KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

FOURT YEAR YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: **SCH 420**

COURSE TITLE: **SCIENTIFIC INSTRUMENTATION**

DURATION: 2 HOURS

DATE: 03/10/2018 TIME: 11:30-1:30 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

KIBU observes ZERO tolerance to examination cheating

Question one (30 marks)

a) The basis of instrumentation is that there are energy interactions and reactions happening in a **'transducer'** instrument. Define a transducer. Give an example. **(2mks)**

b) Any chemical analysis has to be subjected to statistical techniques to determine the extent of accuracy. Explain the meaning of the following terms in statistical analysis;
   i. Mean
   ii. Deviation
   iii. Precision **(6mks)**

c) Sources of error during analysis can be broadly classified as being ***instrumental*** and **human**. By giving examples, **differentiate** between instrumental errors and human errors. **(4mks)**

d) Digital (electronic) measurements presents measured analytical signal much better than analog (Mechanical) measurements. Discuss **FOUR** disadvantages of analog instruments and **FOUR** advantages of digital instruments. **(8mks)**

e) Semi-conductors are the most commonly used signal readers in instrumentation.
   i. Differentiate between intrinsic and extrinsic semi-conductors. **(2mks)**
   ii. Differentiate between **P-type** and **N-type** semiconductors. **(2mks)**
   iii. What is **doping** of a semi-conductor and why is it important? **(2mks)**
   iv. State any **FOUR** applications of extrinsic semi-conductors. **(4mks)**

Question two (20 marks)

a) Mossbauer spectroscopy is also called Nuclear gamma resonance spectroscopy. Explain the principle behind this spectroscopic technique. **(2mks)**

b) State any four elements that are analysed by Mossbauer spectroscopy (Mossbauer nuclides). **(2mks)**

c) What is recoil effect? **(1mks)**

d) Draw a schematic diagram to show the parts of instrumentation of Mossbauer spectroscopy. **(4mks)**

e) Explain nthe meaning of the following terms as used in Mossbauer spectroscopy
   i. Isomer shift
   ii. Nuclear quadrupole splitting
   iii. Magnetic (Hyperfine) splitting. **(6mks)**

f) Give three advantanges of Mossbauer spectroscopy over other spectroscopic methods. **(3mks)**

g) To record Mossbauer spectrum of iron containing samples, an element X is used such that after transformation Y it gives gamma radiation used in Mossbauer spectroscopy of iron. Identify element X and transformation Y respectively. **(2mks)**

Question three (20 marks)

a) What is an electron microscope? **(1mks)**
b) Explain the major advantage(s) of an electron microscope over a light microscope. **(2mks)**
c) Using a schematic diagram, draw the parts of an electron microscope and explain how it works. **(4mks)**
d) Materials to be viewed under an electron microscope may require processing to produce a suitable sample. The technique required varies depending on the specimen and the analysis required: Explain the following sample preparation techniques as used in electron microscopy; **(8mks)**
   i. Chemical fixation
   ii. Cryofixation
   iii. Dehydration
   iv. Staining
e) Discuss any three applications of electron microscopes. **(3mks)**
f) Discuss the main disadvantages of electron microscopes. **(2mks)**

Question four (20 marks)

a) What are biosensors? **(1mks)**
b) State three major components of a biosensor system. **(3mks)**
c) State and explain the working of **FOUR** different types of Biosensors. **(8mks)**
d) Biosensors have been applied in many fields. Discuss their application in
   i. Food industry **(3mks)**
   ii. Medical field **(3mks)**
   iii. Marine sector. **(2mks)**