

Code No: 133BX

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year I Semester Examinations, September/October - 2023

THERMODYNAMICS

(Common to ME, AE)

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) Differentiate between path function and point function. [2]
- b) What are various types of systems? Give examples in context of thermodynamics. [3]
- c) Write down the applications of SFEE. Derive expression for exit velocity from the nozzle. [2]
- d) Define heat pump and draw a suitable diagram. [3]
- e) List out the various methods for determining the dryness fraction of steam. [2]
- f) Define the pure substance. [3]
- g) What is meant by molecular internal energy? [2]
- h) What are mass fraction and mole fraction? [3]
- i) What do you mean by air standard cycle and what are the assumptions in air standard cycles? [2]
- j) Draw the Bell Coleman cycle in operation. [3]

PART – B

(50 Marks)

- 2.a) A mass of 1 kg of air initially compressed in a quasi static process from 0.1 MPa to 0.7 MPa for which $pv=C$. The initial density of air is 1.16 kg/m^3 . Find the work done by the piston to compress the air.
 - b) Explain what do you understand by thermodynamic equilibrium. [7+3]
- OR**
- 3.a) What is a irreversible process? Explain the causes of irreversible process.
 - b) What is the qualitative difference between heat and work? Why are heat and work not completely interchangeable forms of energy?
 - c) What do you understand by path function and point function? What are exact and inexact differentials? [4+3+3]
- 4.a) Derive Clausius inequality and explain its significance.
 - b) Discuss about Third Law of Thermodynamic. [5+5]
- OR**
- 5.a) Explain the causes of Irreversibility.
 - b) An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400K, rejects 42 MJ at a temperature of 200 K, and delivers 15 kWh of mechanical work. Listing out all the reasons, suggest your advice inventing money to put this engine in the market. [4+6]

- 6.a) Why cannot a throttling calorimeter measure the quality if the steam is very wet?
b) Find the enthalpy, entropy and volume of steam at 1.4 MPa, 380^o C. Using steam tables only. [4+6]

OR

7. The following data were obtained in a test on a combined separating and throttling calorimeter: Pressure of steam sample =12 bar, pressure of steam at exit = 1 bar, temperature of steam at the exit =150^oC, discharge from separating calorimeter = 0.5 kg/min, discharge from throttling calorimeter =10 kg /min. Determine the dryness fraction of the sample steam. [10]

- 8.a) Write down the Vander Waals equation of state. How does it differ from the ideal gas equation of state?

- b) A gas occupies 0.034 m³ at 600 kPa and 85^oC. It is expanded in the non-flow process according to the law $pv^{1.2} = \text{constant}$ to a pressure of 60 kPa after which it is heated at constant pressure back to its original temperature. Sketch the process on the p-v and T-s diagrams, and calculate for the whole process the work done, the heat transferred. Take $C_p = 1.047$ and $C_v = 0.775$ kJ/kg K for the gas. [5+5]

OR

- 9.a) Prove that $pv^\gamma = c$.
b) A container of 3 m³ capacity contains 10 kg of CO₂ at 27^oC. Estimate the pressure exerted by CO₂ by using
i) Perfect gas equation
ii) Vanderwaal's equation. [5+5]

- 10.a) Compare Otto, Diesel and Dual combustion cycles.
b) An ammonia vapour compression refrigerator operates with evaporator pressure of 3.5 bar and condenser pressure of 15 bar. Calculate ideal and actual COP also calculate the mass flow rate per kW of refrigeration assuming that dry saturated vapour is delivered by the compressor and liquid after condensation is sub cooled to 20^oC. [5+5]

OR

- 11.a) Draw p-v and T-s plots of Diesel cycle and explain various processes constituting the cycle.
b) Derive the expression for mean effective pressure of Diesel cycle. [5+5]

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