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



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April / May – 2017**

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

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

**Students are allowed to use the steam-table they have in their possession**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Is the *p*d*V* work a path function? | CO1 | 1 |
| b. | What is quasi-static process? | CO2 | 1 |
| c. | Explain 1st law of TD for a closed system undergoing a change in state. | CO1 | 2 |
| d. | Write down the steady flow Energy Equation (SFEE). | CO1 | 2 |
| e. | 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 | 14 |
| (OR) | | | | |
| 2 | a. | What is unavailable energy about a cycle? | CO1 | 1 |
| b. | How is work and heat transfer are conserved in a cyclic process? | CO1 | 1 |
| c. | Work can be converted into heat, and vice versa. Whats the difference? | CO1 | 2 |
| d. | If both source and sink temperatures are decreased by 10 K, how would the efficiency be changed? | CO1 | 2 |
| e. | A fluid (0.18 m3) at a pressure of 3 N/m2 contained in a cylinder behind a piston that expands reversibly to a pressure of 0.6 N/m2 per a law, pv2=constant. Calculate the work done by the fluid on the piston. | CO1 | 14 |
| 3. | a. | Define heat engine. | CO1 | 1 |
| b. | How would you calculate efficiency of heat engine? | CO1 | 1 |
| c. | Explain a PMM2 engine. | CO1 | 2 |
| d. | Find sink temperature when source temperature is 694 K & efficiency is 40%? | CO1 | 2 |
| e. | A reversible heat engine receives heat from a high temperature reservoir at T1 K and rejects heat to low temperature sink at 227°C. A second reversible engine receives the heat rejected by first engine and rejects to a cold reservoir at 27°C. Find T1 when both the heat engine has equal thermal efficiencies. | CO1 | 14 |
| (OR) | | | | |
| 4. | a. | What are the four successive steps in a Carnot cycle? | CO1 | 1 |
| b. | When do you refer a thermodynamic system as reversible? | CO1 | 1 |
| c. | Explain Kelvin-Planck’s law. Which kind of engine can violate this law? | CO1 | 2 |
| d. | What is the COP of a refrigerator which maintain 4°C against 25°C ambient temperature? | CO1 | 2 |
| e. | 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 |
| 5. | a. | What is the entropy change in reversible adiabatic process? | CO2 | 1 |
|  | b. | Is entropy change between two state is path dependent? | CO2 | 1 |
|  | c. | Write down relationship between entropy, enthalpy, internal energy for a system. | CO2 | 2 |
|  | d. | Explain Clausius inequality statement. | CO2 | 2 |
|  | e. | 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 | 14 |
| (OR) | | | | |
| 6. | a. | Is entropy change a path dependent property? | CO2 | 1 |
| b. | What is a Carnot cycle? | CO2 | 1 |
| c. | Explain Clausius’s Theorem in reversible cycle. | CO2 | 2 |
| d. | A cycle takes 500 kJ of heat at 373K and rejects 100 kJ at 273K. Is it reversible, irreversible or impossible cycle? | CO2 | 2 |
| e. | 1.4 kgof air is heated reversibly at constant atmosphere pressure from 300 K to 600 K. Calculate: (i) The net heat flow. (ii) The overall change in entropy. Given cp = 1.005 kJ/kg K | CO2 | 14 |
| 7. | a. | Which Phase transition is absent below triple point line in P-V diagram? | CO3 | 1 |
| b. | What is critical point in a phase equilibrium diagram. | CO3 | 1 |
| c. | Derive correlation between specific volumes for saturated liquid, saturated vapor mixture and dryness fraction. | CO3 | 2 |
| d. | What is superheated water and what is compressed water? | CO3 | 2 |
| e. | Find the temperature, dryness fraction, enthalpy, and entropy for steam-water mixture of specific volume 0.03 m3/kg at 3 Mpa. | CO3 | 14 |
| (OR) | | | | |
| 8. | a. | What is equation of state for a gas? | CO1 | 1 |
|  | b. | Write down the van der Wall’s Equation of state. | CO1 | 1 |
|  | c. | Define specific heats, i.e. cp and cv for and ideal gas. | CO1 | 2 |
|  | d. | Derive the value for universal gas constant (in SI unit) from the information that 1 gmol gas volume is 22.4 L at STP. | CO1 | 2 |
|  | e. | Two vessels A, B containing nitrogen and carbon-dioxide separated by a valve can mix and attain equilibrium temperature 25°C. Before mixing the information is given here: PA = 1.5 MPa, tA= 50°C, mA= 10 kg, PB = 0.5 MPa, tB = 10°C, mB= 5 kg. What is the final equilibrium pressure? | CO1 | 14 |
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|  | | **Compulsory:** |  |  |
| 9. | a. | What is due point temperature? | CO4 | 1 |
|  | b. | What is wet bulb temperature? | CO4 | 1 |
|  | c. | Differentiate between specific and relative humidity. | CO4 | 2 |
|  | d. | If specific humidity of atmospheric air at 20°C is 0.0095 kg/kg of dry air, calculate partial pressure of water vapor | CO4 | 2 |
|  | e. | In the same problem, above, calculate relative humidity, and dew point temperature. | CO4 | 14 |