamic temperature scale?

d) Show that the COP of heat pump is greater than COP of refrigerator by unity? [10]

OR

7.a) 2 kg of water at 80 ^{0}C is mixed adiabatically with 3 kg of water at 30 ^{0}C in a constant pressure process of 1 atmosphere. Find the increase in entropy at the total mass of water due to the mixing process. Take specific heat of water has 4.187 kJ/kgK.

b) A domestic freezer maintains a temperature of -50 ^{0}C. The ambient air temperature is 30^{0}C. If heat leaks in to the freezer at a continuous rate of 1.75 kJ/s, what is the least power necessary to pump the heat out continuously? [5+5]

8. A mass of wet steam at temperature 165^{0}C is expanded at constant quality 0.8 to pressure 3 bar. It is then heated at constant pressure to a degree of superheat of 66.5 ^{0}C. Find the enthalpy and entropy changes during expansion and during heating. Draw the T–s and h–s diagrams. [10]

OR

9.a) 4 kg of O_2 at a pressure 100 kPa and 75 are mixed with 7 kg of N_2 at the same pressure and temperature. Find the increase in entropy.

b) Explain about compressibility charts. [5+5]

10.a) The stroke and cylinder diameter of a compressor ignition engine are 250 mm and 150 mm respectively. If the clearance volume is 0.0004 m^3 and fuel injection takes place at constant pressure for 5 percent of the stroke, determine the efficiency of the engine. Assume engine is working on diesel cycle.

b) Explain briefly about Avogadro's law and Dalton's law of partial pressures. [5+5]

OR

11. A certain gas C_P = 1.968 and C_V = 1.507 kJ/kgK. Find the molecular weight and the gas constant. A constant volume chamber of 0.3 m ^{3} capacity contains 2 kg of this gas at 5 bar. Heat is transferred to the gas until the temperature is 100 ^{0}C. Find the work done, the heat transferred and the changes in internal energy, enthalpy and entropy. [10]

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