Reg. No. \_\_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov / Dec – 2019**

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| **Code :** | **14ME2014** | **Duration :** | **3hrs** |
| **Sub. Name :** | **ENGINEERING THERMODYNAMICS** | **Max. Marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. |  | A piston cylinder machine contains a fluid system which passes through a complete cycle of four processes. During a cycle, the sum of all heat transfer is -170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item, and compute the net rate of work output in kW.   |  |  |  |  | | --- | --- | --- | --- | | **Process** | **Q (kJ/min)** | **W (kJ/min)** | **ΔE (kJ/min)** | | a - b | 0 | 2170 | --- | | b - c | 21000 | 0 | --- | | c – d | -2100 | --- | -36600 | | d - a | --- | --- | --- | | CO1 | 20 |
| **(OR)** | | | | |
| 2. |  | Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kN/m2 pressure, and 0.95 m3/kg volume, and leaving at 5 m/s, 700 kN/m2, and 0.19 m3/kg. The internal energy of the air leaving is 90 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat form the air at the rate of 58 kW (i) Compute the rate of shaft work input to the air in kW. | CO1 | 20 |
|  |  |  |  |  |
| 3. | a. | Explain Kelvin-Planck’s law. Which kind of engine can violate this law? | CO1 | 3 |
| b. | What is the COP of a refrigerator which maintain 4°C against 25°C ambient temperature? | CO1 | 3 |
| c. | A Carnot cycle operates between source and sink temperatures of 250°C and 15°C. If the system receives heat at 90 kJ/s from the source, find:  (i) efficiency of the system; (ii) heat rejected to sink. | CO1 | 14 |
| **(OR)** | | | | |
| 4. |  | A reversible heat engine operates between two reservoirs at temperatures of 600˚ C and 40˚C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40˚C and −20˚C. The heat transfer to the heat engine is 2000kJ and the net work output of the combined engine refrigerator plant is 360kJ. Evaluate the heat transfer to the refrigerant and the heat transfer to the reservoir at 40˚ C. | CO2 | 20 |
|  |  |  |  |  |
| 5. | a. | Explain Clausius inequality statement. | CO2 | 4 |
| b. | 1 kg of ice at –5°C is exposed to the 25°C atmosphere. The ice melts and comes into thermal equilibrium, calculate entropy change in atmosphere. Take: cp of ice is 2kJ/kgK, cpof water 4 kJ/kgK and latent heat of fusion 300 kJ/kg. | CO2 | 16 |
| **(OR)** | | | | |
| 6. | a. | Draw and explain the phase equilibrium diagram for a pure substance on p-v coordinates. | CO2 | 10 |
| b. | Draw and explain the phase equilibrium diagram for a pure substance on p-T coordinates. | CO2 | 10 |
|  |  |  |  |  |
| 7. |  | Two vessels A and B both containing nitrogen are connected by a valve which is opened to allow the contents to mix and achieve an equilibrium temperature of 270C. Before mixing, vessel A had pressure, temperature and contents as 1.5 Mpa, 500C and 0.5 kg mol respectively. Vessel B had pressure, temperature and contents as 0.6 Mpa, 200C and 2.5 kg mol respectively. Calculate the final equilibrium pressure, and the amount of heat transferred to the surroundings. If the vessel had been perfectly insulated, calculate the final temperature and pressure which would have been reached. Take γ = 1.4 | CO3 | 20 |
| **(OR)** | | | | |
| 8. |  | A vessel having a capacity of 0.04 m3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9 kg. Find the following:   1. The pressure. 2. The mass. 3. The specific volume. 4. The specific enthalpy. 5. The specific entropy. 6. The specific internal energy. | CO3 | 20 |
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|  | | **Compulsory**: |  |  |
| 9. |  | Atmospheric air at 1.0132 bar has a DBT of 320C and WBT of 260C. Compute.   1. The partial pressure of water vapour 2. The specific humidity 3. The dew point temperature 4. The relative humidity 5. The degree of saturation 6. The density of the air in the mixture 7. The density of vapour in the mixture     The enthalpy of the mixture. | CO4 | 20 |