



# Technical University of Mombasa

Faculty of Applied and Health Sciences

**DEPARTMENT OF PURE AND APPLIED SCIENCES**  
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF  
TECHNOLOGY IN APPLIED CHEMISTRY  
**BTAC13S / BTAC12S**

## **ACH 4202 : ANALYTICAL INSTRUMENTATION I**

SEMESTER EXAMINATION

DECEMBER 2013 SERIES

2 HOURS

Instructions to candidates:

This paper consist of **FIVE** questions

Answer question **ONE** (compulsory) and any other **TWO** questions

### **QUESTION ONE**

a) Define and give the mathematical equation of the following terms as used in analytical chemistry

(i) Sensitivity

(ii) Detection limit

(iii) Limit of quantitation

**(6 marks)**

b) State the importance of monochromator in a spectrometer

**(2 marks)**

c) A certain research lab deals with trace analysis of metals using Atomic Absorption spectrometer found that most signals were too tiny and with so much background noise. As an analytical chemist, which signal conditioning operations would you advice them to apply to improve their output signals

**(4 marks)**

d) Name the type or types of noise that can be reduced by

(i) Decreasing the temperature of the measurement

**(1 mark)**

- (ii) Decreasing the frequency used for the measurement **(1 mark)**
- (iii) Decreasing the bound width of the measurement **(1 mark)**

e) The response of a volumetric test of grease was checked with aid of standard glucose solutions. Determine the correlation coefficient from the following data and comment on the results

Glucose concentration, mM	0	2	4	6	8	10
Absorbance	0.002	0.150	0.294	0.434	0.570	0.704

- f) Sketch a block diagram of the basic components of an instrument and state the work of each component. **(4 marks)**
- g) List any THREE factors that affect photometric accuracy **(3 marks)**

## QUESTION TWO

- a) Define the term Fourier analysis **(1 mark)**
- b) Draw Fourier transforms for a square wave signal and random noise **(4 marks)**
- c) In which instrument is Fourier analyses mostly applied state at least three advantages of such an instrument over an ordinary instrument **(3 marks)**
- d) Discuss three types of noise that are frequency dependent and explain how they are reduced **(12 marks)**

## QUESTION THREE

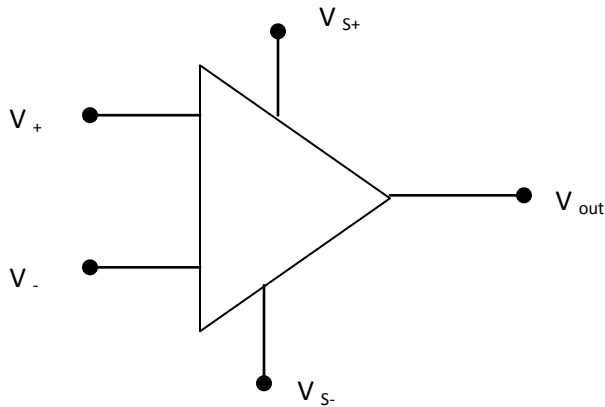
- a) Differentiate between spectroscopy and spectrometry **(2 marks)**
- b) State the Beer-Lambert's law. **(2 marks)**
- c) Using equations describe how stray light affects Beer-Lambert's Law **(4 marks)**
- d) Draw a UV spectrometer and explain its working principle **(12 marks)**

## QUESTION FOUR

- a) Define the term signal to noise ratio. **(2 marks)**
- b) State the TWO methods of achieving signal enhancement **(2 marks)**
- c) Give the advantages and disadvantages of automation in instrumentation. **(4 marks)**
- d) Using schematic diagrams, explain how Low-pass RC filters, High-Pass RC and LC filters help in noise reduction **(12 marks)**

## QUESTION FIVE

- a) (i) Give the name of the component below and also state the name of terminal  $V_-$  and  $V_+$



**(3 marks)**

- (ii) List FOUR major characteristics the component in (i) above **(4 marks)**
- (iii) Describe how the component in (i) above functions as a signal inverter **(2 marks)**

b) Define the term calibration **(1 mark)**

c) Briefly explain how each of the following calibration method is carried out

- (i) Direct calibration **(2 marks)**
- (ii) Internal standard calibration **(4 marks)**
- (iii) Standard addition calibration **(4 marks)**