



MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF
SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 208: ELECTRICAL MEASUREMENTS

DATE: 20/6/ 2017

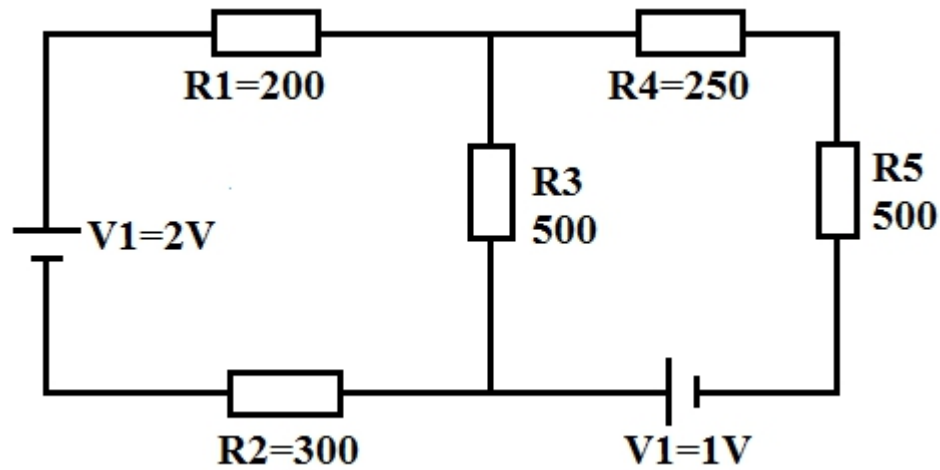
TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Sketch a measurement system and state the function of each block. (10 marks)
- b) Stating one example in each case, give a distinction between a base and derived SI unit. (4 marks)
- c) Accuracy and precision are two terms that are often taken to mean the same thing in the English language. With the aid of an illustration, give a clear distinction of the two terms. (4 marks)
- d) For the circuit given below, if the instrument measuring the output voltage across 500 ohm resistance has resistance of 4750 ohm. What is the measurement error due to the **loading** effect of the instrument?



(6 marks)

- e) Give a clear distinction between active and passive instruments. Give one example of each and discuss the relative merits of this two classes of instruments. (6 marks)

QUESTION TWO (20 MARKS)

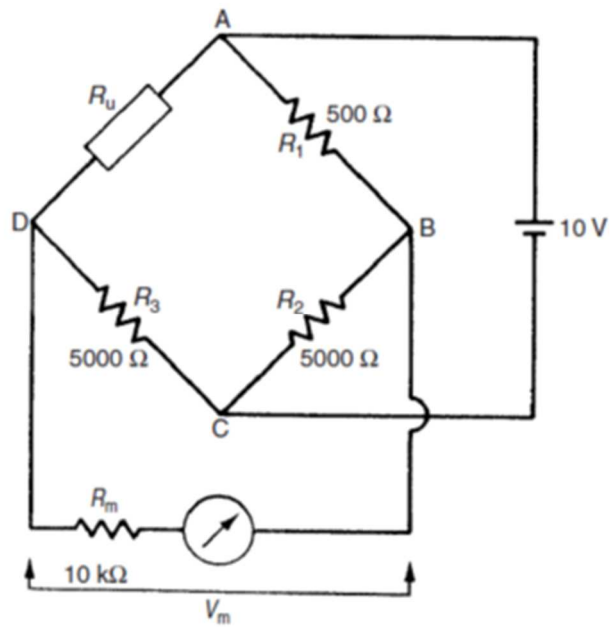
- a) Briefly explain the meaning of the following terms.

- i) Resolution
- ii) Range or Span
- iii) Bandwidth
- iv) Sensitivity

(6 marks)

- b) A bridge circuit, as shown below, is used to measure the value of the unknown resistance R_u of a strain gauge of nominal value $500\ \Omega$. The output voltage measured across points DB in the bridge is measured by a voltmeter. Calculate the measurement sensitivity in volts/ohm change in R_u if

- (i) the resistance R_m of the measuring instrument is neglected, and
- (ii) account is taken of the value of R_m .



(6 marks)

- c) Define the term Calibration and give the instances when instruments need to be calibrated.

(6 marks)

QUESTION THREE (20 MARKS)

- a) Explain the difference between systematic and random errors. Name four typical sources of these two types of error? (6 marks)
- b) In a test on a sample at 20 kV, 50 Hz by a Schering bridge, having a standard capacitor of 106 pF, balance was obtained with a capacitance of 0.35 μ F in parallel with a non-inductive resistance of 318 ohms, the non-inductive resistance in the remaining arm of the bridge being 130 ohms.

Determine the capacitance, the p.f. and equivalent series resistance of the specimen.

(8 marks)

- c) Explain the difference between analogue and digital instruments giving the advantages and disadvantages of each. (6 marks)

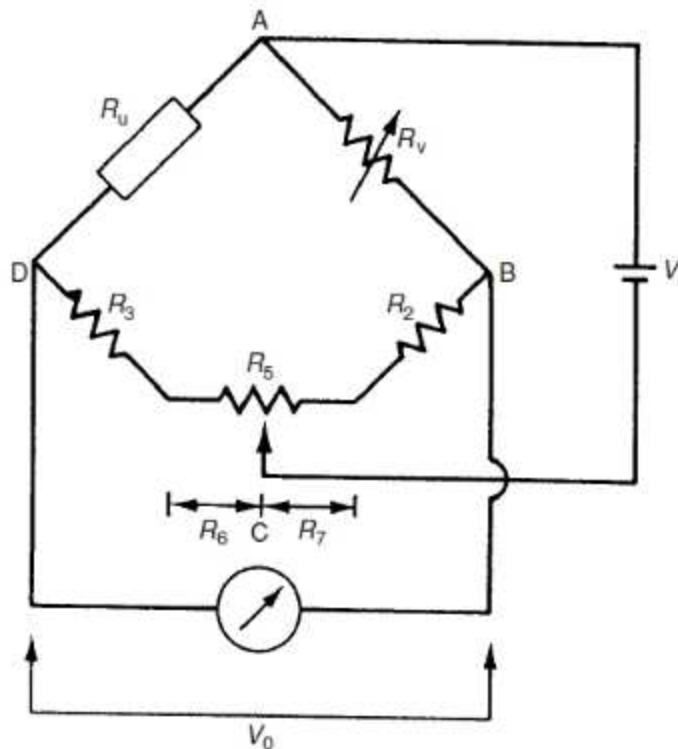
QUESTION FOUR (20 MARKS)

- a) What is a transducer? (2 marks)
- b) Explain the working principles of a hall effect transducer. What is it used for? (5 marks)
- c) Show how current is measured by current transformer (5 marks)
- d) Explain the advantages of Instrument Transformers. (4 marks)
- e) Discuss the advantages and disadvantages of null and deflection types of measuring instrument. (4 marks)

QUESTION FIVE (20 MARKS)

- a) With the aid of a well labeled diagram discuss the main components of a cathode ray oscilloscope (CRO) (10 marks)
- b) A potentiometer R_5 is put into the apex of the bridge shown below to balance the circuit. The bridge components have the following values:

$$R_u = 500 \, \Omega, R_v = 500 \, \Omega, R_2 = 515 \, \Omega, R_3 = 480 \, \Omega, R_5 = 100 \, \Omega.$$



Determine the required value of the resistances R_6 and R_7 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 R_2 and R_3 . (5 marks)

- c) Any device following a transducer draws a significant current. This may result to an erroneous measure of the measured variable. Considering a potentiometer connected to a voltmeter as an example, derive an equation to show how the loading effect of the voltmeter influences the actual measurement. (5 marks)