Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC– SEMESTER I– • EXAMINATION –WINTER- 2016**

**Subject Code: X11902** **Date:09/01/2017**

**Subject Name: Engineering Thermodynamics**

**Time: 10:30 AM to 1:00 PM** **Total Marks: 70**

**Instructions:**

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

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Engine working on otto cycle. The pressure and temperature at the beginning of compression stroke are $10^5$ N/m$^2$ and 273 $^0$c and the temperature at the end of compression stroke is 590 k. if the temperature at the end of constant volume heat addition process is 1800 k, calculate the air standard efficiency, heat addition per kg of air and rejected per kg of air, assume ,$\gamma$ =1.4, $C_v$= 0.75 kj/kg k. | **07** |
| | **(b)** | In a gas turbine unit, the gas flows through the turbine is 14 kg/s and the power developed by the turbine is 11500 kw. The enthalpy of gas at inlet and outlet are 1250 kj/kg and 400 kj/kg respectively and the gas at inlet and outlet are 52 m/s and 107 m/s respectively. Calculate the rate at which heat is rejected from the turbine. | **07** |
| **Q.2** | **(a)** | A reversible heat engine operating between two thermal reservoirs at 800 $^0$c and 30 $^0$c respectively. It drives a reversible refrigerator operating between -15 $^0$c and 30 $^0$c. The heat input to the heat engine is 1900 kj and the net work output from the combined plant is 290kj. Find the heat absorbed by the refrigerant and the total heat transferred to 30 $^0$c reservoir. | **07** |
| | **(b)** | Simple rankine cycle works between pressure of 30 bar and 0.07 bar, the initial condition of steam is dry. Calculate the cycle efficiency and work ratio. | **07** |
| | | **OR** | |
| | **(b)** | Show that the two reversible adiabatic processes cannot intersect each other | **07** |
| **Q.3** | **(a)** | Discuss first law of thermodynamics and derive steady flow energy equation for open system | **07** |
| | **(b)** | State and prove carnot theorem | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Derive steady flow energy equation for boiler, turbine and nozzle. | **07** |
| | **(b)** | Explain different statement of second law of thermodynamics | **07** |
| **Q.4** | **(a)** | Define clausius inequality and prove it | **07** |
| | **(b)** | Explain available and un-available energy. Derive an expression for availability of a non flow process | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Explain principle of increase of entropy. | **07** |
| | **(b)** | What are the limitations of carnot cycle? Give comparision of carnot and rankine cycle. | **07** |
| **Q.5** | **(a)** | Derive expression of thermal efficiency for rankine cycle. | **07** |
| | **(b)** | Derive equation of air standard efficiency of otto cycle | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Derive equation of air standard efficiency of diesel cycle | **07** |
| | **(b)** | Explain bomb calorimeter with sketch. | **07** |