

# CBCS SCHEME

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## Third Semester B.E. Degree Examination, June/July 2023 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Use of thermodynamics data hand book, steam table, psychrometry chart allowed.

### Module-1

- 1 a. Distinguish between :
- Open System and Closed System
  - Mechanical and Chemical Equilibrium
  - Intensive and Extensive Properties
  - Macroscopic and Macroscopic Approach. (08 Marks)
- b. State and explain Zeroth law of thermodynamics. (04 Marks)
- c. The reading  $t_A$  and  $t_B$  of two Celsius thermometers A and B agree at the ice point and the steam point and are related by the equation  $t_A = \ell + m t_B + n t_B^2$ . Between these two points  $\ell$ ,  $m$ ,  $n$  are constants. When both are immersed in an oil both, A indicates  $55^\circ\text{C}$  and B indicates  $50^\circ\text{C}$ . Determine the values of  $\ell$ ,  $m$  and  $n$  and also find the reading on A if B reads  $25^\circ\text{C}$ . (08 Marks)

OR

- 2 a. Derive an expression for work done during quasistatic process. (06 Marks)
- b. Define work and heat, mention similarities and dissimilarities between them. (06 Marks)
- c. Explain constant volume gas thermometer with neat sketch. (08 Marks)

### Module-2

- 3 a. Derive Steady Flow Energy Equation (SFEE) state assumptions mode. (08 Marks)
- b. Prove that internal energy a property of a system. (08 Marks)
- c. What are PMM – I and PMM – II? (04 Marks)

OR

- 4 a. State Kelvin – Plank and Clausius statements of second law of thermodynamics and show that violation of Clausius statement leads to violation of Kelvin Planck's statement. (08 Marks)
- b. One kg of air at  $15^\circ\text{C}$  and  $98.1\text{KPa}$  is compressed isentropically to  $588.6\text{KPa}$ . Determine the final temperature and the work done. If the air is now cooled to  $15^\circ\text{C}$  at constant pressure, find the heat exchanged. (06 Marks)
- c. A  $1\text{m}^3$  container is filled with air at  $0.20\text{MPa}$  and  $70^\circ\text{C}$ . Calculate the final pressure in the container if  $10\text{kJ}$  of heat are added. Assume ideal gas behavior with constant specific heats. (06 Marks)

### Module-3

- 5 a. Prove that entropy a property of a system. (08 Marks)
- b. Stat and prove Clausius inequality. (08 Marks)
- c. What is available and unavailable energy? (04 Marks)

OR

- 6 a. Define following terms :
- Heat of fusion
  - Wet steam
  - Triple point
  - Sensible heat
  - Saturation temperature
  - Dryness fraction. (06 Marks)
- b. Sketch and explain the PT diagram of water. (06 Marks)
- c. Explain with neat sketch, the method of estimating quality of steam by throttling Calorimeter. (08 Marks)

**Module-4**

- 7 a. Explain vapor absorption refrigeration system with a neat sketch. (08 Marks)
- b. Explain steam jet refrigeration with sketch. (08 Marks)
- c. Explain desirable properties of refrigerants. (04 Marks)

OR

- 8 a. Explain summer air conditioning system for :
- Hot and dry outdoor condition
  - Hot and wet outdoor condition. (10 Marks)
- b. A hall is to be air conditioned for 100 persons requiring  $0.5\text{m}^3/\text{min}/\text{person}$ . Outdoor condition =  $35^\circ\text{C}$  DBT, 65% RH, Required conditions =  $15^\circ\text{C}$  DBT, 40% RH. The required conditions are achieved first by cooling and dehumidification and then by heating, find :
- Capacity of the humidifier
  - Cooling coil capacity
  - Heating coil capacity. (10 Marks)

**Module-5**

- 9 a. Derive an expression for work done in a single stage compressor by neglecting clearance volume. (10 Marks)
- b. Derive the condition for maximum work input to a two-stage compressor with perfect inter cooling between stages. (06 Marks)
- c. Explain the necessity of multi-stage compression using P-V diagram. (04 Marks)

OR

- 10 a. Explain open and closed cycle gas turbine cycles. (10 Marks)
- b. Explain with a neat sketch :
- Turbo – jet engine
  - Rocket propulsion. (10 Marks)

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