**Seat No.: _____** **Enrolment No._____**

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–III (NEW) - EXAMINATION – SUMMER 2018**

**Subject Code: 2131905** **Date: 25/05/2018**

**Subject Name: Engineering Thermodynamics**

**Time: 10:30 AM to 01:00 PM** **Total Marks: 70**

**Instructions:**

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

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Define following terms: 1) Steam Rate, 2) Brake thermal Efficiency, 3) Compression Ratio | **03** |
| | **(b)** | List out the assumptions made for analysis of Air standard cycle. | **04** |
| | **(c)** | Derive equation for efficiency for Diesel Cycle. | **07** |
| **Q.2** | **(a)** | Draw Brayton cycle on p-V and T-s diagram. | **03** |
| | **(b)** | Shaw the comparison on p-V and T-s diagram for Otto and Diesel cycle for same maximum pressure and temperature. | **04** |
| | **(c)** | A steam power plant operating on Rankine cycle receives steam from a boiler at 3.5 MPa and 350$^{o}$ C. It is exhausted to condenser at 10 kPa. Calculate: i) Energy supplied per kg of steam generated in a boiler, ii) Quality of steam entering the condenser, iii) Rankine cycle efficiency considering feed pump work and iv) Specific steam consumption. | **07** |
| | | **OR** | |
| | **(c)** | An air standard Otto cycle is required to operate between the temperature limits of 300 K and 1800 K. Estimate the optimum compression ratio and the corresponding thermal efficiency. Assume, $\gamma$ =1.4. | **07** |
| **Q.3** | **(a)** | Explain state and property also describe intensive and extensive property. | **03** |
| | **(b)** | Define Heat, Show that heat is an inexact differential. | **04** |
| | **(c)** | One kg of gas is confined to a constant volume tank. Initial pressure and volume are 4 bar and 0.21 m$^3$ respectively. When a heat energy of 82 kJ is supplied to the system, the final temperature of the gas becomes 127$^{o}$ C. Find: i) Work done, ii) Change in internal energy, iii) Specific heat at constant volume. Assume, R = 300 N-m/kg-K. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain Quasi-static process. | **03** |
| | **(b)** | Derive an expression for displacement work for a closed system and state its limitations. | **04** |
| | **(c)** | One kg of air having an initial volume of 0.3 m$^3$ is heated at constant pressure of 3.2 bar until the volume is doubled. Calculate i) heat added; ii) work done; iii) initial and final temperature of air. Take $C_p$ = 1.003 kJ/kg K and R = 0.2927 kJ/kg K. | **07** |
| **Q.4** | **(a)** | Derive Steady Flow Energy Equation for Boiler. | **03** |
| | **(b)** | What do you mean by thermal equilibrium? Explain it with suitable example. | **04** |
| | **(c)** | Derive the expression for the entropy change for pure substance. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Define the 3$^{rd}$ law of thermodynamics. | **03** |
| | **(b)** | Comparison of 1$^{st}$ law and 2$^{nd}$ law of thermodynamics. | **04** |
| | **(c)** | State and prove Carnot's theorem for Heat Engine and also write statement of Carnot's theorem in the view of refrigerator and Heat Pump. | **07** |

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|---|---|---|---|
| **Q.5** | **(a)** | Define Entropy. | **03** |
| | **(b)** | Explain thermodynamic temperature scale. | **04** |
| | **(c)** | Prove the Ideal Gas equation. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Show entropy as property of the system by using Clausius inequality. | **03** |
| | **(b)** | Write a short note on reversibility and irreversibility. | **04** |
| | **(c)** | Explain p-V-T surface for a pure substance by defining i) Triple point, ii) Critical point and iii) Vapour dome | **07** |

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