KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
MAIN EXAMINATIONS

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

COURSE CODE: REN 221

COURSE TITLE: THERMODYNAMICS I

DURATION: 2 HOURS

DATE: 4/10/2021 **TIME: 2:00-4:00PM**

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