TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Electrical & Electronic Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Electrical & electronic Engineering
EME 2315 : Engineering Thermodynamics
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Pick Date **Sep 2018**

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

a) Explain the following terms

   i. Isolated System

   ii. Homogeneous system **(2 marks)**

b) Describe a reversible process and state conditions it should fulfill **(5 marks)**

c) Prove that the work done in a polytropic process is given by the following expression

$$Work\ done = \frac{P_1V_1 - P_2V_2}{n-1}$$

Where P=pressure at state 1 and 2 respectively

. V = volume at state 1 and 2 respectively

n= index of expansion/compression **(5 marks)**

d) A certain quantity of air has a volume 0.028m3 at a pressure of 1.25 bar and 25^{o}C.It is compressed to a volume of 0.0042m^3 according to the law $pv^{1.3}$ = Constant. Find the final temperature and work done during compression. **(8 marks)**

Question TWO

a) Explain the following

i. Heat

i. Internal Energy

ii. Enthalpy **(6 marks)**

b) Derive the steady flow energy equation and state the assumptions **(9 marks)**

c) A gas expands through an ideally ,insulated nozzle following a reversible polytropic law

$$pv^{1.2} = C$$

There is no change in potential energy but the pressure drops from 20 bars to 2 bar and specific volume increases from 0.05 m^3 to 0.3 m^3.If the entrance velocity is 80m/s calculate the exit velocity

(5 marks)

Question THREE

a) Explain the three methods of heat transfer. **(3 marks)**

b) Explain the following terms

i. Heat exchanger

ii. Black body **(4 marks)**

c) Describe a direct contact exchangers and give examples **(6 marks)**

d) A Furnace wall is made up of refractory bricks of 300mm thick. The inner and outer surfaces of wall have temperature of 1000^{o}C and 150^{o}C.Find the heat loss per meter square per hour. If the outside temperature becomes 50^{o}C, the furnace wall is covered with an insulation bricks of 200 mm thickness. Find the reduction in heat loss. Take thermal conductivities of refractory and insulating bricks as 4.5 and 0.5 W/m K

(7 marks)

Question FOUR

a) Explain how the following forms of steam are produced

i. Wet steam

ii. Dry saturated steam.

iii. Superheated steam

(6 marks)

b) Describe the various operations of Rankine cycle and derive the expression of its efficiency.

(8 marks)

c) Calculate the quantity of heat required to produce 1 kg of steam at a pressure of 6 bars at a temperature of 25^{o}C,under the following conditions

i. When the steam is wet having a dryness fraction 0.9

ii. When the steam is dry saturated

iii. When it is superheated at a constant pressure at 250^{o}C assuming the mean specific heat capacity of superheated steam to be 2.3 kJ/kg K.

(6 marks)

Question FIVE

a) State Zeroth law of thermodynamics **(2 marks)**

b) Explaining the following terms

i. State

ii. Process

iii. Cycle

iv. Heterogeneous system

(4 marks)

c) The relation between 't' and property 'K' on a thermometric 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 point and steam point .Calculate the temperature, when K reads 2.42 on the thermometer. Take temperature as 0^oC and 100^oC at ice and steam point respectively.

(3 marks)

d) A U-tube mercury manometer with one arm to atmosphere is used to measure pressure in a steam pipe. The level of mercury in open arm is 97.5 mm 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

(5 marks)

e) An ideal gas occupies a volume of 0.5 m^3 at a temperature of 340K and a given pressure. The gas undergoes a constant pressure process until the temperature decreases to 290 K. Calculate

i. The final volume

ii. The work if the pressure is 120 KPa

(6 marks)