

CBCS SCHEME

USN

--	--	--	--	--	--	--	--	--	--

17ME33

Third Semester B.E. Degree Examination, Jan./Feb. 2021

Basic Thermodynamics

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamic data book, steam tables are permitted.

Module-1

- 1 a. What is thermodynamics? Differentiate between the classical and statistical approaches to thermodynamics. (06 Marks)
- b. Classify the following into intensive and extensive properties.
- Enthalpy specific entropy
 - Viscosity
 - Quality of steam
 - Refractive index
 - Roll strength of class. (06 Marks)
- c. A new scale N of temperature is devised in such a way that the freezing point of ice is 100°N and the boiling point of water is 400°N . What is the temperature reading on this new scale when the temperature is 150°C ? At what temperature both the Celsius and the new scale reading would be the same? (08 Marks)

OR

- 2 a. Distinguish between:
- Point function and path function
 - Intensive and extensive property. (08 Marks)
- b. What is flow work? Is it different from displacement work? (04 Marks)
- c. To a closed system 150kJ of work is supplied. If the initial volume is 0.6m^3 and pressure of the system changes as $P = 8-4V$, where P is in bar and V is in m^3 , determine the final volume and pressure of the system. (08 Marks)

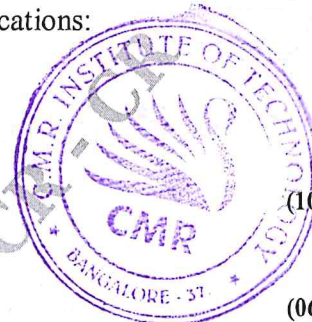
Module-2

- 3 a. State the first law of thermodynamics for a closed system undergoing change of state. Explain the property introduced by this law. (04 Marks)
- b. What are the limitations of first law of thermodynamics? (04 Marks)
- c. A stationary fluid system goes through a following cycle:
- Process 1-2 isochoric heat addition of 235kJ/kg
Process 2-3 adiabatic expansion to its original pressure with loss of 70kJ/kg in internal energy.
Process 3-1 isobaric compression to its original volume with heat rejection of 200kJ/kg
Prepare a balance sheet of energy quantities. (12 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 a. Define the following:
- Thermal Energy Reservoir (TER)
 - Mechanical Energy Reservoir (MER). (04 Marks)
- b. Show that efficiency of a reversible engine is independent of the nature or amount of the working substance going through the cycle. (06 Marks)
- c. An inventor claims that his engine has the following specifications:
- | | |
|---------------------------|------------------|
| Heating value of the fuel | : 74500kJ/kg |
| Temperature limits | : 750°C and 25°C |
| Power developed | : 75kW |
| Fuel burnt | : 0.07kg/min |
- State whether claim is valid or not. (10 Marks)

Module-3

- 5 a. Explain the conditions for reversibility. (06 Marks)
- b. Show that heat transfer through a finite temperature difference is irreversible. (06 Marks)
- c. Determine the entropy change of 4kg of a perfect gas whose temperature varies from 127°C to 227°C during a constant volume process. The specific heat varies linearly with absolute temperature and is given by the relation $C_v = (0.48 + 0.0096T)$ kJ/kg K. (08 Marks)

OR

- 6 a. Define entropy and show that entropy is a property of system. (06 Marks)
- b. Write the criteria of reversibility, irreversibility and impossibility to a thermodynamic cycle. (06 Marks)
- c. A Carnot engine absorbs 200J of heat from a reservoir at the temperature of the normal boiling point of water and rejects heat to a reservoir at the temperature of the triple point of water. Find the heat rejected, the work done by the engine and the thermal efficiency. (08 Marks)

Module-4

- 7 a. Define the following:
- Thermodynamic dead state
 - Energy
 - Second law efficiency. (06 Marks)
- b. Energy is always conserved, but its quality is always degraded. Explain. (04 Marks)
- c. Prove that, $\eta_{II} = \frac{\eta_I}{\eta_{\text{Carnot}}}$ (10 Marks)

OR

- 8 a. Draw the phase equilibrium diagram on P-V coordinate for a pure substance, whose volume decreases on melting. (04 Marks)
- b. State whether the following samples of steam are wet, dry or superheated: Justify your answer.
- Temperature = 200°C, pressure = 1.2MPa
 - Pressure = 1MPa volume = 0.235m³/kg
 - Pressure = 500kPa enthalpy = 2530kJ/kg
 - Temperature = 100°C entropy = 7.35kJ/kg K (08 Marks)
- c. What is dryness fraction of steam? Explain the method of estimating quality of wet steam by a combined separating and throttling calorimeter. (08 Marks)

Module-5

- 9 a. State 'Dalton's law of partial pressure' (04 Marks)
- b. Define the following terms: (04 Marks)
- Saturated air
 - Wet bulb temperature
 - Specific humidity
 - Dew point temperature.
- c. A mixture of gas has the following volumetric analysis. $O_2 = 30\%$, $CO_2 = 40\%$, $N_2 = 30\%$. Determine: (12 Marks)
- The analysis on a mass base.
 - The partial pressure of each component if the total pressure is 100kPa and temperature is $32^\circ C$.
 - The molecular weight of mixture.

OR

- 10 a. What is the generalized compressibility chart? Explain. (04 Marks)
- b. Write the Vander Waal's equation of state. In what ways, it is an improvement over the ideal gas equation of state. (04 Marks)
- c. One kg-mol of oxygen undergoes a reversible non-flow isothermal compression and the volume decreases from $0.2m^3/kg$ to $0.08m^3/kg$ and the initial temperature is $60^\circ C$. If the gas obeys Vander Waal's equation find: i) the work done during the process ii) the find pressure. (12 Marks)
