KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN PHYSICS

COURSE CODE: SPM423

COURSE TITLE: THERMODYNAMICS AND SELECTION OF MATERIALS

DURATION: 2 HOURS

DATE: 31/8/2022 **TIME: 2:00 – 5:00 PM**

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

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

QUESTION ONE (30 MARKS)

a) What is Energy? (1 Mark)

b) A slab of a thermal insulator is $100cm^2$ in cross- section and 2cm thick. If it has a thermal conductivity of 0.1 $J.s^{-1}\ m^{-1}\ (C^0)^{-1}$, and a temperature difference of 100^0C between opposite faces; calculate the heat flow through the slab in a day. (4 Marks)

c) Derive a formular for the work done by any gas (ideal or not) which expands isobarically? (4 Marks)

d) What do you understand by the term dissociation Pressure? (1 Mark)

e) Define the term diffusion in materials (1 Mark)

f) What is the main difference between forced convection and free convection (2 Mark)

g) What is Sintering? (1 Mark)

h) What is corrosion? (1 Mark)

i) Give a detailed account of the electrochemical theory of wet corrosion (5 Marks)

j) What is a Pourbaix diagram? What are its uses? (5 Marks)

k) What do you understand by the term material selection (2 Marks)

l) Derive a formular for the work done by a gas when it expands isothermally (3 Marks)

QUESTION TWO (20 MARKS)

a) What is Thermodynamics? (1 mark)

b) Differentiate between extensive and intensive state variables (2 marks)

c) Write short notes on the following: Internal Energy (U), Enthalpy (H), Helmholtz free Energy (F), Gibbs Free Energy (G) and Chemical Potential (17 marks).

QUESTION THREE (20 MARKS)

a) What do you understand by the term Gibbs free energy? Explain the physical meaning when its value is either negative or positive (3 Marks)

b) What is an Ellingham diagram? What is it use in studying properties of materials (4 Marks)

c) Discuss the processes involved in the thermal degradation of organic matter at atmospheric pressure (13 Marks)

QUESTION FOUR (20 MARKS)

a) What are the major highlights of the following types of diffusion
   i. Steady-state diffusion (5 Marks)
   ii. Non-steady-state diffusion (5 Marks)

b) Explain the various factors that influence diffusion in materials (10 Marks)

QUESTION FIVE (20 MARKS)

a) Write short notes on: i) Reaction sintering ii) Solid Phase sintering (10 Marks)
b) Discus at least ten major harmful effects of corrosion? (10 Marks)