UPES
UNIVERSITY OF TOMORROW

## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
### Supplementary Examination, December 2023

Course:    Thermodynamics                                    Semester: III
Program:   B.Tech Mechanical                                 Time      : 03 hrs.
Course Code: MECH2043                                        Max. Marks: 100

**Instructions:** Make suitable assumptions (if any needed)

### SECTION A
### (5Qx4M=20Marks)

| S. No. | Question | Marks | CO |
|---|---|---|---|
| Q 1 | What do you mean by Specific Heat? Explain the Specific heat at constant pressure and volume. | 4 | CO1 |
| Q 2 | Explain the following terms (a) Thermometric property (b) Latent Heat and (c) Superheat. | 4 | CO1 |
| Q 3 | Explain the following (a) Zeroth law (b) Third law of thermodynamics. | 4 | CO1 |
| Q 4 | Explain why the term "Thermodynamics" is a misnomer. | 4 | CO1 |
| Q 5 | What is air standard cycle? | 4 | CO1 |

### SECTION B
### (4Qx10M= 40 Marks)

| Q 6 | Derive the Steady flow energy equation (SFEE) and express it on per unit mass basis. | 10 | CO3 |
|---|---|---|---|
| Q 7 | Prove the following<br>(a) Two adiabatic cannot intersect each other<br>(b) Entropy is a property of the system. | 10 | CO3 |
| Q 8 | Draw and analyse the vapour compression refrigeration cycle on t-s and P-h axes and explain the following (a) COP, (b) refrigeration Effect and (c) Tonnage  (d) Condenser work | 10 | CO2 |

| Q 9 | Dry saturated steam at a pressure of 25 bar is expanded isentropically in a nozzle to pressure of 0.1 bar. With the help of Mollier's diagram, find the velocity and dryness fraction of the steam issuing from the nozzle. <br><br> **OR** <br><br> In a cold storage plant 500 kg of vegetable at 5°C are to be frozen and stored at -10°C. The specific heat of vegetable above freezing point is 3.182, and below freezing point it is 1.717 kJ/kgK. The freezing point is -1°C, and the latent heat of fusion is 234.5 kJ/kg. How much heat must be removed to cool the vegetables, and what percent of this is latent heat? | **10** | **CO4** |
|---|---|---|---|

| SECTION-C <br> (2Qx20M=40 Marks) | | | |
|---|---|---|---|
| Q 10 | (a) What is thermodynamic equilibrium? Provide the necessary conditions for thermodynamic equilibrium. <br> (b) Analyse the entropy change of the universe because of the following processes: (a) A Metal block of 1 kg mass and with $Cp$ of 180 J/K at 100°C is placed in a pond at 8°C. (b) Two such blocks, at 300 and 0°C are joined together. | **20** | **CO4** |
| Q 11 | (a) Drive the relation for air standard efficiency of Diesel Ccycle. <br> (b) Steam at 25 bar, 450°C, is expanded in a steam turbine to 0.1 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water in the boiler, (a) Assuming all ideal processes, find per kg of steam the network and the cycle efficiency. <br><br><br> OR <br><br> (a) Compare the efficiency of a Carnot cycle and Rankine cycle in steam and comment the suitability of Carnot cycle in steam? <br> (b) In an Air standard Diesel cycle the compression ratio is 18, and the compression begins at 30 °C, 0.1 MPa, the maximum temperature of the cycle is 1300°C. Find (a) the temperature and pressure at the cardinal points of the cycle, (b) the heat supplied per kg of air, (c) the work done per kg of air (d) the cycle efficiency, and (e) the mean effective pressure of the cycle. | **20** | **CO2** |