PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : COMPUTER SYSTEMS* *ENGINEERING : ELECTRICAL*
SUBJECT	:	**MEASUREMENTS III**
CODE	:	**EMA 3111**
DATE	:	SUMMER MAIN EXAMINATION 16 NOVEMBER 2019
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	50 : 50
TOTAL MARKS	:	100

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ASSESSOR	:	DR AA ALONGE
MODERATOR	:	J. SEBASTIAN
NUMBER OF PAGES	:	6 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 Which of the following is true of the dart positions in the bulls-eye chart below?
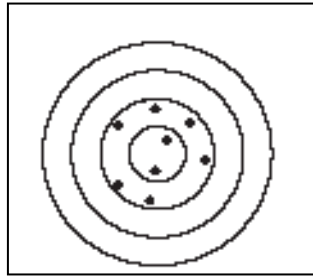
    A) Accurate but not precise
    B) Precise but not accurate
    C) Precise but not related
    D) Not precise and not accurate
    E) None of the above

1.2 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

1.3 Which central tendency/mean function is denoted by this:

$$A_{mean} = (A_1.A_2.A_3 \dots A_n)^{\frac{1}{n}} \cong \left(\prod_{i=1}^{n} A_i\right)^{\frac{1}{n}}$$

    A) Geometric mean
    B) Arithmetic mean
    C) Sample mean
    D) Harmonic mean
    E) Progressive mean

1.4 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.

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1.5 A faulty deflection voltmeter is used to measure threshold voltage across a circuit. Three readings were repeatedly undertaken given by 16.3 V, 15.9 V and 16.02 V. The precision of the voltmeter (in percent) for this measurement is _____
  A) 10.2 %
  B) 2.27 %
  C) 14.12 %
  D) 6.3 %
  E) 15.62 %

1.6 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

1.7 The following is true of the theory behind Fourier series decomposition except:
  A) A true signal is a composite addition of several infinite sinusoids of different amplitudes.
  B) Each of these sinusoids are the nth harmonics of the original signal.
  C) The Fourier series is actually a sum of finite sinusoids.
  D) These sinusoids can be obtained using Fourier series decomposition technique.
  E) Any AC waveform can be obtained in terms of its sum of harmonics.

1.8 The unit multiplier for 10 Femto-Ohms is given as:
  A) 10^{-3}
  B) 10^{-9}
  C) 10^{18}
  D) 10^{-21}
  E) 10^{-15}

1.9 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

1.10 For calculations using regression analysis, _____can be applied when the required variable lies outside the boundaries of the original values
  A) Interpolation
  B) Multipolation
  C) Intrapolation
  D) Bifurcation
  E) Extrapolation

SECTION A (TOTAL) = 20 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.   (6)

2.2   A voltmeter was used measure a voltage of 15 Volt where the following readings from five trials are obtained:

Trials	1	2	3	4	5	6
Reading	14.75	14.92	15.06	15.17	14.88	14.91

2.2.1   Determine the accuracy of the voltmeter.   (5)
2.2.2   Determine the precision of the voltmeter.   (5)

2.3   Define the following terms as related to measurements:
    2.3.1   Calibration   (2)
    2.3.2   Metrology   (2)

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QUESTION 3

3.1   Define the following classifications of noise;
    3.1.1   White noise   (2)
    3.1.2   Pink noise   (2)

3.2   A batch of 725 Ω resistors were measured. The tolerance specification is ± 15% at 30°C and the temperature coefficient is given as 130 ppm /°C. Calculate the following:

3.2.1   The minimum and maximum absolute values at 30°C,   (4)
3.2.2   The corresponding values at 100°C, and,   (4)
3.2.3   The tolerance at 100°C.   (3)

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

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QUESTION 4

4.1   List three multimeter functions.   (3)

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4.2 The specifications of a standard ammeter are given as 50 Ω and 5 mA. Calculate the values of the shunt resistors for an instrument with ranges of 1 A, 10 A and 20 A full-scale deflection.

4.2.1 Implement the circuit design using shunt resistors (5)

4.2.2 Implement the circuit design using series resistors (7)

[15]

QUESTION 5

5.1 List three types of Alternating Current (AC) voltmeters. (3)

5.2 An ammeter has internal resistance of 10 Ω and full-scale current of 5 mA. For a 15 A full-scale deflection, calculate:

5.2.1 The value of the shunt resistor, and, (3)

5.2.2 The meter equivalent resistance. (3)

5.3 Mention three precautions to be taken when using a wattmeter for power measurements. (3)

[12]

QUESTION 6

6.1 Describe the functions of the following parts of an oscilloscope:
  6.1.1 Volt/division dial (2)
  6.1.2 Time/division dial (2)
  6.1.3 CRT output screen (2)

6.2 Sketch and describe the following bridges:
  6.2.1 Maxwell-Wein bridge (3)
  6.2.2 Hay bridge (3)

6.3 Mention two differences in the functions of an oscilloscope and spectrum analyzer as applied in the measurement of voltage characteristics of a signal. (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)