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



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

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| **Code :** | **18ME2036** | **Duration :** | **3hrs** |
| **Sub. Name :** | **THERMODYNAMICS** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Marks** |
| **PART – A (10X1 = 10 MARKS)** | | | |
| 1. | Enumerate the difference between Heat and Internal Energy | CO1 | 1 |
| 2. | Pressure is a \_\_\_\_\_\_\_\_\_\_\_\_ property | CO1 | 1 |
| 3. | State zeroth law of thermodynamics. | CO2 | 1 |
| 4. | Define entropy. | CO2 | 1 |
| 5. | State First law of thermodynamics. | CO3 | 1 |
| 6. | What is PMM of first kind1? Why it is impossible? | CO3 | 1 |
| 7. | COP of heat pump is equal to COP of refrigerator plus one (True / False). | CO4 | 1 |
| 8. | State Carnot theorem. | CO4 | 1 |
| 9. | The value of universal gas constant is \_\_\_\_\_\_\_\_\_\_\_\_\_\_. | CO5 | 1 |
| 10. | What is a pure substance? | CO5 | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Prove that Cp– Cv = R. | CO1 | 3 |
| 12. | Show that energy is a property of the system. | CO2 | 3 |
| 13. | Write the equations of first law of thermodynamics applicable to a closed and open system. | CO3 | 3 |
| 14. | A Carnot cycle operates between the temperature limits of 470 C & -300 C. Determine COP when it operates on;  (i) a refrigerating machine (ii) a heat pump (iii) efficiency of heat engine. | CO4 | 3 |
| 15. | State the Kelvin-plank and Classuis statements of Second law of Thermodynamics. | CO5 | 3 |
| 16. | Draw P-V, T-V and P-T diagrams for a pure substance. | CO6 | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is a Compulsory Question)** | | | | |
| 17. | a. | A piston and 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 min. 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 | 21,000 | 0 | - | | c-d | -2100 | - | -36,000 | | d-a | - | - | - | | CO1 | 12 |
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| 18. | a. | An insulated tank contains 10 liters of water at 100 kilo Pascal and 20 oC and a 2 kW electric heater is immersed in water considering all the electrical energy is used to raise the temperature of water.Find the time require to raise the water temperature to 70 oC . Water can be considered as a constant density fluid with a water density of 1000 kg/m3 water and the specific heat constant is 4.2 kJ/kg K in the given range of temperature. | CO2 | 6 |
| b. | An electric generator coupled to a windmill produces an average electric power of 5 kW. The power is used to charge a storage battery. Heat transfer from the battery to the surroundings is 0.6 kW. Determine the total amount of energy stored in the battery in 8 hour operation. | CO2 | 6 |
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| 19. |  | Air flows steadily at th rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure, and 0.95 m3/kg volume and leaving at 5 /s 700 kPa and 0.19 m3/kg. The internal energy of the air leaving is 90 kJ/kg greater that that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. (a) Compute the rate of shaft work input to the air in kW. (b) Find the ratio of the inlet pipe diameter to the outlet pipe diameter. | CO3 | 12 |
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| 20. |  | A reversible heat engine operates between two reservoirs at temperatures of 600 oC. The engine rives a reversible refrigerator which operates betweeen reservoirs at temperature of 40 oC and -20 oC. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. (i) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40 oC. (ii) Reconsider (iii) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values. | CO4 | 12 |
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| 21. |  | A certain gas has Cp = 1.968 and Cv = 1.507 kJ/kg K. Find its molecular weight and the gas constant. A constant volume chamber of 0.3 m3 capacity contains kg of this gas at 5 oC. Heat is transferred to the gas until the temperature is  100 oC. Find the work done, the heat transferred, and the changes in the internal energy, enthalpy and entropy. | CO5 | 12 |
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| 22. |  | From first law of thermodynamics derive steady flow energy equation and derive the steady flow equation for (i) Nozzle, (ii) Turbine, (iii) Pump, (iv) Compressor and (v) Heat Exchanger. | CO2 | 12 |
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| 23. |  | One kg of ice at -5oC is exposed to the atomosphere which is at 20 oC. The ice melts and comes into thermal equlilbrium with atmosphere. (i) Determine the entropy increase of the universe. (ii) What is the minimum amount of work necessary to convert the water back into ice at 5 oC? Cp of ice is 2.093 kJ/kg K and the latent heat of fusion of ice is 333.3 kJ/kg. | CO4 | 12 |
|  |  | **Compulsory:** | | |
| 24. |  | A vessel of volume 0.04 m3 contains a mixture of saturated water and saturated steam at a temperature of 250 oC. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entopy and the internal energy. | CO6 | 12 |