THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

P.O. Box 62157

00200 Nairobi - KENYA

Telephone: 891601-6

MAIN EXAMINATION

SEPTEMBER – DECEMBER 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

PART-TIME PROGRAMME

PHY 203: THERMODYNAMICS II

Date: DECEMBER 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY other TWO Questions	

Q1. a) Define the following terms as used in thermodynamics

(i) Thermodynamic contact **(1 mark)**

(ii) Thermodynamic equilibrium **(1 mark)**

(iii) Thermodynamic process **(1 mark)**

(iv) Thermodynamic co-ordinates **(1 mark)**

(v) Thermodynamic system **(1 mark)**

(vi) Thermodynamic boundary **(1 mark)**

b) Write down the four thermodynamics potentials in differential form **(4 marks)**

c) (i) Define Gibb's free energy **(1 mark)**

(ii) Show that for a reversible isothermal and isobaric process,

$\Delta G = 0$ **(4 marks)**

d) State the following

(i) Zeroth law of thermodynamics **(1 mark)**

(ii) first law of thermodynamics **(1 mark)**

e) Show that it is true that for an isothermal process

(i) $\Delta U = 0$ **(3 marks)**

(ii) $\Delta Q = \Delta W$ **(3 marks)**

f) Calculate the molar specific heat capacities c_p and c_v of oxygen given that the ratio of molar heat capacities $\gamma = 1.4$ **(4 marks)**

g) Calculate the change in entropy of 5 kg of water when it is heated reversibly from 0º C to 100º C given that the specific heat capacity of water is 4200 J/kg **(3 marks)**

Q2. a) Derive the Maxwell's thermodynamics relations from the thermodynamic potentials **(12 marks)**

b) Derive the Claussius - Clapeyron equation **(8 marks)**

Q3. a) A liquid of mass m and specific heat capacity C_p at temperature T_1 is mixed with an equal amount of the same liquid at a temperature T_2. The system is thermally insulated. Find the total entropy and hence show that it is always positive **(10 marks)**

b) Show that for a Carnot cycle, the ratio of the heat supplied Q_H to the heat rejected Q_C is the ratio of their absolute temperature T_H and T_C respectively **(10 marks)**

Q4. a) Show that the equation of a reversible adiabatic is given by $TV^{\gamma-1}$ **(10 marks)**

b) A Carnot cycle operates between 200º C and 1200º C.
(i) calculate its efficiency **(4 marks)**

Calculate its coefficient of performance if it operates as a
(ii) refrigerator **(3 marks)**
(iii) heat pump **(3 marks)**

Q5. a) Given that U = U(P, T) and V = V(P, T), show that the specific heat capacity at constant pressure can be expressed as

$$C_P = \left(\frac{\partial H}{\partial T}\right)_P$$ **(10 marks)**

b) Using Maxwell's first relation and any other appropriate relations and functions derive, the first
(i) energy relation **(5 marks)**
(ii) Tds equation **(5 marks)**

END