BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: IMSc **SEMESTER: VI**
BRANCH: FOOD TECHNOLOGY **SESSION : SP/2020**

SUBJECT : IMF6003 FOOD ENGINEERING- III –THERMODYNAMICS AND REFRIGERATION

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Define zeroth law of thermodynamics. [2]

(b) When a system is taken from state a to state b along path acb, 100 J of heat flows into the system and the system does 40 J of work. [3]

(i) How much heat flows into the system along path aeb if the work done by the system is 20 J?
(ii) The system returns from b to a along path bda. If the work done on the system is 30 J, does the system absorb or liberate heat? How much?

Q2 Air is compressed from an initial condition of 1 bar and 298.15 K volume 0.02479 to a final state of 5 bar and 298.15 K by three different mechanically reversible processes in a closed system: [5]

(i) Isothermal compression.
(ii) Adiabatic compression followed by cooling at constant volume.

Assume air to be an ideal gas with the constant heat capacities, $C_V = 2.5R$ and $C_P = 3.5R$. Calculate the work required, heat transferred, and the changes in internal energy and enthalpy of the air for each process.

Q3 (a) Draw the paths of polytropic processes characterized by specific values of δ on a PV diagram. [2]

(b) Derive PV^{γ} = constant for an ideal gas in an adiabatic process. γ is heat capacities ratio with its usual meaning. [3]

Q4 (a) Define the mathematical statement of the second law of thermodynamics. [2]

(b) What is the difference between heat pump and refrigeration system? Derive the coefficient of performance (COP) relationship of heat pump and refrigeration system. [3]

Q5 Derive the following relation for an ideal gas. All the symbols are of their usual meaning. [5]

$$\frac{\Delta S}{R} = \int_{T_o}^{T} \frac{C_P^{ig}}{R} \frac{dT}{T} - ln \frac{P}{P_o}$$

Q6 (a) Draw T-S and P-H diagrams of vapor-compression refrigeration cycle. [2]

(b) Write a note on common refrigerant and their choice criteria for a refrigeration system. [3]

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