8. Briefly explain (any two)

(a) Basic Brayton cycle

(b) Vapour compression cycle

(c) Rankine cycle 5+5

*****

B. Tech Odd Semester Examination, February, 2023

Agricultural Engineering

(3rd Semester)

Course No.: AE-302

(Thermodynamics)

Full Marks: 50
Pass Marks: 25

Time: 2 hours

Note:
1. Attempt any five questions.
2. Begin each answer in a new page.
3. Answer parts of a question at a place.
4. Assume reasonable data wherever required.
5. The figures in the right margin indicate full marks for the question.
6. All the mathematical symbols and abbreviations have their usual meanings.

1. Briefly explain with the formula (wherever necessary): Pure substance, Second law ofthermodynamics, Specific heat at constant volume,Entropy, Internal Energy, Inexact differential, Quasi-static process, Equilibrium, Microscopic and Macroscopic property, Latent heat. 10

2. (i) Explain the working of Electrical Resistance Thermometers with the necessary diagram and the underlying principle. 5

(ii) A stationary mass of gas is compressed without friction from an initial state of $0.3m^3$ and 0.105 MPa to a final state of 0.15 m3and 0.105 MPa, the pressure remainingconstant during the process. There is atransfer of 37.6 kJ of heat from the gas duringthe process,

How much does the internalenergy of the gas change? 5

3. (i) Write down the difference between intensive and extensive property with example. Briefly explain the specific enthalpy of mixture for a pure substance. 5

(ii) A certain gas has C_P = 1.968 and C_V = 1.507 kJ/kg K. Find its molecular weight and the gas constant.A constant volume chamber of 0.4 m^3 capacity contains 2 kg of this gas at 5 °C. Heat is transferred to the gas until the temperature is 100 °C. Find the work done, the heat transferred, and the changes in internal energy, enthalpy and entropy. 3

(iii) Define saturation states. List the saturation states during heating of pure water. 2

4. (i) Define clausius inequality? Give examples of reversibility and irreversibility process. Prove that Cp-Cv=R (Meyers Equation) for an ideal gas. 1+2+2

(ii) What is Exergy? A cyclic heat engine operatesbetween a source temperature of 800°C anda sink temperature of 30°C. What is the leastrate of heat rejection per kW net output ofthe engine? 2+3

5. (i) Define Thermal Energy Reservoirs with example. 3

(ii) A heat pump working on a reversed Carnotcycle takes energy from a reservoirmaintained at 5 °C and delivers it to anotherreservoir at 77°C. The heat pump takes powerfor its operation from an engine operatingwithin higher and lower temperature of1077°C and 77°C. For 100 kJ/kg of energysupplied to reservoir at 77°C, estimate theenergy taken from reservoir at 1077°C. 7

6. What is Carnot cycle? A Carnot engine working between 400! and 40! produces 130 kJ of work. Determine

(i) The engine thermal efficiency

(ii) The heat added

(iii) The entropy changes during heat rejection process. 2+8

7. (i) What is reversibility? A refrigerator maintains the temperature of the freezer compartment at 5°C when the air surrounding the refrigerator is at 22 °C. The rate of heat transfer from the freezer compartment to the refrigerant (the working fluid) is 8000 kJ/h and the power input required to operate the refrigerator is 3200 kJ/h. Determine the coefficient of performance of the refrigerator and compare with the coefficient of performance of a reversible refrigeration cycle operating between reservoirs at the same temperatures. 1+3

(ii) Briefly explain (any three)

(a) Absolute temperature scale (b) Turbine and nozzle (c) Availability and exergy (d) Heat pump and Refrigerator 6