KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Food Technology) 2023 Admission
II Semester Final Examination – July 2024

Pafe.1206 **Food Thermodynamics (2+0)** **Marks: 50**
Time: 2hours

I **Fill in the blanks** **(10 x 1=10)**

1. The wet bulb depression is zero, when relative humidity is .....%.
2. In Rankine cycle the work output from turbine is given by Change of ..... between inlet and outlet.
3. A system contains water at 2.00 MPa, 220 °C. The phase of this water is .....
4. Adiabatic curve is ..... than isothermal curve.
5. In the absence of any heat transfer, entropy change is due to .....only.

State True or False

6. The dew point temperature is less than the wet bulb temperature for unsaturated air.
7. Freezing temperature of water decreases with increase in pressure.
8. With increase of pressure, the latent heat of steam increase.
9. In a free expansion process internal energy remains constant.
10. If index of compression for first stage of compression is higher than second stage, then for perfect inter-cooling and minimum total work, the first stage shares lesser work than second.

II **Write short notes on ANY FIVE of the following** **(5x2=10)**

1. Prove that Efficiency of diesel cycle will always be less than that of Otto cycle for a given compression ratio.
2. Give comparison between heat and work.
3. Define Macroscopic and Microscopic approach in Thermodynamics.
4. Define thermal efficiency of heat engine. Can it be 100%?
5. Define dry bulb temperature, wet bulb temperature and dew point temperature.
6. What are the four processes which constitute the otto cycle?
7. Sketch a psychrometric chart and show the following properties of air on it.
   (i) DBT lines
   (ii) WBT lines
   (iii) Specific volume lines
   (iv) Relative humidity lines.

III **Answer ANY FIVE of the following** **(5x4=20)**

1. Prove that for a reversible adiabatic process: $PV^{\gamma} = c$.
2. Apply steady flow energy equation to boiler, condenser and turbine.
3. In a Brayton cycle based power plant, the air at the inlet is at 27°C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C. Find
   (a) the compressor work per kg of air
   (b) the turbine work per kg or air
   (c) the heat supplied per kg of air and
   (d) the cycle efficiency.
4. Find the dryness fraction, specific volume and internal energy of steam at 7 bar and enthalpy of 2550 kJ/kg.

5. The pressure and temperature of air in a room are 1.0132 bar and 30°C respectively. If the relative humidity is found to be 40%, estimate:
   (i) The partial pressure of water vapour;
   (ii) The dew point temperature;
   (iii) The specific volume of each component;
   (iv) The specific humidity.
6. Explain the effect of superheating and subcooling on the performance of vapour compression cycle.
7. An insulated cylinder contains 25 kg of nitrogen. Its volume capacity is 5 m^3. Paddle work is done on the gas by stirring it till the pressure in the vessel gets increased from 5 bar to 10 bar. Determine
   (i) change in internal energy
   (ii) work done and
   (iii) heat transferred

   Assume C_p =1.04 kJ/kgK and C_V = 0.7432 kJ/kgK for nitrogen.
   Sketch the process on PV graph.

IV **Write an essay on ANY ONE of the following** **(1x10=10)**

1. Steam is supplied to a turbine at a pressure of 32 bar and a temperature of 410°C. It expands isentropically to pressure of 0.08 bar. What is the dryness fraction at the end of expansion and the thermal efficiency of the cycle? Calculate the modified exhaust condition and thermal efficiency if the steam is reheated at 5.5 bar to a temperature of 395°C and then expanded isentropicallyto a pressure of 0.08 bar.
2. A Diesel air standard cycle has a compression ratio of 15. The lowest and highest temperature of the cycle are 27°C and 1627 °C respectively. The pressure at the beginning of compression is 1 bar. Calculate
   (a) the pressures and temperatures at the salient points of the cycle
   (b) the heat supplied;
   (c) the heat rejected
   (d) net work output
   (e) efficiency
   (f) clearance
   (g) cut-off and
   (h) mep

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