MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)
University Examinations for 2015/2016 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST SEMESTER EXAMINATION FOR DIPLOMA IN EDUCATION

SPH 0205: ELECTRICITY AND MAGNETISM II

DATE: 3/8/2016 **TIME: 11:00 – 1:00 PM**

INSRUCTIONS:

Answers question ONE and any other two. Question one carries 30marks while each of the others carry 20 marks

SECTION A : QUESTION ONE IS COMPULSORY (30 MARKS)

QUESTION ONE

a) Define the terms electric field E due to a point charge q and give its mathematical expression (2 marks)

b) Use coulombs law to show that the electric field E due to a test charge is given by

$E = \frac{q}{4\pi\varepsilon_o r^2}$ where the symbols have their usual meaning (4 marks)

c) Derive Amperes law from Biot-Savart law (4 marks)

d) A long straight conductor X carrying a current of 2A is placed parallel to a short conductor Y of the length 0.05m carrying a current of 3A. The two conductors are 0.1m apart. Calculate

i) The flux density due to X at Y

ii) The force on Y (4 marks)

e) State the laws of electromagnetic induction (2 marks)

f) i) Describe three factors that affect photoelectric effect (3 marks)

ii) Describe two applications of photoelectric effect (4 marks)

g) Describe three uses of x-rays. (3 marks)

h) Derive the expression of the force experienced by two parallel current carrying conductors (4 marks)

SECTION B: ANSWER ANY THREE QUESTIONS (20 MARKS EACH)

QUESTION TWO

a) i) With the aid of a diagram, derive an expression for the impedance Z, of an inductor L, and a resistor R connected in series to an alternating voltage. (5 marks)

ii) Determine the expression for the resonant frequency f_o in a series RLC circuit. (4 marks)

iii) Sketch the variation of impedance Z, Inductive reactance χ_L, resistance R and capacitive reactance χ_C, with the frequency of the supply, for RLC series circuit. (2 marks)

b) A series RLC circuit has the following elements: R = 100 Ω, C = 20 μF and L = 0.35 H. The circuit is connected to an a.c. source of V_{Max} = 240 V and a frequency of 50 Hz. Calculate the following.

i. Inductive reactance (3 marks)

ii. Capacitive reactance (3 marks)

iii. Impedances of the circuit (3 marks)

QUESTION THREE

a) i) state faraday's and Lenz's laws of electromagnetic induction (2 marks)

ii) Explain three factors affecting the magnitude of the induced e.m.f (6 marks)

b) Show that inductive reactance χ_L is given by $\chi_L = 2\pi fL = \omega L$ when a.c passes through an inductor. Where the symbols have their usual meaning (6 marks)

c) An x-ray tube operates at 60 kV and the current through it is 4.0 mA. Calculate the,

i) Number of electrons striking the target per second. (3 marks)

ii) Speed of the electrons when they hit the target. (3 marks)

QUESTION FOUR

a) Define the following terms, photoelectric effect, work function and threshold Frequency (3 marks)

b) A photon in the light of frequency 2 x 10^{15} Hz falls on a material whose work function is 2.28 eV. Calculate

i) Energy in the photon (3 marks)

ii) Maximum kinetic energy of the liberated electrons (3 marks)

iii) The threshold frequency of the material used (3 marks)

iv) Stopping potential required to stop the electrons from reaching the anode (3 marks)

c) Explain how the intensity of x-rays can be increased; hence distinguish between soft and hard x-rays. (5 marks)

QUESTION FIVE

a) Describe how x-rays are produced in the x-ray tube (6 marks)

b) Electrons are accelerated to the anode of the x-ray tube at a potential difference of 20,000V. Calculate the wavelength of the generated x-rays. (4 marks)

c) Explain reason why electricity is transmitted at high voltages (2 marks)

d) State three dangers of high voltage transmission (3 marks)

e) An electric heater running on 240 V mains has a current of 2.5 A. calculate

i) its power rating (3 marks)

ii) the resistance of its element (2 marks)