



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 208 ELECTRICAL MEASUREMENTS

DATE: 10/12/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

Attempt Question one and Any other Two questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Differentiate primary and secondary standards (2 marks)
- b) Why would a measuring system have the following elements? (6 marks)
 - i) variable conversion element
 - ii) primary sensing element
 - iii) data presentation element
- c) The arms of a Wheatstone bridge ABCD have the following resistances: AB: $R_1 = 1000\Omega \pm 1.0\%$; BC: $R_2 = 100\Omega \pm 0.5\%$; CD: unknown resistance R_x ; DA: $R_3 = 432.5\Omega \pm 0.2\%$. Determine the value of the unknown resistance and its accuracy of measurement. (4 marks)
- d) List 5 quantities that can be measured using a cathode ray oscilloscope. (5 marks)
- e) An ammeter has a f.s.d. of 100 mA and a resistance of 50Ω . The ammeter is used to measure the current in a load of resistance 500Ω when the supply voltage is 10 V. Calculate (a) the ammeter reading expected (neglecting its resistance), (b) the actual current in the circuit, (c) the power dissipated in the ammeter, and (d) the power dissipated in the load. (4 marks)
- f) What are the advantages of digital Instruments over analogue instruments. (6 marks)
- g) Sketch the curves showing deflection versus time for analog indicating instruments for underdamping, critical damping and overdamping. (3 marks)

QUESTION TWO (20 MARKS)

- a) Discuss the different types of errors with respect to their origin. (10 marks)
- b) 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. (5 marks)
- c) A PMMC instrument has a coil of dimensions 15 mm $\times$ 12 mm. The flux density in the air gap is 1.8×10^{-3} wb/m² and the spring constant is 0.14×10^{-6} N-m/rad. Determine the number of turns required to produce an angular deflection of 90° when a current of 5 mA is flowing through the coil. (5 marks)

QUESTION THREE (20 MARKS)

- a) Give 6 differences between Current Transformers and Potential Transformers. (12 marks)
- b) Briefly describe the construction and working of a current transformer. (4 marks)
- c) Give 4 differences between the potential and power transformers. (4 marks)

QUESTION THREE (20 MARKS)

- a) A Maxwell bridge circuit ABCD has the following arm impedances: AB, 250 Ω resistance; BC, 15 μ F capacitor in parallel with a 10 k Ω resistor; CD, 400 Ω resistor; DA, unknown inductor having inductance L and resistance R . Determine the values of L and R assuming the bridge is balanced. (10 marks)
- b) For the c.r.o. display of a pulse waveform shown in Fig. 1 the 'time/cm' switch is on 50 ms/cm and the 'volts/cm' switch is on 0.2 V/cm. Determine (a) the periodic time, (b) the frequency, (c) the magnitude of the pulse voltage. (10 marks)

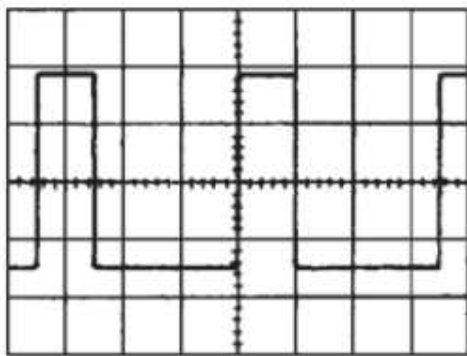


Fig. 1

- c) For a Schering bridge, show that $C_1 = C_2 \frac{R_4}{R_3}$ and $r_1 = \frac{R_3 C_4}{C_2}$ (6 marks)
- d) List 4 a.c. bridges and what they are used to measure. (4 marks)

QUESTION FOUR (20 MARKS)

- a) What are the basic requirements of a transducer? (6 marks)
- b) Briefly define all the static characteristics of measuring instruments (8 marks)
- c) What are the essential devices of an analogue electrical indicating instruments?
Briefly describe their function. (6 marks)

QUESTION FIVE (20 MARKS)

- a) Give 5 areas of applications of magnetic shielding and why it's important in that area. (10 marks)
- b) With a block diagram, explain the working of a general purpose CRO. (6 marks)
- c) Differentiate fundamental and derived units. (4 marks)