TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

UNIVERSITY EXAMINATION FOR:

THE DEGREE IN BACHELOR OF TECHNOLOGY IN ELECTRICAL ENGINEERING

TMC 4256 : THERMODYNAMICS

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2017

TIME: 2 HOURS

DATE: Pick Date Aug 2017

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of Choose No questions. Attempt Choose instruction.

Do not write on the question paper.

Question One

a) What is an Ideal gas (2 marks)

b) State and explain the following

i. Charle's Law

ii. Boyle's Law

iii. Avogadro's Law (6 marks)

c) A gas occupies a volume of 0.1m^3 at a temperature of 20^{0}C and a pressure of 1.5 bar. Find the final temperature of the gas, if is compressed to a pressure of 7.5 bar and occupies a volume of 0.04 m^3. (4 marks)

d) A quantity of gas has a pressure of 350 KN/m^2 when its volume is 0.03m3 and its temperature is 35Oc.If the value of R=0.29 KJ/kg K.

i. Calculate the mass of the gas .

ii. If the gas pressure is increased to 1.05 MN/m^2 while the volume remains constant , Calculate new temperature. (8 marks)

Question Two

a. State first law of thermodynamics. (2 marks)

b. Derive the equation for working the following cases
   i. Constant Volume process.
   ii. Constant Pressure (6 marks)

c. A certain gas occupies a space of $0.3m^3$ at a pressure of 2 bar and a temperature of 77^0C. It is heated at a constant volume, until the pressure is 7 bar. Determine:
   i. Temperature at the end of the process
   ii. Mass of the gas
   iii. Change in internal energy (6 marks)

   Assume c_p = 1.005 kJ/kg K c_V = 0.712 kJ/kg K and R = 287 J/kg K

d. 0.015 m^3 gas at constant pressure of 2060Kn/m2 expands to a pressure of 210 KN/m^2 by following the law $PV^{1.35} = C$. Determine the work done by the gas during expansion process.

(6 marks)

Question Three

a) Define the following terms
   i. Heat Pump
   ii. Heat engine
   iii. Thermal reservoir. (6 marks)

b) State Kelvin-Planck and Clausius statements of second Law of thermodynamics (4 marks)

c) A cyclic heat engine operates between a source temperature of 800^o C and a sink temperature of 30^o C .find the least rate of heat rejection per kW net output of the engine? (5 marks)

d) A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Determine :
   i. The thermal efficiency

ii. The rate of heat rejection (5 marks)

Question Four

a) Define the following terms
   i. Sensible heat of water
   ii. Superheated steam
   iii. Total heat of steam (4 marks)

b) Describe the process of formation steam and give it's graphical representation also. (8 marks)

c) Calculate the quantity of heat required to produce 1 kg of steam at a pressure of 6 bar at a temperature of 25°C, under the following conditions:
   i. When the steam is wet having a dryness fraction of 0.9
   ii. When the steam us dry saturated.
   iii. When it is superheated at a constant pressure at 250°C .Assuming the mean specific heat of superheated steam is 2.3.kJ/kg K. (8 marks)
   [use: from steam tables ,for 6 bar h_f=670.4kJ/kg,h_{fg}=2085 kj/kg,t=158.8° K]

Question Five

a) State eight advantages of each case below
   i. liquid fuels over sold fuels.
   ii. Gaseous fuels over liquid fuels (8 marks)

b) State the assumptions made in the analysis of steady flow energy equation. (5 marks)

c) At the inlet to a certain nozzle the enthalpy of fluid passing is 2800kJ/kg and the velocity is 50 m/s. At the discharge end the enthalpy is 2600 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.
   i. Find the velocity at the exit of the nozzle.
   ii. If the inlet area is 900 cm^2 and the specific volume at inlet is 0.187m^3/kg. Find the mass flow rate.
   iii. If the specific volume at the nozzle exit is 0.498 m^3/kg. Find the area of the nozzle. (7marks)