

 W1-2-60-1-6

**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2014/2015**

**……………………………………………. EXAMINATION FOR THE DEGREE**

**FOR BACHELOR OF SCIENCE IN ……………………………………………**

**SCH 2355: INSTRUMENTATION FOR ANALYTICAL CHEMISTS**

**DATE: AUGUST, 2015 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE (30 MARKS)**

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

 instruments.

ii) What is the function of analytical instruments.

iii) Give FIVE (5) motivating factors for carrying out

 measurements. [7 marks]

1. i) Define a standard of measurement

ii) What is calibration?

iii) Give TWO requirements for a measurement to be useful.

 [4 marks]

1. i) Explain the term ‘Doping’ as used in semi-conductor materials.

ii) Give FOUR (4) characteristics of semi-conductor diodes.

iii) TWO diodes, one of a germanium type and the other a silicon

 types have equal rating. If the silicon diode needs 0.60 volts

 to conduct 10 MA, what voltage must be applied to a germanium

 diode to get the same current flow.

 [5 marks]

1. i) Explain the following terms:
* Signal-to-noise ration
* Sensitivity
* Detection limit

 ii) Give TWO (2) reasons why the amount of noise in an

 instrument is important.

 [6 marks]

1. i) Briefly describe a bipolar base current of a bipolar transistor.

ii) GIVE THREE (3) components of the base current of

 a bipolar transistor.

iii) Define the short circuit current gain of a transistor.

 [5 marks]

1. i) List TWO (2) reasons why linear integrated circuits need

 additional components.

ii) Give FOUR (4) advantages of using integrated circuits. [3 marks]

**QUESTION TWO (20 MARKS)**

1. i) Define the a.c. resistance of a diode

ii) Distinguish a signal diode from a power diode

 [5 marks]

1. i) Plot a sketch of current flow versus bias voltage applied

 to u-p semi conductor diode.

ii) Explain briefly why a p-n junction has self-capacitance.

iii) A silicon diode has a permittivity of 1.05 x 10-10 F/M2 is

 reverse biased such that the depletion region has a width

 of 4.5 x 10-6 M. If the cross-section of the diode is a square

 measuring 1.2mm on a side, what is the value of transition

 capacitance.

 [9 marks]

1. i) Give FOUR (4) desirable characteristics of an operational

 amplifier.

ii) Give the differences in amplification obtained when

 an operational amplifier is operated with and without

 negative feedback loop.

 [6 marks]

**QUESTION THREE (20 MARKS)**

1. Give the sources and methods of minimizing/elimination

of each of the following types of instrument noise.

i) Thermal noise

ii) Environmental noise

 [11 marks]

1. i) List TWO (2) popular software signal enhancement technique

ii) Show how each of the following hardware components are

 used to discriminate signal from noise:

* Integrator circuit
* Lock-in or phase sensitive amplifier.

[9 marks]

**QUESTION FOUR (20 MARKS)**

1. i) A bipolar transistor is connected in the common base configuration.

 Give TWO (2) reasons why the collector current is less than the

 emitter current.

 ii) A n-p-n transistor connected in the configuration has an

 emitter current of 3.2 mA and a base current of 90A.

 - calculate the collector current

 - use appropriate illustrations to show how

 n-p-n transistor connected in the common

 emitter configuration

 [6 marks]

1. i) Give FOUR (4) advantages of using integrated circuits.

ii) What is the load regulation of a rectifier circuit?

 [4 marks]

1. Briefly explain how full wave rectification of a.c. to d.c. voltage

may be achieved using two and four diodes. [7 marks]

1. How is a pH meter maintained to be in good working condition? [3 marks]