THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER –DECEMBER 2021

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

REGULAR PROGRAMME

PHY 407: ELECTRONIC MEASUREMENT AND INSTRUMENTATION

Date: DECEMBER 2021	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any TWO Questions	

Q1.

a) Define the following with reference to measurement;
   i). Unit
   ii). Fundamental units
   iii). Derived units **(3 marks)**

b) Differentiate between analog and digital instrument **(2 marks)**

c) A voltage has a true value of 1.50 V. An analog indicating instrument with a scale range of 0-2.50 V shows a voltage of 1.46 V. What is the value of absolute error? **(2 marks)**

d) State any three electrical physical quantities indicating the unit for each physical quantity **(6 marks)**

e) An instrument records temperature of a body as 68^0F. What value would another instrument calibrated in Kelvin give for the same temperature. **(3 marks)**

f) List any two elements of an electronic device **(2 marks)**

g) Describe any three systems for mechanical units **(6 marks)**

h) What is dimension? **(1 mark)**

i) With reference to dimension of charge and work done, show that the dimension for resistance is given as $M L^2 T^{-3} I^{-2}$ **(4 marks)**

j) A digital voltmeter has a read-out reading from 0 to 9,999 counts. Determine the resolution of the instrument in volt when the full scale reading is 9.999 V.

(3 marks)

Q2.

a) Describe the term error as used in instruments **(2 marks)**

b) Explain any four sources of errors in measurement **(8 marks)**

c) The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79 V. Calculate the; **(10 marks)**

i). absolute error,

ii). % error,

iii). relative accuracy,and

iv). % of accuracy.

Q3.

a) Define the following terms as applied in measurement: **(3 marks)**

i). Accuracy

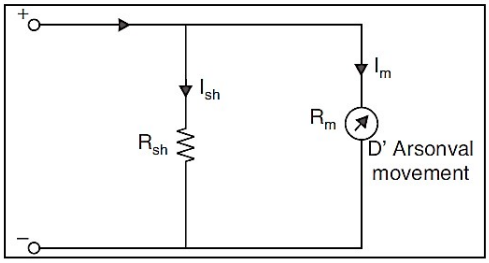
ii). Precision

iii). Resolution

b) Explain dynamic characteristics of instruments in detail **(10 marks)**

c) The figure below shows a D.C ammeter. Considering that the source current is I, show that the shunt resistance is given by; **(4 marks)**

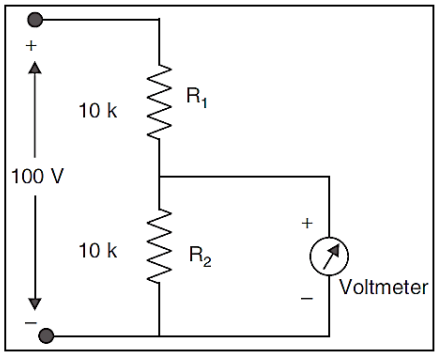
$$R_{sh}=\frac{I_m R_m}{I-I_m}$$



d) A 1 mA meter movement with an internal resistance of 100 W is to be converted into 0–100 mA. Calculate the value of shunt resistance required **(3 marks)**

Q4.

a) Figure below shows a simple series circuit of R_1 and R_2 connected to a 100 V dc source.



If the voltage across R_2 is to be measured by voltmeter having

i). A sensitivity of 1000 W/V, and

ii). A sensitivity of 20,000 W/V,

Find which voltmeter will read the accurate value of voltage across R2. Both meters are used on the 50 V range. **(10 marks)**

b) A 50 W basic movement requiring a full scale current of 1 mA is to be used as series ohmmeter. The internal battery voltage is 3 V. A half scale deflection marking desired is 1000 Ω. Calculate **(10 marks)**

i). Values of R_{se} and R_{sh}

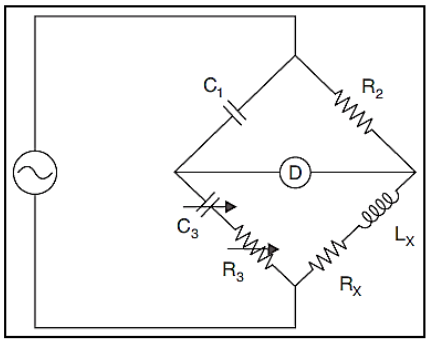
ii). Maximum value of R_{sh} to compensate for a 5 % drop in battery voltage

Q5.

a) Describe the three classes of resistors **(3 marks)**

b) In a measurement of resistance by potentiometer, the voltage drops across a resistor under test and across 0.025 Ω standard resistors were found to be 0.882 V and 1.2 V respectively. Determine the value of resistor under test. **(4 marks)**

c) The figure below shows a bridge for measuring self inductance of an unknown inductor L_x .



Show that the unknown inductance is given as; **(5 marks)**

$$L_x = R_2 R_2 C_1$$

d) With the aid of a well labelled diagram, discuss briefly, the basic parts of cathode ray oscilloscope **(8 marks)**

END