



**PROGRAM** : NATIONAL DIPLOMA  
*ENGINEERING : COMPUTER SYSTEMS*  
*ENGINEERING : ELECTRICAL*

**SUBJECT** : **MEASUREMENTS III**

**CODE** : **EMA 3111**

**DATE** : SUMMER MAIN EXAMINATION  
15 NOVEMBER 2017

**DURATION** : (SESSION 1) 08:30 - 11:30

**WEIGHT** : 50 : 50

**TOTAL MARKS** : 100

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**ASSESSOR** : DR AA ALONGE

**MODERATOR** : DR GR AIYETORO

**NUMBER OF PAGES** : 6 PAGES AND 1 ANSWER SHEET

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**INSTRUCTIONS TO ALL STUDENTS**

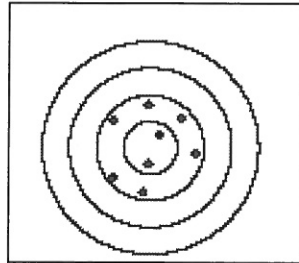
1. ATTEMPT ALL QUESTIONS.
  2. TOTAL MARKS = 100%.
  3. MARKS WILL BE DEDUCTED FOR UNATTRACTIVE AND UNREADABLE WORK.
  4. DIAGRAMS AND SKETCHES MUST BE DRAWN NEATLY.
  5. DIAGRAMS AND SKETCHES MUST BE LABELLED CORRECTLY.
  6. QUESTIONS MAY BE ANSWERED IN ANY ORDER, BUT ALL PARTS OF THE QUESTION MUST 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 3 marks.*

### **QUESTION 1**

- 1.1 Which of the following is true of the spatial positions of all darts in the bull-eyed diagram below?



- A) Accurate and precise
  - B) Not accurate and not precise
  - C) Precise but not accurate
  - D) Not precise but accurate
  - E) All of the above
- 1.2 An AC signal with a peak value of 5 Volt is combined with a DC signal of 9 Volt will have a resulting RMS voltage of \_\_\_\_\_
- A) 4 Volt
  - B) 14 Volt
  - C) 3.74 Volt
  - D) 1.8 Volt
  - E) 9.67 Volt
- 1.3 Measurement of AC signals can be achieved using the following procedure.
- A) Using a DC instrument, preceded by a rectifier
  - B) Using a rectifier, preceded by a DC instrument
  - C) Using an inverter, preceded by a DC instrument
  - D) Using a DC instrument, preceded by an inverter
  - E) Directly using a DC instrument
- 1.4 If the distribution of information around a probable value is symmetric or evenly distributed, then it is a \_\_\_\_\_
- A) Lognormal distribution
  - B) Binomial distribution
  - C) Weibull distribution
  - D) Normal distribution
  - E) Exponential distribution
- 1.5 The threshold voltage of a circuit is 25 Volt. If the deflection voltmeter used to measure this threshold voltage gives a value of 23.2 Volt. The accuracy of the voltmeter (in percent) for this measurement is \_\_\_\_\_

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- A) 7.2 %
  - B) 7.8 %
  - C) 92.8 %
  - D) 1.8 %
  - E) 5.4 %
- 1.6 When a spectrum analyzer just measures the ratio or amplitude of the output, it is known as: \_\_\_\_\_
- A) Vector network analyzer
  - B) Logic analyzer
  - C) Spectrum analyzer
  - D) Scalar network analyzer
  - E) Wave analyzer
- 1.7 Calculations using regressions are called interpolation if,
- A) The values are within the boundaries of the original values
  - B) The values are greater than one
  - C) The values exist within a defined interval.
  - D) The values are outside the boundaries of the original values
  - E) The values are within acceptable limit.
- 1.8 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
- 1.9 A spectrum analyzer can perform the following functions except:
- A) Display a signal's amplitude versus within a frequency range
  - B) Validating the characteristics and strength of a signal
  - C) Display a signal's amplitude versus time with a time range
  - D) To detect and quantify interference in signals
  - E) Applied in the analysis of vector signals
- 1.10 Which value of correlation coefficient below defines total correlation?
- A) 0
  - B) -1
  - C)  $\infty$
  - D) 1
  - E) -2

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SECTION A (TOTAL) = 30 MARKS

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**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 Discuss the terms accuracy and precision with respect to measurement. (4)
- 2.2 A voltmeter was used measure a voltage of 20 Volt where the following readings from five trials are obtained:

<b>Trials</b>	1	2	3	4	5
<b>Reading</b>	19.67	19.50	19.88	19.72	19.93

- 2.2.1 Determine the accuracy of the voltmeter. (3)
- 2.2.2 Determine the precision of the voltmeter. (3)
- 2.3 Use dimensional analysis to determine the constituent dimension units of Volt. (3)
- [13]**
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**QUESTION 3**

- 3.1 Discuss three classes of error to consider in measurement processes. (6)
- 3.2 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:

- 3.2.1 The arithmetic mean (2)
- 3.2.2 The geometric mean (2)
- 3.2.3 The harmonic mean (2)
- 3.3 Mention three applications of the spectrum analyzer for frequency domain measurements. (3)

**[15]**

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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 An ammeter has internal resistance of  $10\ \Omega$  and full-scale current of 3 mA. For a 10 A full-scale deflection, calculate:
- 4.2.1 The value of the shunt resistor, and, (2)
- 4.2.2 The meter equivalent resistance. (2)
- 4.3 A multi-range DC voltmeter must be constructed for 10 Volt, 100 Volt and 500 Volt ranges. The basic instrument has an internal resistance of  $10\ \Omega$  and 2 mA current causes full-scale deflection. Calculate:
- 4.3.1 The required series resistors for parallel design. (3)
- 4.3.2 The required series resistors for series design. (3)

**[14]****QUESTION 5**

- 5.1 Discuss the three types of noise you may encounter in electronic design. (3)
- 5.2.1 A batch of  $120\ \Omega$  resistors were measured. The tolerance specification is  $\pm 10\%$  at  $30^\circ\text{C}$  and the temperature coefficient is given as  $140\ \text{ppm}/^\circ\text{C}$ . Calculate the following:
- 5.2.2 The minimum and maximum absolute values at  $30^\circ\text{C}$ , (2)
- 5.2.3 The corresponding values at  $120^\circ\text{C}$  and (2)
- 5.2.4 The tolerance at  $120^\circ\text{C}$ . (2)
- 5.3 Mention three precautions to be taken when using a wattmeter for power measurements. (3)

**[12]****QUESTION 6**

- 6.1 Using appropriately labelled diagram of a Cathode Ray Tube (CRT), describe the functions of each component on the internal structure of a CRT. (6)
- 6.2 Describe the functions of the following parts of an oscilloscope:
- 6.2.1 Volt/division dial (1)
- 6.2.2 Time/division dial (1)
- 6.2.3 CRT output screen (1)

- 6.3 Explain the two modes of frequency measurements. (2)  
**[11]**
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**QUESTION 7**

- 7.1 Mention two advantages of measuring in the frequency domain over the time domain. (2)
- 7.2 Sketch and label the block diagram of a logic analyzer. (3)
- 7.3 A memory of 400 Mb is available and 4 input channels are applied on a logic analyzer. Calculate the maximum clock rate that can be used if a measured time is 500 ms is required. (2)  
**[5]**
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**SECTION B (TOTAL) = 70 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