

**GUJARAT TECHNOLOGICAL UNIVERSITY****PDDC - SEMESTER-I • EXAMINATION – SUMMER 2013****Subject Code: X11902****Date: 11-06-2013****Subject Name: Engineering Thermodynamics****Time: 02.30 pm - 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.

**Q.1** (a) What do you mean by thermodynamics? Explain the concepts of microscopic and macroscopic point of view of thermodynamics. **07**

(b) Define the following terms:- **07**

- (1) Process (2) Cycle (3) Pure substance
- (4) Control volume (5) Closed System
- (6) Intensive Properties (7) Extensive Properties

**Q.2** (a) Explain Joule's Experiment for first law of thermodynamics with neat sketch. **07**

(b) Derive and explain steady flow energy equation. **07**

**OR**

(b) Explain the concept of perpetual motion machine of the first kind. **07**

**Q.3** (a) What are the various limitations of first law of thermodynamics? Explain in detail with various examples. **07**

(b) An Engine operating on Carnot cycle works within temperature limits of 700 K and 350 K. If the engine receives 1800 kJ of heat, Calculate the following:- **07**

- (1) Thermal efficiency
- (2) Work done
- (3) Heat Rejected.

**OR**

**Q.3** (a) In a gas turbine unit, the gas flow through the turbine is 14 kg/s and the power developed by the turbine is 11500 kW. The enthalpies of the gases at the inlet and outlet are 1250 KJ/kg and 380 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 45m/s and 100m/s respectively. Calculate the following:- **07**

- (1) The rate at which heat is rejected to the turbine
- (2) The area of inlet pipe given that the specific volume of the gases at the inlet is  $0.40 \text{ m}^3/\text{kg}$ .

(b) 1. State Kelvin-Planck and Clausius statement for second law of thermodynamics. **07**

2. State and prove Carnot's theorem.

**Q.4** (a) What do you mean by Availability? Derive an expression for availability in non-flow systems. **07**

(b) Determine the air standard efficiency of Otto cycle from the following data. **07**

Bore of the cylinder = 13 cm

Stroke Length = 12 cm

Clearance volume =  $300 \text{ cm}^3$ , Take  $\gamma=1.4$

**OR**

- Q.4 (a)** Compare the Carnot Cycle with Rankine Cycle. **07**
- Q.4 (b)** A vessel of volume  $0.38 \text{ m}^3$  consists of  $0.40 \text{ kg}$  of  $\text{CO}$  and  $1 \text{ kg}$  of Air at  $14^\circ \text{C}$ . Calculate **07**  
 (1) The partial pressure of each constituent  
 (2) Total pressure in the vessel.  
 The air contains  $23\% \text{ O}_2$  and  $76.9\% \text{ N}_2$  by mass.  
 Take the molecular mass of  $\text{CO}$ ,  $\text{O}_2$ ,  $\text{N}_2$  as  $28$ ,  $32$  and  $28 \text{ kg/kg mole}$  respectively.  
 Take Universal Gas constant,  $R=8.3143 \text{ kJ/kg mol K}$
- Q.5 (a)** What do you mean by Calorific value? Explain Junker's Gas Calorimeter with neat sketch. **07**
- (b)** State and explain the following:- **07**  
 (1) Avogadro's law (2) Gibbs-Dalton Law
- OR**
- Q.5 (a)** Explain Diesel Cycle with neat sketch and derive the equation for the efficiency of Diesel cycle. **07**
- (b)** State and explain the following in brief:- **07**  
 (1) Third Law of thermodynamics  
 (2) Entropy and disorder

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