TECHNICAL UNIVERSITY OF MOMBASA

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

SECOND YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE IN BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (BSME)

EMG 2206
THERMODYNAMICS I

END OF SEMESTER EXAMINATIONS

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES

1. You should have the following for this examination:-
   - Answer Booklet
   - Scientific Calculator
   - Drawing Instruments
   - Thermodynamic Table

2. This paper consists of **FIVE** questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. This paper consists of **FOUR** printed pages.

Question ONE

(a) State zeroth law of thermodynamics. **(2 marks)**

(b) Explain the following terms:

(i) Heterogeneous system
(ii) Cycle
(iii) Process
(iv) State

(4 marks)

(c) U-tube mercury manometer with an arm exposed to atmosphere is used to measure pressure in a steam pipe. The level of mercury in open arm is 97.5mm greater than that

in the arm connected to the pipe. Some of the steam in the pipe condenses in the manometer arm connected to the pipe. The height of this column is 34mm. The atmospheric pressure is 760mm of Hg. Find the absolute pressure of the steam.

(6 marks)

(d) A vessel of capacity $3m^3$ contains 1kg mole of $N_2(28)$ at 90^oC use R = 8314)

(i) Calculate the pressure and specific volume of the gas.
(ii) If the ratio of specific heat is 1.4 evaluate the value of cp and cv.

(8 marks)

Question TWO

(a) With aid of a diagram show the component of steam plant and explain their functions.

(6 marks)

(b) Using both PV and T-S diagrams describe cycle and each process. **(8 marks)**

(c) A heat engine working in carnot cycle converts one-fifth $\left(\frac{1}{5}\right)$ of the heat input in to work when the sink temperature is reduced by 70^oC, the heat engine efficiency gets doubled. Determine the temperature of the source. **(6 marks)**

Question THREE

(a) Define the following terms:

(i) Enthalpy
(ii) Internal Energy
(iii) Heat
(iv) Entropy

(6 marks)

(b) State the Kelvin-planks statement of second-law of thermodynamics. **(2 marks)**

(c) Explain the following terms:

(i) Open system
(ii) closed system

(4 marks)

(d) The relationship between t and property 'k' on a thermodynamic scale is given by:
$t = a \ln k + b$

The values of k are found to be 1.83 and 6.5 at the ice and steam points respectively. Calculate the temperature, when k reads 2.42 on the thermometer. Take temperature as 0^oC and 100^oC at ice and steam points respectively.

(2 marks)

(e) Describe a reversible process and state three of its properties. **(5 marks)**

Question FOUR

(a) Explain the following terms and give two examples of each:

(i) Intensive properties
(ii) Extensive properties
(iii) Path functions
(iv) Heat sink

(8 marks)

(b) Derive an expression for work done when a gas expands from an initial volume of V_1 to a final volume V_2. The pressure varies with volume according to the function:

$PV^n = C$

Where:

P = Pressure
V = Volume
n and c = Constants

(6 marks)

(c) A certain volume of gas contained behind a piston is expanded reversibly. If the initial pressure and volume are 1 x $10^6 N/m^2$ and $0.05m^3$ respectively, and the final volume is $0.06m^3$, determine the work done given that the expansion follows the law, PV^3 = constant. **(6 marks)**

Question FIVE

(a) State the necessary conditions for steady flow process. **(5 marks)**

(b) Derive the steady flow equation and state the assumptions. **(6 marks)**

(c) The velocity and enthalpy of fluid at the inlet of a certain nozzle are 50m/s and 2800kJ/kg respectively. The enthalpy at the exit nozzle is 26000kJ/kg. The nozzle is horizontal and insulated so that no heat transfer takes place from it. Calculate:

(i) The velocity of the fluid at the exist of the nozzle.

(ii) Mass flow rate if the nozzle is $0.09m^2$ at a specific volume of $0.185m^3/kg$

(iii) Exist area of the nozzle, if the specific volume at the exit of the nozzle is $0.495m^3/kg$.

(9 marks)