TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2206: THERMODYNAMICS I

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MARCH 2014

TIME: 2 HOURS

INSTRUCTIONS:

- You should have the following for this examination:
  i) Scientific calculator
  ii) Answer booklet
  iii) Thermodynamics table
- This paper consists of **FIVE** questions.
- Answer any **THREE** questions.

This paper consists of Three printed pages

QUESTION 1 (Compulsory)

a) Define the following thermodynamics properties:
   i) Intensive property
   ii) Extensive property **(4 marks)**

b) Explain the following terms giving an example for each:
   i) Heat sink
   ii) Heat source **(3 marks)**

c) Derive the heat efficiency of a heat engine. **(5 marks)**

d) A heat engine working on a carrot cycle converts a quarter (¼) of the heat input into work when the sink temperature is reduced by 80^0C, the heat engine efficiency gets doubled. Calculate the temperature of the source and the sink. **(8 marks)**

QUESTION 2

a) State the properties of steam which makes it a preferred working fluid. **(3 marks)**

b) Explain the following terms:
   i) Wet steam
   ii) Dry saturated steam
   iii) Superheated steam **(3 marks)**

c) Define dryness fraction of steam. **(2 marks)**

d) Stat the advantages of superheated steam.

e) Calculate the quantity of heat required to produce 1kg of steam at a pressure of 6 bar at a temperature of 25^0C, under the following conditions
(steam table at 6 bar $G_f = 670.4kJ/Kg$.
$G_{fg} = 2085kJ/Kg \qquad t = 158.8^0 C$)
   i) When the steam is wet having dryness fraction of 0.9
   ii) When the steam is dry saturated
   iii) When it is superheated at a constant temperature of 2500C assuming the mean specific heat of superheated steam to be 2.3kJ/Kgk. **(8 marks)**

QUESTION 3

a) State Charles Law and Boyles law. **(4 marks)**

b) Explain the following terms:
   i) Mole fraction
   ii) Volume fraction
   iii) Mass fraction **(3 marks)**

c) Show that $Q - Cv = R$ **(5 marks)**

d) $0.1m^3$ of gas is at a pressure of $260kN/m^2$ and 180^0C. During a constant pressure process, its temperature decreases to 20^0C. Calculate heat transfer from the gas and work done on the gas during the process. Take $R = 0.29kJ/Kgk.$
$Q = 1.00kJ/Kgk$

(8 marks)

QUESTION 4

a) Define the concept of heat pump and derive the co-efficient of performance (CO). **(4 marks)**

b) State second laws of thermodynamics according to Kelvin-plancs statement. **(4 marks)**

c) Define perpetual motion machine. **(3 marks)**

d) Derive thermal efficiency of a heat engine. **(5 marks)**

e) A heat engine in a cycle delivering work equal to 26 x 103 and absorbs heat of 92kJ. Determine the engine and heat transfer from the working fluid. **(4 marks)**

QUESTION 5

a) Explain the following:
   i) Heat
   ii) Internal energy
   iii) Enthalpy **(6 marks)**

b) Derive the steady flow equation and state the assumptions. **(8 marks)**

c) In an air compressor air flows steady at rates of 0.5kg/s through an air compressor. It enters at 6m/s with a pressure of 1 bar and a specific volume $0.85m^3/kgs$ and leaves at 5m/s with a pressure of 7 bars and specific volume of $0.16m^3/kg$.

   Calculate the inlet and outlet pipe cross sectioned area. **(6 marks)**