

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-III (New) EXAMINATION – WINTER 2018****Subject Code: 2130405****Date: 28/11/2018****Subject Name: Thermodynamics****Time: 10:30 AM TO 01:00 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) Define: Macroscopic approach, Quasi-static process, Latent heat **03**
- (b) What are different types of Thermodynamic Systems? Explain with suitable example. **04**
- (c) State Kelvin-Planck statement of second law of thermodynamics. Prove that violation of Kelvin Planck statement leads to violation of Clausius statement. **07**

- Q.2**
- (a) Differentiate between macroscopic approach and microscopic approach. **03**
- (b) Explain perpetual motion machine of the first kind. **04**
- (c) In a gas turbine unit, the gases flow through the turbine is 15 kg/s and the power developed by the turbine is 12000 kW. The enthalpies of gases at the inlet and outlet are 1260 kJ/kg and 400 kJ/kg respectively, and the velocity of gases at the inlet and outlet are 50 m/s and 110 m/s respectively. Calculate : **07**
- a. The rate at which heat is rejected to the turbine, and
  - b. The area of the inlet pipe given that the specific volume of the gases at the inlet is 0.45 m<sup>3</sup>/kg.

**OR**

- (c) Derive general energy equation for steady flow process (SFEE). **07**
- Q.3**
- (a) Sketch p-V-T surface for pure substance. **03**
- (b) Explain heat engine. **04**
- (c) A house requires  $2 \times 10^5$  kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is  $3 \times 10^4$  kJ/h. Determine : **07**
- a. Heat abstracted from outside
  - b. Co-efficient of performance.

**OR**

- Q.3**
- (a) Explain concept of entropy. **03**
- (b) Explain Virial equation of state. **04**
- (c) For Van der Waals' equation show that **07**

$$v_c = 3b,$$

$$p_c = \frac{a}{27b^2},$$

$$T_c = \frac{8}{27} * \frac{a}{bR}$$

- Q.4** (a) Explain standard heat of reaction. **03**

- (b) One kg of CO<sub>2</sub> has a volume of 1 m<sup>3</sup> at 100 °C. Compute the pressure by Van der Waals' equation. **04**  
 (For CO<sub>2</sub> take  $a = 362850 \text{ Nm}^4/(\text{kg-mol})^2$  and  $b = 0.0423 \text{ m}^3/\text{kg-mol}$ )
- (c) Using thermodynamic relations derive entropy equations. (TdS Equations) **07**
- OR**
- Q.4** (a) Define Hess law and write its applications. **03**  
 (b) Write down all four Maxwell's equations with usual notations. **04**  
 (c) Explain vapour compression refrigeration (VCR) system with help of block diagram,  $T-s$  and  $p-h$  chart. **07**
- Q.5** (a) Using thermodynamic relations prove that the internal energy of an ideal gas is a function of temperature only. **03**  
 (b) Explain any one approximate method for the estimation of the latent heat of vaporization. **04**  
 (c) Write short note on **07**  
     a. Standard heat of combustion and  
     b. Standard heat of formation..
- OR**
- Q.5** (a) Explain third law of thermodynamics. **03**  
 (b) Compare vapour compression refrigeration (VCR) and vapour absorption refrigeration (VAR) systems. **04**  
 (c) A refrigerating system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 35 °C and the lower temperature is – 15 °C. The capacity is to be 12 tonnes. Neglect all losses. Determine : **07**  
     a. Co-efficient of performance.  
     b. Heat rejected from the system per hour.  
     c. Power required.

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