



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 208 ELECTRICAL MEASUREMENTS

DATE: 11/12/2020

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Differentiate primary and International standards (4 marks)
- b) A moving-coil instrument gives a f.s.d. when the current is 40mA and its resistance is 25Ω . Calculate the value of the shunt to be connected in parallel with the meter to enable it to be used as an ammeter for measuring currents up to 50A (4 marks)
- c) Calculate the power dissipated by the voltmeter and by resistor R in Fig. 1 when (a) $R = 250\Omega$ (b) $R = 2M\Omega$. Assume that the voltmeter sensitivity (sometimes called figure of merit) is $10k\Omega/V$ (6 marks)

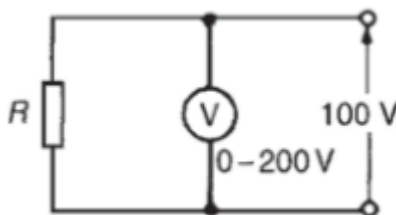


Fig. 1

- d) For the a.c. bridge shown in Fig. 2 determine the values of the inductance and resistance of the coil when $R_1 = R_2 = 400\Omega$, $R_3 = 5k\Omega$ and $C = 7.5\mu F$ (4 marks)

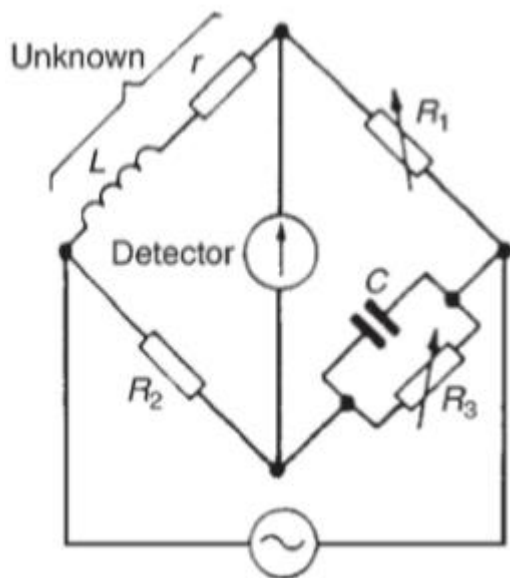


Fig. 2

- e) The coil of a PMMC instrument has 60 turns, on a former that is 18mm wide, the effective length of the conductor being 25 mm. It moves in a uniform field of flux density 0.5 Tesla. The control spring constant is $1.5 \times 10^{-6} \text{ Nm/degree}$. Calculate the current required to produce a deflection of 100 degrees (4 marks)
- f) A 0-250V voltmeter has a guaranteed accuracy of 2% of full-scale reading. The voltage measured by the voltmeter is 150 volts. Determine the limiting error in percentage. (3 marks)
- g) Name five quantities that a c.r.o. is capable of measuring (5 marks)

QUESTION TWO (20 MARKS)

- a) List 5 advantages of PMMC Instruments (5 marks)
- b) Define the three types of torque needed for satisfactory operation of any indicating instrument (6 marks)
- c) For the c.r.o. square voltage waveform shown in Fig. 3 determine (a) the periodic time, (b) the frequency and (c) the peak-to-peak voltage. The 'time/cm' (or timebase control) switch is on $100 \mu\text{s/cm}$ and the 'volts/cm' (or signal amplitude control) switch is on 20V/cm (5 marks)

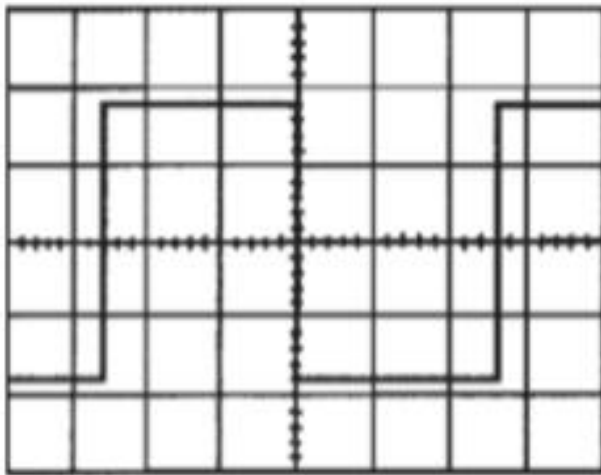


Fig 3, (assume that the squares shown are 1cm by 1cm)

- d) Define random errors and explain how they are analysed statistically. (4 marks)

QUESTION THREE (20 MARKS)

- a) Differentiate indicating and recording instruments. (2 marks)
- b) What are the different types of errors in a measuring instrument? Briefly describe their source. (6 marks)
- c) The current I flowing in a resistor R is measured by a 0–10 A ammeter which gives an indication of 6.25 A. The voltage V across the resistor is measured by a 0–50 V voltmeter, which gives an indication of 36.5 V. Determine the resistance of the resistor, and its accuracy of measurement if both instruments have a limit of error of 2% of f.s.d. Neglect any loading effects of the instruments. (8 marks)
- d) How should voltmeter and ammeter be connected in a circuit? Explain why. (4 marks)

QUESTION FOUR (20 MARKS)

- a) How does a C.T. differ from a P.T.? (12 marks)
- b) An ammeter has a f.s.d. of 100 mA and a resistance of $50\ \Omega$. The ammeter is used to measure the current in a load of resistance $500\ \Omega$ when the supply voltage is 10 V. Calculate
- The ammeter reading expected (neglecting its resistance),
 - The actual current in the circuit,
 - The power dissipated in the ammeter, and
 - The power dissipated in the load
- (8 marks)

QUESTION FIVE (20 MARKS)

- a) What is a transducer? Briefly describe the basic requirements of a transducer (12 marks)
- b) In a Wheatstone bridge ABCD, a galvanometer is connected between A and C, and a battery between B and D. A resistor of unknown value is connected between A and B. When the bridge is balanced, the resistance between B and C is 100Ω , that between C and D is 10Ω and that between D and A is 400Ω . Calculate the value of the unknown resistance. (3 marks)
- c) Give 5 disadvantages of MI Instruments (5 marks)