TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

BACHELOR OF TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 4202 ELECTRICAL MEASUREMENTS

TEE 4203 ELECTRICAL MEASUREMENTS

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: September 2018

Instructions to Candidates

You should have the following for this examination
-*Answer Booklet, examination pass and student ID*
This paper consists of **FIVE** questions. Attempt **Question ONE and ANY other TWO questions.**

Do not write on the question paper.

Question ONE

(a)   The expression for the mean torque of an electrodynometer type wattmeter may be written as

$$T = M^a E^b Z^c \qquad \text{where } T = Torque; \quad M = Mutual\ inductance$$
$$E = Voltage \quad Z = Impedance$$

Using dimensional equations determine the indices $a, b, and\ c$ (18 marks)

(b)   A $0 - 30A$ ammeter has a guaranteed accuracy of 1% of full scale reading. The current measured by this instrument is $15A$. Determine the limiting error in percentage.   (6 marks)

(c)   Explain the principle of operation of the magnetic field sensor giving examples of its applications.

(6 marks)

Question TWO

(a) Differentiate between fundamental and derived quantities. (4 marks)

(b) (i) Give and explain any ONE reason that illustrates the importance of electrical measurements in the electrical industry.

(ii) Define the following physical constants giving their values and symbols:

I   Permittivity of free space   II   Permeability of free space (4 marks)

(c) Deriving all the quantities involved show that $\frac{1}{\sqrt{\mu\varepsilon}}$ has dimensions of velocity. (12 marks)

Question THREE

(a) Define the following terms with reference to measurement systems

(i) Accuracy (ii) Precision (iii) Sensitivity (6 marks)

(b) Describe how the following errors occur and how they can be minimized:

(i) Environmental errors (ii) Random errors (6 marks)

(c) (i) The measured value of a resistance is 111Ω. Determine the absolute and relative error of measurement.

(ii) The capacitance of a capacitor is specified as $200\ \mu F \pm 5\%$ by the manufacturer. Determine the limits of capacitance between which it is guaranteed. (8 marks)

Question FOUR

(a) (i) Describe the principle of operation of a strain gauge.

(ii) Describe any TWO applications of the strain gauge (10 marks)

(b) Using an appropriate sketch describe a method of measuring motor speed. (5 marks)

(c) Using an appropriate sketch describe the operation of a moving iron meter. (5 marks)

Question FIVE

(a) Functionally describe the following categories of instruments:

(i) Indicating (ii) Recording (iii) Controlling (6 marks)

(b)   Using an appropriate sketch describe the principle of operation of an ohmmeter.   (8 marks)

(c)   Describe a method of measuring frequency.   (6 marks)