



PROGRAM : NATIONAL DIPLOMA
ENGINEERING : COMPUTER SYSTEMS
ENGINEERING : ELECTRICAL

SUBJECT : MEASUREMENTS III

CODE : EMA 3111

DATE : SUPPLEMENTARY EXAMINATION
JANUARY, 2020

DURATION : 180 minutes

WEIGHT : 50 : 50

TOTAL MARKS : 100

ASSESSOR : DR AA ALONGE

MODERATOR : J. SEBASTIAN

NUMBER OF PAGES : 5 PAGES AND 1 ANSWER SHEET

INSTRUCTIONS TO ALL STUDENTS

1. ATTEMPT ALL QUESTIONS.
 2. TOTAL MARKS = 100%.
 3. MARKS WILL BE DEDUCTED FOR UNATTRACTIVE AND UNREADABLE WORK.
 4. DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY.
 5. DIAGRAMS AND SKETCHES MUST BE LABELLED CORRECTLY.
 6. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF THE QUESTION MUST BE GROUPED TOGETHER
 7. QUESTION PAPERS MUST BE HANDED IN WITH EXAMINATION SCRIPTS
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SECTION A: MULTIPLE CHOICE

Choose the most correct answer and mark an X over the corresponding letter on your answer sheet (Do all rough work at the back of the answer script). Each question attracts 2 marks.

QUESTION 1

1.1 The art or science of measurement is described as _____

- A) Astronomy
- B) Technology
- C) Calibration
- D) Metallurgy
- E) Metrology

1.2 Which of these statement(s) are true of the process of measurement?

- i) Most experiments require scientists to make measurements.
- ii) Measurements are rarely
- iii) Measurements are always somewhat different from the “true value.”
- iv) Measurements are not required for engineering and scientific investigations

- A) I only
- B) i and iv
- C) i, ii and iii
- D) iii only
- E) None of the above

1.3 Which one of the following quantities below does not have a base/fundamental unit?

- A) Speed
- B) Length
- C) Mass
- D) Luminous Intensity
- E) Time

1.4 To reduce loading errors in ammeter, which of the following options should be considered?

- A) Minimising meter internal resistance
- B) Increasing meter internal resistance
- C) Increasing the current supply to meter
- D) Reducing the current supply to meter
- E) None of the above

1.5 Noise, which is constant in amplitude and evenly spread out over the frequency band, is called _____

- A) Pink noise
- B) Band-limited noise
- C) Rayleigh noise
- D) White noise
- E) Random noise

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- 1.6 Which statement best describes the function of an oscillator?
- A) A circuit that amplifies the characteristics of different waveforms.
 - B) A circuit that generates direct current signals.
 - C) A circuit that attenuates the characteristics of different waveforms.
 - D) A circuit capable of producing a periodic and oscillating waveforms.
 - E) A circuit that distorts waveforms for different purposes
- 1.7 The digital oscilloscope can be used for the following except:
- A) Undertake voltage measurements
 - B) Determine the frequency of a target signal
 - C) Compare the characteristics of two signal sources
 - D) Amplify the characteristics of a target signal
 - E) None of the above
- 1.8 Which type of signal generator cannot be used to generate a waveform with frequency of 1 GHz?
- A) RF signal generator
 - B) Sine wave generator
 - C) Pulse generator
 - D) Arbitrary waveform generator
 - E) All of the above
- 1.9 Which value of correlation coefficient below defines “no correlation”?
- A) 0
 - B) -1
 - C) ∞
 - D) 1
 - E) -2
- 1.10 Which option below is not an advantage of measurement in the frequency domain?
- A) It gives a better estimate of bandwidth consumption.
 - B) It can be used to determine the time domain property of a signal.
 - C) It can help provide information on bandwidth efficiency.
 - D) It can be used to measure spectral and channel power.
 - E) It helps to determine the effectiveness of different signals.

SECTION A (TOTAL) = 20 marks

SECTION B: THEORY AND ESSAY

This section is to be answered in your answer script. Please ensure that your answers are clear, well-ordered and precise.

QUESTION 2

2.1 Define the following terms as related to measurements:

- 2.1.1 Range (2)
 2.1.2 Calibration (2)
 2.1.3 Sensitivity (2)

2.2 The following data have been obtained from the measurement of ten randomly selected resistors (with true value of $150\text{ k}\Omega \pm 10\%$) from a batch of recently ordered boxes from the manufacturer:

142.5; 137.9; 146.4; 155.5; 149.2; 158.6; 162.3; 154.4; 139.2 and 160.5

Calculate the following:

- 2.2.1 The arithmetic mean (4)
 2.2.2 The geometric mean (4)

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QUESTION 3

3.1 Define the following terminologies as applied in measurement:

- 3.1.1 Measurement unit (2)
 3.1.2 Fundamental unit (2)

3.2 Two ammeters, X and Y, were used for the measurement of current 10 A. The following results were obtained for five repeated measurements:

Ammeter X

Trials	1	2	3	4	5
Current (A)	9.4	10.1	9.8	9.7	10.4

Ammeter Y

Trials	1	2	3	4	5
Current (A)	9.5	9.8	10.4	10.1	9.9

Using results from the experiments above, by showing all calculations and steps, answer the following questions:

- 3.2.1 Which of the ammeters is the more precise? (6)
 3.2.2 Which of the ammeters is the more accurate? (6)

3.3 List two sources of error in measurement. (2)

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QUESTION 4

4.1 Compare the four advantages of digital over analog meters as applied in the process of measurement. (4)

4.2 A batch of 20 μf capacitors with a tolerance of $\pm 10\%$ was tested. The following values were obtained during the test:

22.0 μf , 19.4 μf , 19.1 μf , 19.8 μf , 19.3 μf , 20 μf , 19.6 μf , 20.8 μf , 18.4 μf and 21.5 μf

For the above data, determine the following:

4.2.1 Mean of the components (4)

4.2.2 Standard deviation and (6)

4.2.3 Variance. (3)

4.3 List two factors to consider when choosing a measuring instrument (2)

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QUESTION 5

5.1 Mention two precautions when using the ohmmeter. (2)

5.2 A series connected ohmmeter has a total internal resistance of 15 $\text{k}\Omega$ and uses a standard 9 Volt cell. Calculate:

5.2.1 The scale mark values in Ω , for 25%, 50% and 75% of Full Scale Deflection (FSD). (5)

5.2.2 The percentage deflection for 1 $\text{k}\Omega$, 10 $\text{k}\Omega$, 100 $\text{k}\Omega$ (6)

5.3 List three classifications of measuring instruments (3)

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QUESTION 6

6.1 Describe the features of a frequency counter with respect to measurement. (3)

6.2 Using appropriate diagram, draw, label and describe the internal structure of a Cathode Ray Tube (CRT) as applied in oscilloscope design (6)

6.3 List the four applications of spectrum analyzer in relation to measurement (4)

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SECTION B (TOTAL) = 80 Marks

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TOTAL = 100 MARKS

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STUDENT SURNAME: _____

STUDENT NUMBER: _____

ANSWER SHEET*(This sheet must be handed in with your examination script)**Mark your final answer with large clear cross (X) over the box you have chosen as your answer.***QUESTION 1**

1.1	A	B	C	D	E
1.2	A	B	C	D	E
1.3	A	B	C	D	E
1.4	A	B	C	D	E
1.5	A	B	C	D	E
1.6	A	B	C	D	E
1.7	A	B	C	D	E
1.8	A	B	C	D	E
1.9	A	B	C	D	E
1.10	A	B	C	D	E

(20 marks)