MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN ELECTRICAL ENGINEERING

ELECTRICAL MEASUREMENTS

DATE: 30/8/2021 **TIME: 2:30 – 5:30 PM**

INSTRUCTIONS: answer question and any other two questions

1. a) i) State two advantages of SI units (2 marks

ii) Explain what is meant by a measurement (3 marks)

b) i) Define the term maintenance as used in electrical equipment

ii) State any three benefits of preventive maintenance. (5 marks)

c) i) Name three types of solder

ii) Explain what soldering is as used in electrical measurements (6 marks)

iii) Explain the following types of errors stating how they are minimized
i) Systematic

ii) Gross (4 marks)

2. a) i) Name four ways of measuring resistances

ii) Explain how a Ammeter - Voltmeter instrument measure resistances. (8 marks)

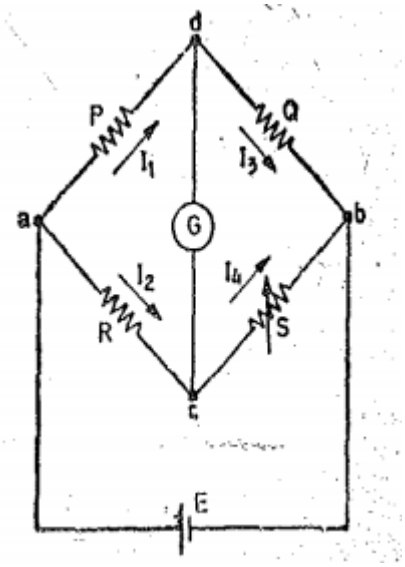
c) A Wheatstone bridge has resistors P=Q=R=S=1KΩ. The Galvanometer, G, can detect as low as 0.1nA. Determine the;

i) Internal resistance of the bridge measured across terminals b-d

ii) Output voltage due to unbalance

iii) Current through the galvanometer for unbalance condition

iv) Smallest change in resistance that can be detected



(12 marks)

3. a) i) Explain what primary units means in measurements.

ii) The dimensional equation of resistance in the LMTI system of dimensions is $[R] = [ML^2I^{-2}T^{-3}]$. Use this equation to obtain the dimensions. (10 marks)

b) Derive the dimensional equation for capacitance in c. g. s. electrostatic units. Take the dimensional equation for charge $[Q] = [\epsilon^{1/2} M^{1/2} L^{3/2} T^{-1}]$ (10 marks)

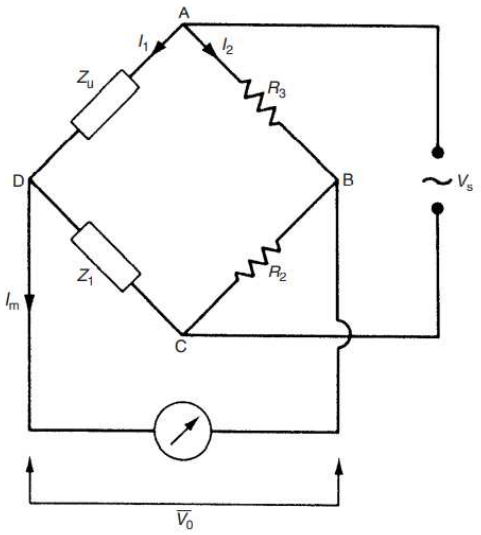
4. a) Show that, from a Carey Foster slide wire bridge, a linear relationship exists between two adjacent resistors separated by a wire of known length and known resistance per unit. (10 marks)

b) An unknown inductance Lu is measured using a deflection type of bridge as shown in the figure below.

The components in the bridge have the following values:

Vs = 10 Vr.m.s., L1 = 20 mH, R2 =100 Ω, R3 = 100 Ω

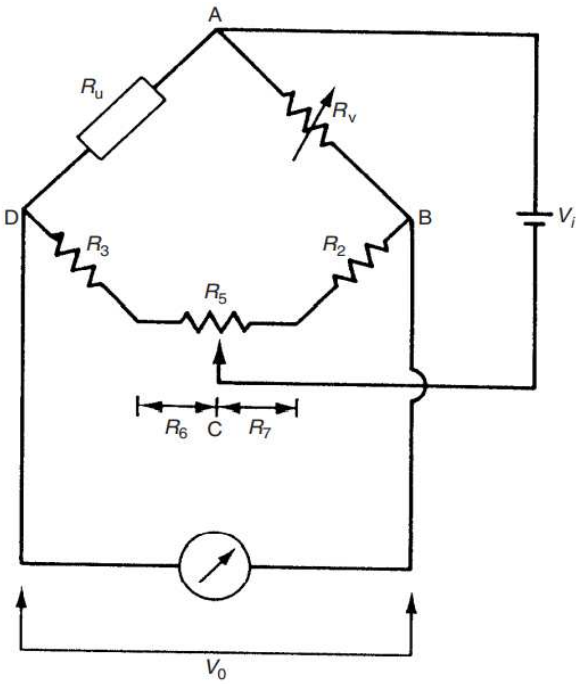
If the output voltage V0 is 1 Vr.m.s., calculate the value of Lu.



(5 marks)

c) A potentiometer R5 is put into the apex of a bridge as shown below to balance the circuit. The bridge components have the following values:

Ru = 500 Ω, Rv = 500 Ω, R2 = 515 Ω, R3 = 480 Ω, R5 = 100 Ω.



Determine the required value of the resistances R6 and R7 of the parts of the potentiometer track either side of the slider in order to balance the bridge and compensate for the unequal values of R2 and R3. (5 marks)

5. a) i) Explain the three (**3**) classified categories of drifts. (3 marks)

ii) Explain how a galvanometer can be converted to measure a

i) Current
ii) Voltage (4 marks)

b) i) A 5Ω galvanometer with a full scale deflection of 10mA is used to measure a current of 10A. Calculate the value of the shunt resistance needed. (5 marks)

ii) A moving-coil instrument having a resistance of 10Ω, gives a f.s.d. when the current is 8 mA. Calculate the value of the multiplier to be connected in series with the instrument so that it can be used as a voltmeter for measuring p.d.s. up to 100V. (4 marks)

iii) In a Wheatstone bridge circuit, calculate the unknown resistor given that R1 = 300 Ω, R2 = 150Ω and R3 = 250 Ω named clockwise. (4 marks)