UNIVERSITY OF NAIROBI
FIRST YEAR CAT EXAMINATONS FEE 142: MEASUREMENTS

DATE 5 APRIL 2016

Notes to candidates:

1. Attempt any **TWO QUESTIONS**
2. All questions carry equal marks
3. Time 1hour 20 mins
4. Mass of electron $= 9.31 \times 10^{-31}$ kg
5. Charge of electron $= 1.6 \times 10^{-19}$ C

Q.1. (a) Sketch the internal construction of a general purpose cathode ray tube .Clearly explain the function of each electrode and hence state the effect of secondary electron emission at the screen and how it affects the performance of the oscilloscope. (6 marks)

(b) Derive the expression for the defection factor for a general-purpose cathode ray oscilloscope. (10 marks)

(c) A general-purpose oscilloscope has an anode voltage of 2500V and parallel deflecting plates 2.5cm long and 5mm apart .The screen is 30cm from the center of the deflecting plates. Calculate the deflecting voltage required to cause the beam to just strike the deflecting plates and find the corresponding deflection on the screen. (4 marks)

Q.2. (a) Derive the working equation of a Wheat stone's bridge hence determine the procedure to Perform accurate measurements with the bridge. (10marks)

(b) In a Wheatstone bridge the value of the resistances of the arms are P=1000Ω, Q=1000Ω R= 1000Ω and S=1000Ω. The battery emf is 10V and has negligible internal resistance .The galvanometer can detect current as low as 0.1nA and has an internal resistance of 0Ω. Calculate the smallest change in resistance that can be detected. . $4 \times 10^{-5}\,\Omega$ (6marks)

(c) List four important precautions that must be taken into considerations when performing precision measurements with a Wheatstone bridge. (4 marks)

Q.3. (a) For the Kelvin's bridge obtain an expression for the unknown resistance R in terms of the known at balance. (12 marks)

(b) The ratio arms of Kelvin's bridge are : P = Q = p = q= 1000 Ω each. The galvanometer has an internal resistance of 500Ω and a current sensitivity of 100mm/μA . The emf of the battery is 10V and a resistance of 2Ω is included in the battery circuit. The bridge is balanced when the standard resistance is S=0.001Ω . Calculate the deflection of the galvanometer when R is changed by 0.1 percent from its value at balance. The link resistance r = 0 Ω. (6 marks)

(c) What factors limit the Kelvin's bridge in low resistance measurements ? (2marks)

Q.4. (a) Sketch the schematic of the construction of an isolation probe hence with aid of analysis show That it offers better performance than the direct reading probe. (8 marks)

(b) List the various triggering modes in an oscilloscope and state their practical applications. (4 marks)

(c) Distinguish **between dimensions , units, fundamental** and **derived units.** (8marks)

$$S_B = \frac{\delta E\, RS}{(R+S)^2} \qquad \frac{\Theta_1}{\frac{\Delta R}{R}} = E\, \Delta R \frac{RS}{R(R+S)^2}$$