Seat No.: _____          Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY
## BE - SEMESTER–IV(OLD) – EXAMINATION – SUMMER 2019

**Subject Code:141903**                                      **Date:13/05/2019**
**Subject Name: Engineering Thermodynamics**
**Time:02:30 PM TO 05:00 PM**                          **Total Marks: 70**

**Instructions:**
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of steam table is permitted.**

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|---|---|---|---|
| **Q.1** | **(a)** | Show the equivalence of Clausius and Kelvin-Plank statements of $2^{nd}$ law of thermodynamics. | **07** |
| | **(b)** | A reversed heat engine is used for producing ice at - 4°C from water at 27°C. The temperature of freezing mixture is - 8°C. Specific heat of ice is 2.1kJ/kg.K and latent heat of ice is 335kJ/kg. Calculate the amount of ice formed per kWh. | **07** |
| **Q.2** | **(a)** | Explain briefly the Otto cycle with help of P-V and T-S diagram and derive an expression for deal efficiency of Otto Cycle. | **07** |
| | **(b)** | A steam turbine power plant operating on ideal rankine cycle, receives steam at 30 bar, 350 °C at a rate of 2kg/s and it exhausts at 0.09bar. Calculate the net power output, steam rate, heat rejection in condenser in kW, rankine cycle efficiency and actual thermal efficiency of the plant if the boiler efficiency is 85%. | **07** |

**OR**

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| | **(b)** | State the Steady Flow Energy Equation and explain how this equation can be applied for (i) Nozzle, (ii) Boiler, and (iii) Steam Turbine. | **07** |
| **Q.3** | **(a)** | Define the following: Avogadro's law, equation of state, law of corresponding states and Gibbs-Dalton law. | **07** |
| | **(b)** | State various methods to improve efficiency of Brayton cycle. With suitable diagrams, explain any two of them. | **07** |

**OR**

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| **Q.3** | **(a)** | Define Flow work, critical point, and triple point. And explain the phase change process of water using a T-V diagram. | **07** |
| | **(b)** | Discuss perpetual motion machine of the first and second kind. | **07** |
| **Q.4** | **(a)** | Write short note on "Bomb calorimeter". | **07** |
| | **(b)** | What the meaning of word "Entropy "? Carnot cycle is not practical. Justify. | **07** |

**OR**

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| **Q.4** | **(a)** | Draw and explain the schematic for an ideal Rankine cycle and represent on p-v, T-S, h-s diagram | **07** |
| | **(b)** | Explain following term: Gibbs function and Helmholtz function. | **07** |
| **Q.5** | **(a)** | Explain the concept of available and unavailable energy. | **07** |
| | **(b)** | 10 kg/s of chilled water enters a tall building with velocity of 50m/s at an elevation of 30m from ground. The water leaves the system with velocity of 10m/s at an elevation of 60m. The temperature of water entering in and leaving out are 7°C and 12°C respectively. The rate of work done by pump in the line is 35kW. Calculate rate of heat removed by water. | **07** |

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**OR**

**Q.5** **(a)** Using Maxwell relations derive the Causius clapeyron equation.          **07**

**(b)** Define the following terms:          **07**
i) Elements of irreversibility
ii) Maximum work
iii) Dead state of a given system
iv) Availability
v) Irreversibility
vi) Second law of efficiency
vii) Availability function.

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