

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2015/2016**

**THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE**

**DEGREE OF BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY**

**SCH 2350: INTRODUCTION TO INSTRUMENTAL METHODS**

**DATE: DECEMBER 2015 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE (30 MARKS)**

1. i) Give THREE (3) basic components of Analytical instruments.

ii) List FOUR (4) desirable characteristics of transducers

iii) What is the function of a monochromator in optical instruments

[4 ½ marks]

1. i) Distinguish analog from digital instruments

ii) Explain briefly FOUR (4) characteristics used to quantify

the performance of an analytical method

iii) List SIX (6) signal conditioning operations that may be applied

[9 marks]

1. i) Define a standard of measurement

ii) Give THREE (3) types of standards

iii) What is calibration?

[3.5 marks]

1. i) Explain the following terms:

* Sensitivity
* Noise figure F

ii) Give THREE (3) factors that affect sensitivity of a particular

instrumental method.

[7 marks]

1. i) What is electrode fouling?

ii) Low concentrations of Ni-EDTA near the detection limit

gave the following counts in a mass spectral measurement:

175; 131; 104; 193; 164; 151; 189; 176; 155 and 133.

Ten measurements of a blank had a mean of 45 counts. A sample containing 1.0  Ni-EDTA gave 1797 counts.

Estimate the detection limit for Ni-EDTA. [6 marks]

**QUESTION TWO**

1. i) What is the act of measurement?

ii) Give TWO (2) requirements for a measurement to be useful

[3 marks]

1. i) List FOUR (4) components of a monochromator

ii) What is the speed of a monochromator?

iii) Compare the resolving power of a grating to the resolving

power of a prism.

iv) Briefly explain Czerny-Turner mounting in monochromator design.

[11 marks]

1. How is each of the following instrument components applied

in enhancement of signal-to-noise ratio

* Integrator
* Ensemble software

[6 marks]

**QUESTION THREE**

1. i) Give TWO reasons why the amount of noise in an equipment

is important.

ii) Explain briefly the following instrument noise filters

* Low pass
* High pass
* Band pass

[9marks]

1. Write short notes on each of the following types of instrument noise
2. Thermal noise
3. Environmental noise
4. Shot noise

[11 marks]

**QUESTION FOUR**

1. i) Explain the meaning of ‘Fourier transformation’ of an aptitude

variation plot as a function of time. [2 marks]

ii) Sketch the Fourier transformation plot of:

* Sine wave (A0 sin)
* Square wave
* Pulse

[4 marks]

iii) Compare the frequency transfer function (T) for an ideal

measurement system to the non-ideal response measurement. [4 marks]

1. i) Give FOUR (4) properties of operational amplifiers.

ii) Give the output of an operational amplifier connected

without feedback loop when the input is:

* alternating signal (ac)
* direct signal (dc)

[6 marks]

1. Compare the frequency response of a negative feedback circuit

with open loop circuit of an operational amplifier. [4 marks]