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

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**End Semester Examination – Nov/Dec – 2018**

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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 stationary mass of gas is compressed without friction from an initial state of 0.3m3 and 0.105MPa to a final stage of 0.15m3 and 0.105MPa, the pressure remaining constant during the process. There is a transfer of 37.6kJ of the heat from the gas during the process. How much does the internal energy of the gas change? | CO1 | 10 |
| b. | A gas of 4 kg is contained within a piston cylinder machine. The gas undergoes a process of which pV1.5 = constant. The initial pressure is 3 bar and initial volume is 0.1m3 and final volume is 0.2m3. The specific internal energy of the gas decreases by 4.6 kJ/kg. There is no significant change in KE and PE. Determine the net heat transfer for the process. | CO1 | 10 |
| (OR) | | | | |
| 2. | a. | A certain water heater operates under steady flow conditions receiving 4.2kg/s of water at 75oC temperature, enthalpy 313.93kJ/kg. The water is heated by mixing with steam which is supplied to the heater at temperature 100.2oC and enthalpy 2676kJ/kg. The mixture leaves the heater as liquid water at temperature 100oC and enthalpy 419kJ/kg. How much steam must be supplied to the heater per hour? | CO2 | 8 |
| b. | Derive steady flow energy equation from first principle. | CO2 | 12 |
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| 3. | a. | A Carnot engine absorbs 200J of heat from a reservoir at the temperature of the normal boiling point of water and rejects heat to a reservoir at the temperature of triple point of water. Find the heat rejected, the work done by the engine and the thermal efficiency. | CO3 | 8 |
| b. | Establish equivalence of Kelvin – Planck and Clausius statement. | CO3 | 12 |
| (OR) | | | | |
| 4. | a. | (i) One kg of water at 273 K is brought into contact with a heat reservoir at 373K. When the water has reached 373 K, find the entropy change of the water, of the heat reservoir, and of the universe. (ii) If water is heated from 273 to 373K by first bringing it in contact with a reserviour at 323K and then with a reservoir at 373K, what will be the entropy change for the universe be?  (iii) Explain how water might be heated from 273K to 373K with almost no change in the entropy of the universe. | CO3 | 10 |
| b | Explain the effect of irreversibility in various thermodynamics systems. | CO3 | 10 |
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| 5. | a. | Steam initially at 0.3MPa, 250oC is cooled at constant volume   1. at what temperature will the steam become saturated vapour? 2. What is the quality at 80oC?What is the heat transfer per kg of steam in cooling from 250oC to 80oC? | CO4 | 10 |
|  | b. | Draw the phase equilibrium diagram on *p-v* coordinates for a substance which shrinks in volume on melting and then for a substance which expands in volume on melting. Indicate there on the constant property lines. | CO4 | 10 |
| (OR) | | | | |
| 6. | a. | Steam initially at 1.5MPa, 300oC expands reversibly and adiabatically in a steam turbine to 40oC. Determine the ideal work output of the turbine per kg of steam. | CO4 | 10 |
| b. | Draw the phase equilibrium diagram for a pure substance on T-S plot with relevant constant property lines. | CO4 | 10 |
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| 7. | a. | A reversible adiabatic process begins at p1= 10bar, t1 = 300oC and ends with p2 =1 bar. Find the specific volume and the work done per kg of fluid if:   1. fluid is air 2. fluid is steam | CO5 | 10 |
| b. | Show the enthalpy of an ideal gas is a function of temperature only. | CO5 | 10 |
| (OR) | | | | |
| 8. | a. | 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 | 10 |
| b | Derive the equations used for computing the entropy changes of an ideal gas. | CO5 | 10 |
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|  | | **Compulsory**: |  |  |
| 9 | a. | An air conditioning system is designed under the following conditions:  Outdoor condition – 30oC dbt, 75% RH  Required indoor conditions- 22oC dbt, 70%RH  Amount of free air circulated – 3.33m3/s  Coil dew point temperature -14oC  The required conditions is achieved by cooling and dehumidification, and then by heating. Estimate.   1. the capacity of the cooling coil in tones. 2. the capacity of the heating coil in kW. 3. the amount of water vapour removed in kg/s. | CO6 | 15 |
| b | Explain the process of heating and humidification. | CO6 | 5 |