DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATIONS 2014/2015

SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING

EEE 2205 : ELECTRICAL MEASUREMENT

DATE: 11TH AUGUST 2014   TIME: 11.00AM – 1.00PM

INSTRUCTIONS

(i)   This paper contains **FIVE (5)** questions.

(ii)   Answer question **ONE(1)** and any other **TWO(2)** questions.

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?
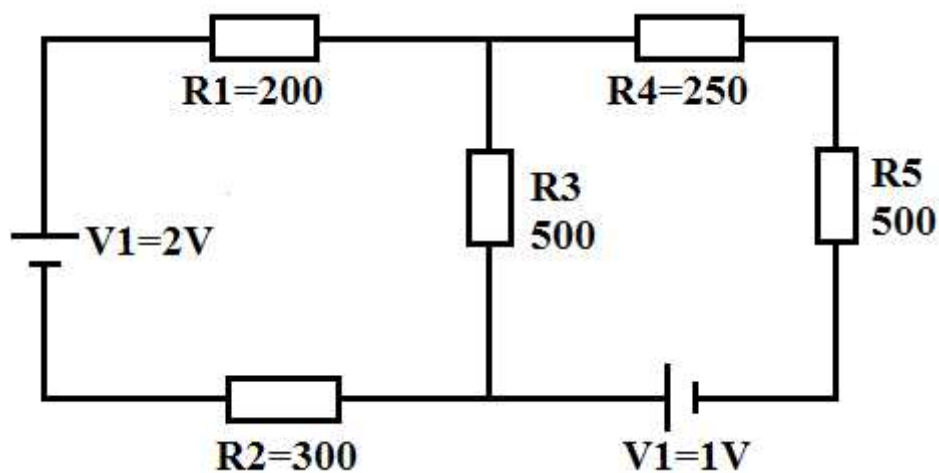
(6 marks)

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)*

a) Briefly explain the meaning of the following terms.

       i.   Resolution

      ii.   Range or Span

     iii.   Bandwidth

     iv.   Sensitivity   *(8 marks)*

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

    (i) the resistance Rm of the measuring instrument is neglected, and

    (ii) account is taken of the value of Rm.
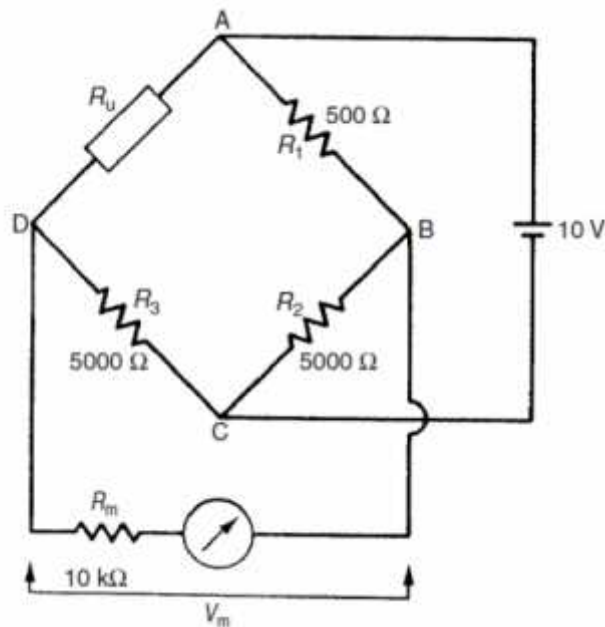
                                                                         (6 marks)

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

                                                                          (6 marks)

Question 3   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 μF 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 4   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)*

a) With the aid of a well labeled diagram discuss the main components of a cathode ray oscilloscope (CRO)   *(10 marks)*

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

$R_u = 500\ \Omega,\ R_v = 500\ \Omega,\ R_2 = 515\ \Omega,\ R_3 = 480\ \Omega,\ R_5 = 100\ \Omega.$
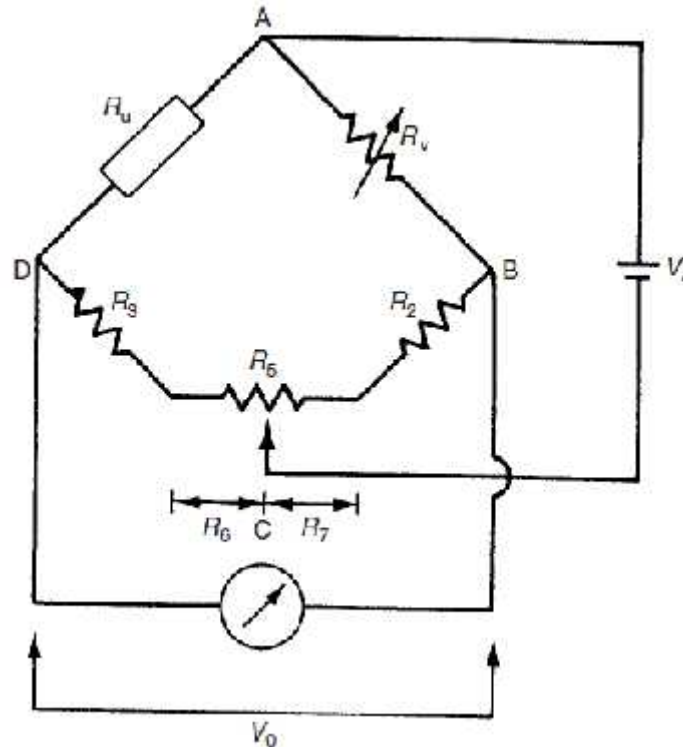
Determine the required value of the resistances R6 and R7 of the parts of the potentiometer track either side of the slider in order to balance the bridge and compensate for the unequal values of R2 and R3.   *(5 marks)*

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)*