Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV (New) EXAMINATION – WINTER 2015**

**Subject Code:2142004** **Date:01/01/2016**

**Subject Name: Engineering Thermodynamics**

**Time: 2:30pm to 5:00pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

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|---|---|---|---|
| **Q.1** | **(a)** | Define Thermodynamic system. Also explain different thermodynamic systems with appropriate examples. | **7** |
| | **(b)** | Derive an expression for Otto cycle efficiency with usual notation. | **7** |
| **Q.2** | **(a)** | Prove the equivalency of Kelvin-Plank and Clausius statements. | **7** |
| | **(b)** | Derive the general energy equation for steady flow process. | **7** |
| | | **OR** | |
| | **(b)** | Gas enters a nozzle at 15 bar and 1500k with a velocity of 30 m/s. The pressure at the exit of nozzle is 5 bar. If the nozzle efficiency is 90%, calculate the actual exit velocity. Neglect change in P.E. and heat exchange between nozzle and surrounding. Take $C_p$ = 1.005 KJ/kg k. | **7** |
| **Q.3** | **(a)** | Explain following terms: law of corresponding states, Gibbs- Dalton law, Coefficient of volume expansion. | **7** |
| | **(b)** | Draw and explain the schematic for an ideal Rankine cycle and represent on p-v, T-S, h-s diagram. | **7** |
| | | **OR** | |
| **Q.3** | **(a)** | Write note on reversibility and irreversibility. | **7** |
| | **(b)** | State and explain<br>(i) Equation of state<br>(ii) Avogadro's law | **7** |
| **Q.4** | **(a)** | Explain briefly Otto cycle with help of p-v and T-s diagram and derive an expression for ideal efficiency of Otto cycle. | **7** |
| | **(b)** | A heat engine is operated between 700$^o$ C and 30$^o$ C. It drive a heat pump which works between 100$^o$ C and 30$^o$ C. Efficiency and COP of the heat engine and the heat pump are half of that of corresponding carnot values. Calculate amount of heat rejected by heat pump at 100$^o$ C when 100 KJ is absorbed by heat engine at 700$^o$ C. | **7** |
| | | **OR** | |
| **Q.4** | **(a)** | State the Carnot theorem and explain PMM-II(Perpetual Motion Machine of second kind). | **7** |
| | **(b)** | In a engine working on otto cycle, air has a pressure of 1 bar and temperature 30$^o$ C at the entry. Air is compressed with a compression ratio of 6. The heat is added at constant volume until the temperature rises to 1500$^o$ C. Determine<br>(i) Air standard efficiency<br>(ii) Pressure and temperature at the end of compression<br>(iii) Heat supplied<br>(iv) Mean effective pressure.<br>Take $C_v$ = 0.716 KJ/kg k, R = 0.287 KJ/kg K | **7** |

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| **Q.5** | **(a)** | Define "Availability". Also derive expression for availability in a non-flow system. | **7** |
| | **(b)** | Compare otto, diesel and dual cycle for<br>(1) Constant maximum pressure and heat input.<br>(2) Same maximum pressure and temperature. | **7** |

**OR**

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| **Q.5** | **(a)** | Discuss the effect of pressure of steam at inlet to turbine, temperature at inlet to turbine and pressure at exit from turbine upon Rankine cycle performance. | **7** |
| | **(b)** | Explain the significance of the Van der Waal's equation of state and find the value of the constant a and b in term of critical parameters. | **7** |

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