



# KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS  
2020/2021 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER  
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN PHYSICS

**COURSE CODE:** SPH425

**COURSE TITLE:** THERMODYNAMICS AND SELECTION OF  
MATERIALS

**DURATION:** 2 HOURS

**DATE:** 13/10/2021

**TIME:** 2:00-4:00PM

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**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



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**QUESTION ONE (30 MARKS)**

- a) What is Energy? (1 Mark)
- b) A slab of a thermal insulator is  $100\text{cm}^2$  in cross-section and 2cm thick. If it has a thermal conductivity of  $0.1 \text{ J.s}^{-1} \text{ m}^{-1} (\text{C}^0)^{-1}$ , and a temperature difference of  $100^0\text{C}$  between opposite faces; calculate the heat flow through the slab in a day. (4 Marks)
- c) Derive a formula 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 formula 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 its 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) Discuss at least ten major harmful effects of corrosion? (10 Marks)