FACULTY: ENGINEERING

FIRST SEMESTER EXAMINATIONS

2016/ 2017 ACADEMIC SESSION

HOD'S SIGNATURE

COURSE CODE: MEE 411

COURSE TITLE: APPLIED THERMODYNAMICS I – 2 UNITS

DURATION: 2 HOURS

INSTRUCTIONS

1. ATTEMPT ANY **THREE** QUESTIONS OF YOUR CHOICE
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM
3. YOU ARE NOT ALLOWED TO BORROW CALCULATORS AND ANY OTHER WRITING MATERIALS

ELIZADE UNIVERSITY

ILARA MOKIN

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE : **APPLIED THERMODYNAMICS**

DATE: **MARCH 2017**

TIME ALLOWED: **2 HOURS**

INSTRUCTION: **ANSWER ANY 3 QUESTIONS**

1. What are the applications of thermodynamics relations.

Starting from the first law of thermodynamics

$dQ_{rev} = du + pdv$ and the second law of thermodynamics $dQ_{rev} = Tds$, Show that Maxwell relation is valid

$$\left(\frac{\partial T}{\partial v}\right)_s = -\left(\frac{\partial P}{\partial s}\right)_v$$

$$\left(\frac{\partial T}{\partial P}\right)_s = \left(\frac{\partial v}{\partial s}\right)_p$$

$$\left(\frac{\partial P}{\partial T}\right)_v = \left(\frac{\partial s}{\partial v}\right)_T$$

$$\left(\frac{\partial v}{\partial P}\right)_p = -\left(\frac{\partial s}{\partial P}\right)_T$$

2. Define a pure substance.

State Dalton's law of partial pressures, Dalton – Gibbs law of internal energy, enthalpy and entropy and Amagat's law of partial volume.

A mixture of gases at a temperature of 150^0c has a pressure of 4 bar. A sample is analysed and the volumetric analysis is found to be CO_2 14%, O_2 5% N_2 81%. Determine the gravimetric analysis and partial pressures of the gasses in the mixture. Determine the moles in 2.3kg of the gasses.

3. A mixture of carbon monoxide and oxygen is to be prepared in the proportion of 7kg to 4kg in a vessel of $0.3m^3$ capacity. If the temperature of the mixture is 15°C, determine the pressure to which the vessel is subject. If the temperature is raised to 40°C, what will then be the pressure in the vessel?

4. (a) An induced draught cooling tower

(b) A natural draught cooling tower

(c) A small-size cooling tower is designed to cool 5.5 litres of water per second, the inlet temperature of which is 44°C. The motor-driven fan induces $9m^3/_s$ of air through the tower and the power absorbed is 4.75kw. The air entering the tower is at 18°C, and has A relative humidity of 60%. The air leaving the tower can be assumed to be saturated and its temperature is 26°C. Assuming that the pressure through out the tower is constant at 1.013bar, and make up water is added outside the tower.

Calculate the air mass flow rate

[Note $\varnothing = = Ps/Py$, Pg at 18°c = 0.02063 bar Pa, = P-Ps, m=PiV/RT]

5. Moist air enters a cooling coil at 30^0c and 50% relative humidity and exists at 15^0c and 80% relative humidity.

Determine the amount of heat and moisture removed per kg of dry air using the psychrometric chart.