



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

APPLIED ANALYTICAL CHEMISTRY

ACH 4202 : ANALYTICAL INSTRUMENTATION I PAPER TWO

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: SEPTEMBER 2018

TIME: 2HOURS

DATE: Pick Date Sep 2018

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

- a) Briefly explain the meaning and the importance of the following terms:
- i. Signal (2 marks)
 - ii. Noise (2 marks)
 - iii. Sensitivity (2 marks)
 - iv. Accuracy (2 marks)
 - v. Dynamic range (2 marks)
 - vi. Linearity range (2 marks)
- b) Describe how to construct a calibration curve (5 marks)
- c) Explain the purpose of a calibration curve (3 marks)
- d) Discuss what is meant by the limit of detection within the context of random noise arising from the instrument being used (4 marks)

- e) Using a diagram describe the difference between an analog signal and digital signal (6 marks)

Question TWO

- a) In a particular FTIR analysis a set of 16 interferograms were collected. The signal-to-noise ratio associated with a particular spectral peak was approximately 5/1. How many interferograms would have to be collected and averaged if the goal is to obtain a $S/N = 50/1$? (6 marks)
- b) The following data were obtained for a voltage measurement, in mV, on a noisy system: 1.37, 1.84, 1.35, 1.47, 1.10, 1.73, 1.54, 1.08.
- Assuming the noise is random, what is the signal-to-noise ratio? (4 marks)
 - How many measurements would have to be averaged to increase the S/N to 10? (4 marks)
- c) List and discuss sources of noise in instrumental methods of analysis (6 marks)

Question THREE

- a) Propose and explain ways by which sensitivity in instrumental methods of analysis can be enhanced (5 marks)
- b) Using examples where appropriate explain how to determine;
- LOQ (5 marks)
 - LOD (5 marks)
- c) List and discuss ways by which noise can be reduced using hardware methods (5 marks)

Question FOUR

- a)
- Write short notes on operational amplifiers (2 marks)
 - Describe the working principle of operational amplifiers (3 marks)
 - List three applications of operational amplifiers (3 marks)
- b) List and explain the main components in a basic data acquisition system (10 marks)
- c) Describe the two methods of sample analysis by flow injection technique (2 marks)

Question FIVE

- a) A 10 k Ω resistor is used as a current-to-voltage converter. The voltage across it is amplified by an amplifier with a bandwidth of 15 kHz. What is the rms noise voltage at 20 °C? at liquid nitrogen temperature (77 K)? at liquid helium temperature (4.2 K)? (8 marks)
- b) Using a block diagram show the basic components of flow injection analysis technique (4 marks)
- c) Using an example explain and illustrate how sample can be analysed using flow injection technique (8 marks)