CHUKA UNIVERSITY

COLLEGE

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF
BACHELOR OF SCIENCE &BACHELOR OF EDUCATION (SCIENCE)

PHYS 313: ELECTRICITY AND MAGNETISM II

STREAMS: B.SC., B.ED (SC) Y3S1 **TIME: 2 HOURS**

DAY/DATE: MONDAY 17/12/2012 **8.30 A.M – 10.30 A.M.**

INSTRUCTIONS:

Answer question 1 and any other 2 questions.
Question 1 contains 40 Marks and the other questions 15 marks each.

1. (a) Define:
   (i) the electric field of a surface
   (ii) the periodic time of an a.c generator
   (iii) the effective value of an a.c [3 marks]

   (b) An alternating current completes 5 cycles in 8ms. What is its frequency? [3 marks]

   (c) A supply has a mean value of 150V. Determine

   (i) its maximum value [2 marks]
   (ii) its rms value [2 marks]

   (d) Define a phasor as used in electricity. [1 mark]

   (e) An alternating voltage is given by V = 282.8 Sin 314t volts.
   Find: (i) the r m s voltage [2 marks]
   (ii) the frequency of the voltage [2 marks]
   (iii) the instantaneous value of the voltage when t = 4 ms [2 marks]

   (f) Define the following single phase a.c circuits:

   (i) purely resistive a.c circuit [1 mark]
   (ii) purely inductive a.c circuit [1 mark]
   (iii) purely capacitive a.c circuit [1 mark]

(g) A capacitor has a reactance of 40Ω when operated on a 50Hz supply. Determine the value of its capacitance. [4 marks]

(h) State Gauss's law. [1 mark]

(i) Write the four Maxwell's equations. [4 marks]

(j) State Faraday's law of electromagnetic induction. [1 mark]

(k) Apart from the Maxwell-Wien a.c bridge circuit, state two other a.c bridge circuits. [2 marks]

(l) A Maxwell-Wien bridge circuit ABCD has the following arm impedances. AB, 250Ω resistance; BC, $2\mu F$ capacitor in parallel with a 10kΩ resistor, CD, 400Ω resistor; DA, unknown inductor L in series with resistance R. Determine the values of L and R if the bridge is balanced. [8 marks]

2. (a) Define:

(i) Polarization of the dielectric of a capacitor
(ii) Dielectric strength
(iii) Filters [3 marks]

(b) Describe in detail low pass filters. [6 marks]

(c) In a series R-L circuit, the p.d across the resistance R is 12V and the p.d across the inductance L is 5V.

Find:

(i) The supply voltage [3 marks]
(ii) The phase angle between current and voltage [3 marks]

3. (a) Starting with Gauss's law, calculate the electric field due to an isolated point charge. [5 marks]

(b) What is the electric flux through a sphere that has a radius of 2.5m and carries a charge of $4\mu C$ at its centre? Take K = 9.0 x 10^9 N.m^2/C^2? [5 marks]

(c) In a R – C series a.c circuit, a resistor of 50Ω is connected in series with a capacitor of $90\mu F$. Calculate,

(i) the impedance [3 marks]
(ii) the current taken from a 240F, 50Hz supply. [2 marks]

4. (a) What is a R-L-C circuit? [1 mark]

(b) In a L-C parallel a.c circuit, a pure inductance of 240 mH is connected in parallel with a $50\mu F$ capacitor and the network is connected to a 100V, 50 Hz supply. Determine:

(i) the branch currents [8 marks]
(ii) the supply current [2 marks]
(iii) the circuit impedance [2 marks]

(c) Explain how temperature affects capacitor dielectrics. [2 marks]

5. (a) Define: (i) Conductance of transmission lines [1 mark]
(ii) Wavelength on a transmission line [1 mark]

(b) A transmission line has an inductance of 8 mH/loop km and a capacitance of $0.004\mu F/kg$. Determine for a frequency of operation of 0.5 kHz

(i) the phase delay [3 marks]
(ii) the wavelength on the line [3 marks]
(iii) the velocity of propagation of the signal in m/s [2 marks]

(c) Define a resonant circuit and state its significance in communication. [2 marks]

(d) A coil having a resistance 20Ω and inductance of 90 mH is connected in series with a $30\mu F$ capacitor across a 240V a.c supply. At what frequency does resonance occur? [3 marks]
