Code No: 153BZ

R18

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, September/October - 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)	Explain what you mean by the thermodynamic property of a system. How will you classify it?	[2]
b)	State and explain First law of thermodynamics.	[3]
c)	Draw the phase diagram on p-v diagrams with water as pure substance.	[2]
d)	Draw Bell-Coleman Cycle.	[3]
e)	What is meant by Clausius inequality?	[2]
f)	Explain the term Latent heat and Sensible heat.	[3]
g)	Distinguish between Universal Gas constant and Characteristic Gas constant.	[2]
h)	Draw the P–V and T-S plots of Atkinson cycle and indicate all the processes	[3]
i)	What is a cyclic heat engine?	[2]
j)	What is meant by specific humidity?	[3]

PART – B

(50 Marks)

2.a) A fluid at a pressure of 3 bar and with specific volume of 0.18 m^3 /kg contained in a cylinder behind a piston expands reversibly to a pressure of 0.6 bar according to a law, $p = c/v^2$ where c is a constant. Calculate the work done by the fluid on the piston.

b) A balloon is filled with air (200 kPa and 300K) such that it becomes as sphere of diameter 1m. It is then gradually heated till the pressure rises to 500 kPa. Determine the amount of work done during the process, assuming that the pressure inside the balloon is proportional to the diameter of the balloon. [5+5]

OR

3.a) Explain the working of constant volume gas thermometer.

b) A three process cycle operating with nitrogen as the working substance has constant temperature compression at 340^0C with initial pressure 100 kPa. Then the gas undergoes a constant volume heating and then polytropic expansion with 1.35 as index of expansion. The isothermal compression requires – 67 kJ/kg of work. Determine i) pressure, volume and temperature around the cycle ii) Heat in and out iii) Network For Nitrogen gas $C_V = 0.7431$ kJ/kg-K. [5+5]

4.a) Describe the classic paddle wheel experiment performed by Joule. What conclusion was drawn based on the experimental observations (Joule experiment).

b) How is the absolute scale independent of the working substance? [5+5]

OR

5.a) A fluid contained in a cylinder receives 150 kJ of mechanical energy by means of a paddle wheel, together with 50 kJ in the form of heat. At the same time, the piston in the cylinder moves in such a way that the pressure remains constant at 200 kN/m^2 during the fluid expansion from 2 m^3 to 5 m^3. What is the change in internal energy and in enthalpy?

b) Discuss the significance of Gibbs and Helmholtz functions. [5+5]

6.a) Why cannot a throttling calorimeter measure the quality if the steam is very wet? How is the quality measured then?

b) Steam initially at 2 MPa, 300^0C expands reversibly and adiabatically in a steam turbine to 50^0C. Determine the ideal work output of the turbine per kg of steam. [5+5]

OR

7.a) In a steam engine cylinder, dry and saturated steam expands from 22 bar to 2 bar isothermally. Calculate the change in enthalpy, change in internal energy, Change in entropy, Heat transferred and work done. Assume the non-flow process in the cylinder.

b) Discuss the significance of carrier's equation. [5+5]

8.a) Distinguish between relative humidity and absolute humidity. How can relative humidity be expressed as the ratio of two mole fractions.

b) A mixture of hydrogen (H_2) and oxygen (O_2) is to be made so that the ratio of H_2 to O_2 is 2:1 by volume respectively. Calculate i) the mass of O_2 required, ii) volume of the container. [5+5]

OR

9.a) Discuss about Triple point.

b) What do you understand by dry bulb temperature and wet bulb temperatures? When do the DBT, WBT and DPT become equal? [5+5]

10.a) Show that efficiency of an Otto cycle depends only on the compression ratio.

b) A theoretical diesel engine operates at suction conditions of 1 bar and 300 K. At the end of compression stroke, the pressure rises to 24 bar. The maximum temperature limit of the cycle is 1473K. Determine (i) cut-off ratio; (ii) Network output of the cycle and (iii) thermal efficiency of the cycle. For air, assume specific heat at constant pressure and volume as 1.005 kJ/kg.K and 0.717 kJ/kg.K. [5+5]

OR

11.a) Explain the working of Bell Coleman cycle.

b) Calculate the thermal efficiency and the mean effective pressure of a dual combustion cycle when the maximum temperature is 2000^0C and the maximum pressure is 70 bar. The pressure and temperature at the start of compression are 1 bar and 17^0C respectively.[5+5]

---ooOoo---