THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT MECHANICAL & AUTOMOTIVE ENGINEERING

INSTITUTIONAL BASED PROGRAMME

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) YEAR III

EME 4304: THERMODYNAMICS I

SEMESTER I EXAMS

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES
You should have the following for this examination:-
-   *Answer booklet*
-   *Drawing instruments*
-   *Scientific Calculator*
This paper consists of FIVE questions
Answer THREE questions
All questions carry equal marks.
Maximum marks for each part of a question are as shown.

Question One

a) i)   Explain the concept of availability
    ii) Define availability function.   (5 marks)

b) Show that Unavailable Energy of cyclic heat engine is given by

$$U.E = T_0 \Delta S$$

Where $U.E$ is unavailable energy

T_0 is the lowest temperature of rejection

ΔS is change in Entropy   (7 marks)

c) 500 KJ of heat is removed from a constant temperature heat reservoir maintained at 835 K. The heat is received by a system at constant temperature of 720 K. The temperature of the surrounding, the lowest available temperature, is 280 K Show on a T-S diagram and calculate the net loss of available energy as a result of this irreversible heat transfer   (8marks)

Question Two

a) Define the following terms
    i.   Partial pressure
    ii.   Relative Molecular weight   (3 marks)

b) Explain Gibbs-Dalton Law   (5 marks)

c) A mixture of ideal gases consist of 4 kg Nitrogen and 6 kg of carbon dioxide at a pressure of 4 bar and temperature of $20°C$.Calculate.
    i.   The mole fraction of each constituent.
    ii.   The equivalent molecular weight of the mixture.
    iii. The equivalent gas constant of the mixture.
    iv.   The Partial pressures and partial volumes..
    v.   The volume and density of the mixture.
                                                                    (12 marks)

Question Three

a) Consider a Carnot cycle in which the working fluid is vapor
    i.   Draw a schematic representation of the cycle showing all the main component, and direction of the fluid flow
    ii.   On a T-S diagram for the cycle, show the processes clearly labeled
    iii. Using steady flow energy equation describe the processes
    iv.   Show the efficiency of the cycle.   (14 marks)

b) In a steam turbine steam at 20 bar,$360°C$ is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes Calculate per Kilogram of steam the net work and the cycle efficiency   (6 marks)

Question Four

a) Define the flowing terms
    i.   Relative humidity
    ii.   Dry air
    iii. Specific humidity
    iv.   Dew point temperature   (4 marks)

b) Explain the working and construction of a sling psychrometer.   (8 marks)

c) A Tank contains 10 kg of dry air and 0.1 kg of water vapour at 30°C and total pressure of 100kPa.Calculate the following
    i.   Specific humidity
    ii.   Relative humidity
    iii.   The volume of the tank.   (8 marks)

Question Five

a) i) Describe Rankine cycle using appropriate diagrams.
     ii) Derive the Rankine efficiency   (12 marks)

b) State limitations of Carnot cycle as practical cycle.   (8 marks)