

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III • EXAMINATION – WINTER 2013****Subject Code: 131404****Date: 30-11-2013****Subject Name: Food 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) State and explain zeroth law of thermodynamics. Also describe gas thermometer along with figure. **07**

(b) Explain the terms – thermal reservoir, sources and sink. What is meant by a heat engine and what are the characteristics? Also explain the index of performance of a heat engine. **07**

Q.2 (a) A constant volume chamber 0.3 m^3 capacity contains 2 kg of gas at 5°C . Heat is added to the gas until the temperature becomes 100°C . Determine (a) the work done (b) the heat transferred (c) change in internal energy and (d) change in entropy. Take $C_p = 1.967 \text{ kJ/kgK}$, $C_v = 1.507 \text{ kJ/kgK}$ **07**

(b) Define the following terms (Any seven). **07**
Specific heat, Enthalpy, Ideal gas, Nozzle, Dew point, COP, Heat pump, Relative humidity, Vapour pressure.

OR

(b) The pressure of steam in a condenser is 12 kN/m^2 and dryness fraction is 0.88. How many heat units must be abstracted from the steam in order to condense (a) 1kg (b) 1m^3 ? **07**

Q.3 a) Explain the following (Any four). **08**
i. Dryness fraction of steam
ii. Reversible and cyclic process
iii. Vacuum and absolute pressure
iv. Isolated and open system
v. Extensive and intensive properties

(b) Explain the first law of thermodynamics. Explain law of conservation of mass and energy. **06**

OR

Q.3 (a) A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C . What is the least rate of heat rejection per kW net output of the engine? **07**

(b) The e.m.f in a thermocouple with the test junction at $t^\circ\text{C}$ on gas thermometer scale and reference junction at ice point is given by: $\epsilon = 0.20t - 5 \times 10^{-4}t^2 \text{ mV}$. The milivoltmeter is calibrated at ice and steam points. What will this thermometer read in a place where gas thermometer reads 50°C ? **05**

(c) Explain requirement of thermodynamics in Food processing. **02**

- Q.4 (a)** Explain flow processes along with their application. **07**
- (b)** Discuss entropy. **03**
- (c)** Explain international temperature scale and ideal gas equation. **04**
- OR**
- Q.4 (a)** Show the following processes on psychrometric chart for moist air. **07**
- i. Sensible heating
 - ii. Humidification and heating
 - iii. Cooling and dehumidification
 - iv. Dehumidification
- For a certain location the following data are available for the atmospheric air:
 Temperature = 35°C
 Barometric pressure = 760 mm Hg
 Relative Humidity = 90%
 Using psychrometric chart determine
- i. Dew point temperature in $^{\circ}\text{C}$
 - ii. Wet bulb temperature in $^{\circ}\text{C}$
 - iii. Mass of moist air in kg/kg d.a.
- Q.4 (b)** Differentiate between dry bulb, wet bulb and adiabatic saturation temperature of moist air. **03**
- (c)** What is Gibb's phase rule? How to find thermodynamic degree of freedom using it? **04**
- Q.5 (a)** Explain the following with relevant examples. **07**
- i. Joule Kelvin effect
 - ii. Types of equilibria and conditions of stability
 - iii. Gibb's phase rule
- (b)** Explain heat pump and heat engine. **04**
- (c)** Explain dew point temperature and relative humidity in relation to moist air. **03**
- OR**
- Q.5 (a)** Explain second law of thermodynamics. What is Clausius statement? **07**
- (b)** State the carnot theorem. It is proposed to design a cold storage for maintaining certain vegetables under frozen conditions at -20°C . The ambient temperature in WINTER is 40°C and the estimated heat entry into the cold storage through various source is 5 kJ/s. Determine the minimum power required to operate a refrigerator for maintaining the cold storage. **07**
