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



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

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| **Code :** | **17ME2004** | **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. | A mass of 1.5kg of air is compressed in a quasi-static process from 0.1 Mpa to 0.7Mpa for which pv= constant. The initial density of air is 1.16 kg/m3. Find the work done by the piston to compress the air. | CO1 | 5 |
| b. | A piston-cylinder device, whose piston is resting on a set of stops, initially contains 3 kg of air at 200 kPa and 27oC. The mass of the piston is such that a pressure of 400 kPa is required to move it. Heat is now transferred to the air until its volume doubles. Determine the work done by the air and the total heat transferred to the air. | CO1 | 15 |
| **(OR)** | | | | |
| 2. | a. | A mixture of gases expands at constant pressure from 1MPa, 0.03 m3 to 0.06m3 with 84kJ positive heat transfer. There is no work other than that done on a piston. Find the change in internal energy for the gaseous mixture.  The same mixture expands through the same state path while a stirring device does 21kJ of work on the system. Find change in internal energy, work done and total heat transfer for the process. | CO2 | 10 |
| b. | State the first law for a closed system undergoing a change of state.  Derive that energy is a property of a system. | CO2 | 10 |
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| 3. |  | Give the Clausius’s statement of the second law. Establish the equivalence of Kelvin – Planck and Clausius statements. | CO3 | 20 |
| **(OR)** | | | | |
| 4. | a. | A reversible heat engine operates between two reservoirs at temperatures of 600o C and 40o C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 40oC and -20oC. The heat transfer to the heat engine is 2000kJ and the net work output of the combined engine refrigerator plant is 360 kJ.  a) Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40oC.  b) Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values. | CO3 | 15 |
| b. | Using an engine of 30% thermal efficiency of drive, a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator? | CO3 | 5 |
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| 5. | a. | Water flows through a turbine in which friction causes the water temperature to rise from 35oC to 37oC. If there is no heat transfer, how much does the entropy of the water change in passing through the turbine? Consider the process to take place at constant volume. | CO3 | 5 |
| b. | A vessel of volume 0.04 m3 contains a mixture of saturated water and saturated steam at a temperature of 250oC. The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy, and the internal energy. | CO4 | 15 |
| **(OR)** | | | | |
| 6. | a. | Steam initially at 0.3MPa, 250oC is cooled at constant volume.  (a) At what temperature will the steam become saturated vapour?  (b) What is the quality at 80oC?  (c) What is the heat transferred per kg of steam in cooling from 250oC to 80oC? | CO4 | 14 |
| b. | Explain the terms critical pressure, critical temperature and critical volume of water. | CO4 | 6 |
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| 7. | a. | A fluid at 200 kPa and 300oC has a volume of 0.8m3. In a friction -less process at a constant volume the pressure changes to 100kPa. Find the final temperature and heat transferred.  a) if fluid is air, and  b) the fluid is steam | CO5 | 15 |
| b. | Show that for an ideal gas cp – cv= R. | CO5 | 5 |
| **(OR)** | | | | |
| 8 | a | Show the enthalpy of an ideal gas is a function of temperature only. | CO5 | 8 |
| b. | A certain gas has cp = 1.968 and cv= 1.507 kJ/kgK. Find its molecular weight and the gas constant. A constant volume chamber of 0.3m3 capacity contains 2kg of this gas at 5OC. Heat is transferred to the gas until the temperature is 100OC. Find the work done, the heat transferred and the changes in internal energy, enthalpy and entropy. | CO5 | 12 |
|  | | **Compulsory**: |  |  |
| 9. | a. | Air at 20°C, 40 % RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1kg of the former with 2kg of the latter (on dry basis). Find the final condition of the air. | CO6 | 12 |
| b. | A sling psychrometer reads 40°C DBT and 36°C WBT. Find the humidity ratio, relative humidity, dew point temperature, specific volume, and the enthalpy of air. | CO6 | 8 |