30

(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF
B.SC RENEWABLE ENERGY AND BIOFUELS TECHNOLOGY

COURSE CODE: RET 272

COURSE TITLE: THERMODYNAMICS I

DURATION: 2 HOURS

DATE: 20-4-2022 **TIME: 12.00-14.00 HRS**

INSTRUCTIONS TO CANDIDATES

(i) Answer **Question 1 (Compulsory)** and any other **TWO** questions
(ii) All symbols have their usual meaning
(iii) Use steam tables provided

This paper consists of **3** printed pages. Please Turn Over

QUESTION ONE (Compulsory) – 30 Marks

a) State the Non-Flow Energy Equation.

(4 Marks)

b) Steam at 110 bar has a specific volume of 0.0196 m^3/kg. Find the following properties:

i) Temperature.

(3 Marks)

ii) Internal energy.

(3 Marks)

c) Given steam at 0.5MPa with an enthalpy of 2.4MJ/kg, determine the:

(i) Dryness fraction.

(5 Marks)

(ii) Specific volume.

(2 Marks)

(iii) Internal energy.

(2 Marks)

d) Show that for a perfect gas the following specific heats can be expressed as shown below:

(i) $C_v = \frac{R}{\gamma - 1}$

(4 Marks)

(ii) $C_p = \frac{\gamma R}{\gamma - 1}$

(3 Marks)

(e) Give two conditions for a thermodynamic equilibrium.

(4 Marks)

QUESTION TWO (20 Marks)

a) Show that for a working fluid undergoing an adiabatic process, the work done can be expressed as:

$$W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$$

(7 Marks)

b) Air at 1bar and 20^0C initially occupying a cylinder volume of $0.016m^3$ is compressed reversibly and adiabatically by a piston to a pressure of 7 bar.
Calculate the:

i) Mass of air. **(2 Marks)**

ii) Final temperature. **(3 Marks)**

iii) Final specific volume. **(6 Marks)**

iv) Net work done. **(2 Marks)**

QUESTION THREE (20 Marks)

Steam at 70 bar, 300^0C is contained in a rigid cylinder of volume $0.02m^3$. The cylinder is cooled until the pressure is 40 bar.

a) Determine the state of steam after cooling

(6 Marks)

b) Calculate the amount of heat rejected by steam

(9 Marks)

c) Show the process on a t-s diagram indicating the area which represents heat flow

(5 Marks)

QUESTION FOUR (20 Marks)

Dry saturated steam at a pressure of 95 bar is expanded isothermally to a pressure of 8 bar. Calculate the:

a) Heat supplied

(10 Marks)

b) Work done

(6 Marks)

c) Show the process on a t-s diagram

(4 Marks)