DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY
UNIVERSITY EXAMINATIONS 2015/2016
SECOND YEAR SEMESTER II EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY

SPH 2172: PHYSICS

DATE: 22ND DECEMBER 2015   **TIME:1.30 PM – 3.30 PM**

Some useful constants

(1) Charge of an electron e $= 1.602 \ x \ 10^{-19} C$

(2) Speed of light $c = \ 3x10^8 \ m/s$

(3) Permittivity of free space $= \ 8.854 \ x \ 10^{-12} \ F/m$

INSTRUCTIONS

**Answer questions one and any other two questions.**

QUESTION ONE (30 MARKS)

(a) State

   (i) Lenz's law.   **(1 mark)**

   (ii) Kirchhoff's loop law.   **(1 mark)**

(b) Show that if three resistors are connected in parallel with resistance $R_1, R_2 \ and \ R_3$ then the total

   resistance R_T is given by$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ **(4 marks)**

(c) Determine the standard value of the carbon corded resistor

             Blue- violet- black- silver.   **(2 marks)**

(d) An alternating current is represented as $i = 120 \ sin(\omega t)$.Calculate its$i_{r.m.s}$.   **(2 marks)**

(e) An R-L a.c circuit is connected in series to 60 Hz 240 Vr.m.s supply. If the resistance is 120Ω and the

   inductance is 300mH, determine the circuit impendence.   **(3 marks)**

(f) A motor coil has 20Ω and 45Ω resistance when its temperature is 40℃ and 90℃respectively. Find

   $R_0$of the coil given that its temperature coefficient of resistance $\alpha = 0.0044/℃$.   **(4 marks)**

(g) State two typesof capacitors.   (**2 mark)**

(h) A certain station transmits its signals at 200km. Determine its frequency.   **(3 marks)**

(i) State and explain two ways how power loss can be reduced in a.c transmission**.**   **(4 marks)**

(j) Three charges are held fixed at the vertices of an equilateral triangle as shown below. Calculate their mutual electric potential energy (U).Take $q = 1.5 \times 10^{-5}C$ and L = 70 cm. **(4 marks)**

+ 4q

70cm

+q   +2q
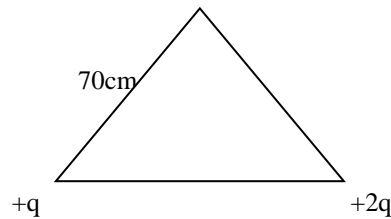
QUESTION TWO (20 marks)

(a) For a purely inductive circuits show that the inductive reactance is given by $X_L = \omega L$ **(5 marks)**

(b) A capacitor of 20µF and resistor of 100Ω are connected in series across a 50Hz 230 $V_{r.m.s}$ supply.

Calculate

        (i) the impendence of the circuit. **(3 marks)**

        (ii) the root mean square current. **(2 marks)**

(c) Two signals $V_1 = 70 \sin(\omega t)$ and $V_2 = 90 \cos(\omega t)$ are fed into one circuit .Determine the

representation of the superposed signal**. (5 marks)**

(d) A particle having a charge $q = 5x10^{-7}C$ moves from point P to point Q along a straight line, covering a distance of 6 m. The electric field is uniform along this line, in the direction from P to Q with magnitude E = 600 N/C. calculate

        (i) the force on the charge. **(3 marks)**

        (ii) the work done on it by the field. **(2 marks)**

QUESTION THREE (20 marks)

(a)Define the following terms.
        (i) electric current. **(1 mark)**
        (ii) the potential **(1 mark)**
 (b)A certain circular conductortransmits a charge of 1200C in 5 minutes. Given that the material making the conductor is 1.5mm in diameter, calculate

        (i) The current in the wire . **(3 marks)**

        (ii) its current density . **(3 marks)**

 (c)A straight wire 12 meters long carries a current of 2 A and is placed in a uniform magnetic field of 30T.Determine the force on the conductor if its inclined at40° to the direction of the field. **(3marks)**
 (d) Calculate the current in the circuit and the p.d across each resistor. **(9 marks)**
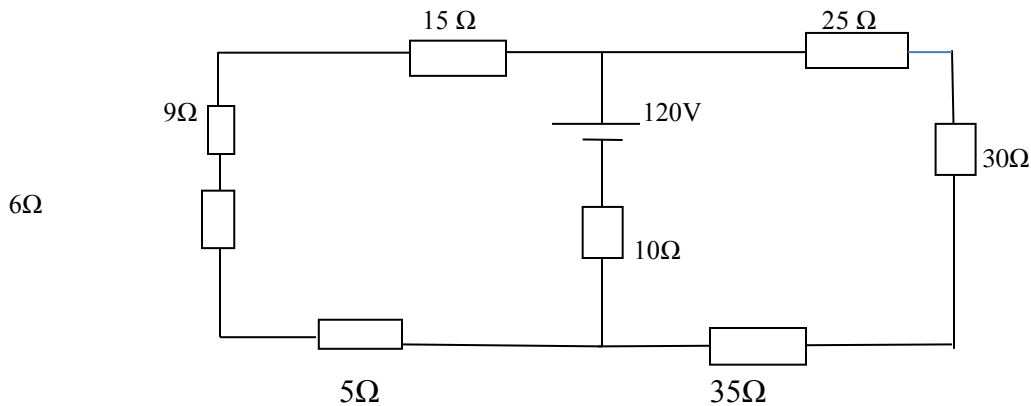
QUESTION FOUR (20 marks)

(a) Define the following terms.
   (i) power .   **(1 mark)**
   (ii) electric field.   **(1mark)**

(b) A R-L d.c circuit consists a 100 mH inductor, a 20Ω resistor and a 24V d.c. The switch is closed at $t = 0$ seconds. Determine
   (i) the time constant of the circuit.   **(2marks)**
   (ii) the current in the circuit at $t = 2.5\ seconds$.   **(3marks)**

(c) Two capacitor 4μF and 8μF are connected in parallel and the parallel connection is connected in series to 6μF capacitor .If the system is connected to 50V d.c ,determine

   (i)   the total capacitance of the circuit.   **(3 marks)**

   (ii) the total charge stored by the circuit.   **(2 marks)**

   (iii)the energy storedin the circuit.   **(3 marks)**

(d)A parallel plate capacitor has two plates each of area of 25cm^2.It has a dielectric of 0.15mm thick and dielectric constant of 4.5.if the capacitor is connected across 12V d.c,calculate
   (i)   Capacitance of the capacitor.   **(3 marks)**

   (ii) the flux density .   **(2 marks)**

QUESTION FIVE (20 MARKS)

(a) State and explain three factors that determine the resistance of a resistor.   **(3 marks)**

(b) State three factors that determine the induced e.m.f in self inductance.   **(3 marks)**

(c) Derive an expression of the electric potential energy U as a charge is moved from point $r_a$tor_b .   **(4marks)**

(d) Determine the color coding of 34 MΩ resistors having a tolerance a tolerance of$\pm2\%$.**(3marks)**

(e) An a.c is represented as V = 150 sin (55πt+3.5). Determine

     (i)   the root mean square potential ($V_{r.m.s}$). (**2 mark)**

     (ii)   the frequency and the period of the a.c.**(3 marks)**

     (iii)   the value of the voltage at t= 1.5 seconds.   **(2 marks)**