

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- I Examination January 2010

Subject code: X11902**Subject Name: Engineering Thermodynamics****Date: 12 / 01 / 2010****Time: 11.00 am – 1.30 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 properties charts and tables is permissible.

- Q.1** (a) Define following terms in relation to thermodynamics and give examples **07**
1. System 2. Process 3. Property.
- (b) What are the similarities and differences between heat and work, from thermodynamics point of view? **07**
- Q.2** (a) 1. What do you understand by Quasi- Static Process? Explain with example. **07**
2. Explain reversible and irreversible processes.
- (b) A steam turbine operates under steady flow conditions. It receives 6000 kg/hr steam from boiler. The steam enters the turbine at enthalpy of 2400 kJ/kg, a velocity of 2000 m/min and elevation of 5 m. The steam leaves the turbine at enthalpy of 1200 kJ/kg, a velocity of 6000 m/min and elevation of 1 m. Due to radiation, heat losses from turbine to the surroundings amounts to 2000 kJ/hr. Calculate the out put of the turbine. **07**
- OR**
- (b) Derive an expression to find the efficiency of Otto Cycle. **07**
- Q.3** (a) Define and explain the term 'Availability' & derive an expression for availability in non-flow systems. **07**
- (b) A system at 600 K receives 7500 kJ/min from a source at 1200 K. The temperature of atmosphere is 300 K. Assuming that the temperature of system and source remain constant during heat transfer find out the following. **07**
1. The entropy produced during heat transfer
2. The decrease in available energy after heat transfer.
- OR**
- Q.3** (a) Explain irreversibility in non-flow and steady flow processes. How irreversibility and effectiveness are related? Explain. **07**
- (b) Unit mass of air is compressed polytropically from 1 bar pressure and temperature of 300 K to a pressure of 7 bar and temperature of 400 K. Determine the irreversibility, if the sink temperature is 290 K. Assume $R = 0.287 \text{ kJ/kg K}$ and $C_p = 1.004 \text{ kJ/kg K}$ and $C_v = 0.716 \text{ kJ/kg K}$. **07**
- Q.4** (a) Compare Otto cycle, Diesel cycle and Dual cycle considering equal compression ratio and heat input for the efficiency and work output. **07**
- (b) A Diesel engine is working on air standard Diesel cycle. Air inlet is at 1 bar & 25°C . The specific volume of air at inlet is $0.8 \text{ m}^3/\text{kg}$. The compression ratio is 10 and 900 kJ/kg heat is added at constant pressure. Determine : **07**
1. Thermal Efficiency
2. Pressure and specific volume at 2, 3 and 4 point of the cycle.
3. Mean effective pressure

OR

- Q.4** (a) Explain 1. Clausius Inequality 2. Kelvin- Planck statement. **07**
(b) What are the characteristics of Entropy? **07**

- Q.5** (a) Prove that entropy of Universe is increasing. **07**
(b) Explain the Dalton's law and Gib-Daltaon's law for mixture of gases. **07**

OR

- Q.5** (a) Explain Rankine cycle and derive an expression for efficiency of Rankine cycle. **07**
(b) In a steam turbine steam at 20 bar, 400^0 C is expanded to 0.08 bar. It then enters the condenser, where it is condensed to saturated water. The pump feeds the water to the boiler. Assume all ideal processes, find per kg of steam net work and cycle efficiency. **07**
