MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL & ELECTRONIC ENGINEERING)

SCH 304: INTRODUCTION TO ANALYTICAL INSTRUMENTATION

DATE: **TIME:**

INSTRUCTIONS; ANSWER QUESTION ONE AND ANY OTHER TWO

QUESTION ONE (COMPULSORY) (30 MARKS)

a)   i)   Explain the three essential parts of a measuring instrument.   (3 marks)

      ii)   With aid of diagrams, describe the Three damping methods of indicating
instruments   (6 marks)

b)   i)   With reference to transducers and sensors explain the terms
I) linearity
II)precision

                                                                        (4 marks)

      ii)   With the aid of a block diagram, explain the functional parts of a measurement
system   (5 marks)

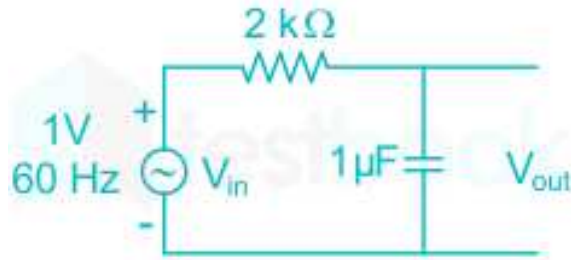c)   Figure 1 below shows a circuit of an R-C low-pass filter

Figure 1

Determine the;

    i) Reactance of capacitor at 1KHZ

    ii) Output voltage at 1KHZ.

    iii) The break frequency of the circuit

    iv) Output voltage at the break frequency

(8 marks)

d)   Figure 2 shows a non- inverting amplifier with an input voltage of 10 V, determine output voltage and closed loop gain
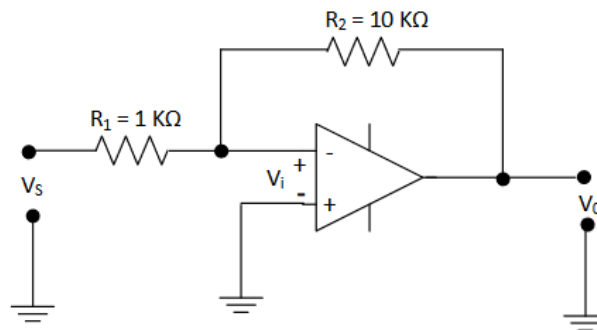

Figure 2

(5 marks)

QUESTION TWO (20 MARKS)

a)   Define and explain the need of signal conditioning in Analytical instrumentation

(3 marks)

b)   Using characteristic curves, explain the following filters in instrumentation.

    i) Low pass filters

    ii) All pass filters   (4 marks)

c)   Explain signal amplification and attenuation in instrument signal conditioning.
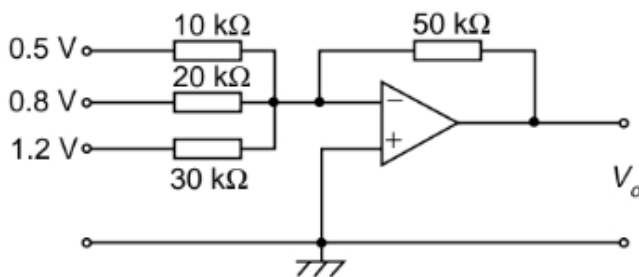
(4 marks)

d)   i)   Explain the operation of the successive approximation ADC systems in instrumentation

(4 marks)

       ii)   Determine the ADC output for a 4-bit converter to a 2.187V input, if the reference is 5V   (5 marks)

QUESTION THREE (20MARKS)

a)   i)   Explain the need and parts of protocol specifications in signal interfacing

(3 marks)

       ii)   With aid of a diagram, explain structure of Transmission Control protocol (TCP)

(4 marks)

b)   Describe the principle operation of DCE serial interface system   (4 marks)

c)   i)   Explain the need of SCADA system in industries
       ii)   Highlight the features of a SCADA system
      iii)   With the aid of a block diagram, explain the major parts of a SCADA system

(9 marks)

QUESTION FOUR (20 MARKS)

a)   With aid of a block diagram, explain the functional parts of a measuring system(6marks)

b)   Figure 4 shows a circuit of a summing up Op Amp, Determine the output voltage Vo

(4 marks)

c)   i)   State three advantages and Two disadvantages of velocity sensors   (5 marks)

       ii)   Explain the operation of a lock in amplifier.   (5 marks)

QUESTION FIVE (20 MARKS)

a) With reference to spectroscopic instruments, explain homogeneous and in homogeneous line broadening   (4 marks)

b) With the aid of a block diagram, explain the operation of a super heterodyne spectrum analyzer.   (10 marks)

c) i)   state the major classifications of spectrum analyzers   (2 marks)

    ii) Figure shows an inverting amplifier with an input voltage of 0.8 V, determine output voltage and closed loop gain   (4 marks)