TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

ACH 4202 : ANALYTICAL INSTRUMENTATION 1

END OF SEMESTER EXAMINATION

SERIES: JULY 2021

TIME: 2 HOURS

DATE: 23 Jul 2021

Instructions to Candidates
You should have the following for this examination
   -Answer Booklet, examination pass and student ID
This paper consists of **FIVE** questions. Answer question ONE (Compulsory) and any other TWO questions.
**Do not write on the question paper.**

Question ONE

(a) Highlight instrumental methods used for separation of complex mixtures, indicating the corresponding classical methods that they are replacing. **(4 marks)**

(b) Briefly describe the role of the following components in instrumental analysis,

   (i) Energy source **(2 marks)**

   (ii) Transducer. **(2 marks)**

(c) Provide any TWO domains for each of the following,

   (i) Electrical Domains **(2 marks)**

   (ii) Non-electrical Domains. **(2 marks)**

(d) Highlight the qualitative performance criteria that may influence the selection of a suitable instrumental method. **(4 marks)**

(e) Provide brief definitions of the following performance criteria,

   (i) Precision **(1 mark)**

(ii) Bias **(1 mark)**

(iii) Sensitivity **(1 mark)**

(iv) Selectivity. **(1 mark)**

(f) Identify sources of the following types of noise in instrumental analysis,

(i) Chemical noise **(2 marks)**

(ii) Instrumental noise. **(2 marks)**

(g) Briefly describe the characteristics of an ideal op amp with a circuit diagram. **(6 marks)**

Question TWO

(a) Using the figure below, briefly describe the flow of information, indicating the interdomain conversions, in the fluorescence measurement of quinine in tonic water.
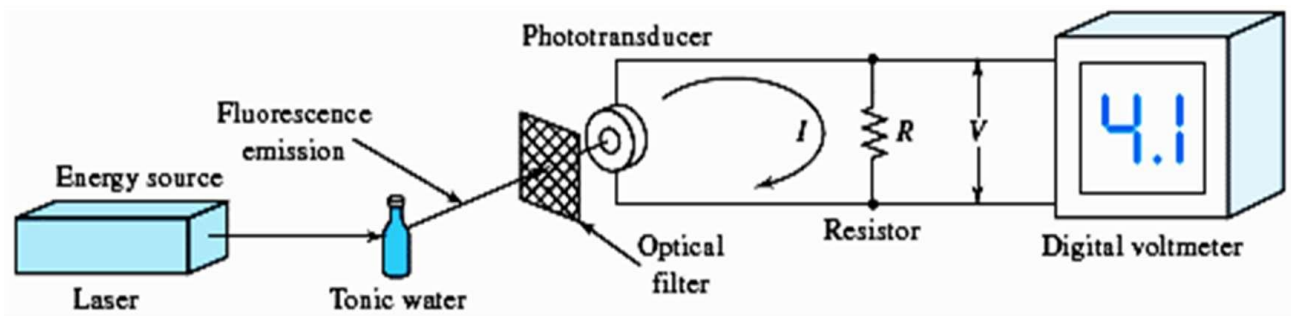
(10 marks)

(b) Briefly explain the following methods used in the enhancement of signal-to-noise ratio,

(i) Ensemble averaging **(3 marks)**

(ii) Fourier transformation. **(3 marks)**

(c) Briefly describe any TWO measures of dispersion of data. **(4 marks)**

Question THREE

(a) Highlight the following types of instrumental noise,

(i) Shot noise **(4 marks)**

(ii) Flicker noise. **(4 marks)**

(b) Briefly describe the following techniques for noise reduction,

(i) Grounding and shielding **(6 marks)**

(ii) An op amp difference amplifier. **(6 marks)**

Question FOUR

(a) (i) Highlight the external standard method for instrument calibration **(6 marks)**

(ii) Identify any TWO/THREE factors that can compromise effective application of the external standard method. **(4 marks)**

(b) Explain the following terms,

    (i) Loading error in voltage measurement **(4 marks)**

    (ii) An op amp voltage follower. **(6 marks)**

Question FIVE

(a) (i) State Nyquist theorem on sampling an analog signal **(2 marks)**

    (ii) State the Valvano postulate on sampling an analog signal **(2 marks)**

    (iii) Briefly explain the term aliasing. **(2 marks)**

(b) Highlight the advantages of sequential injection analysers (SIA) compared to traditional flow injection analysers (FIA). **(10 marks)**

(c) Separation processes in FIA usually do not go to completion. Explain how precision and accuracy is ensured in FIA. **(4 marks)**