DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

SUPPLEMENTARY EXAMINATION
BACHELOR OF SCIENCE IN CIVIL ENGINEERING, MECHATRONICS ENGINEERING
ELECTRICAL AND ELECTRONICS ENGINEERING
GIS AND GEGIS AND MECHANICAL ENGINEERING.
SPH 1222: PHYSICS II/SPH 2174 PHYSICS FOR ENGINEERS II
YI SEMESTER 2 TIME 2 HRS

Instructions

Answer question one and any other two questions

Some useful contents

(1) Charge of an electron = 1.602×10^{-19} C
(2) Speed of light = 3×10^{8} m/s
(3) Mass of Proton = 1.0073 a.m.u
(4) Mass of Neutron = 1.0087 a.m.u
(5) 1 a.m.u = 931M eV
(6) Plank`s constant = 6.626×10^{-34} JS
(7) 1 a.m.u = 1.66×10^{-27} kg
(8) Permitivity of free space = 8.85×10^{-12} F/m
(9) Mass of an electron = 9.11×10^{-31} kg
(10) Half life of carbon 14 = 5730 years.

QUESTION ONE (30 marks)

(a) Define the following terms
  (i) binding energy. (1 mark)
  (ii) the potential (V). (1 mark)
  (iii)current density . (1 mark)
  (iv) capacitance. (1 mark)

(b) A conductor 1.8 m long carrying a current of 40 A lies perpendicular in a uniform magnetic field of 0.95 T. If the conductor moves with uniform speed of 20 m/s. Calculate.
  (i) The power required for the movement of the conductor. **(2marks)**
  (ii) The force acting on the conductor if it is inclined at 35 degrees to the magnetic field. **(2 marks)**

(c) A capacitor of 8 µF capacitance is charged by connecting it across a 80 Vd.c supply .Calculate the energy stored in the capacitor **. (3 marks)**

(d) Calculate the magnitude of the electric force between two point charges if they are 4.5×10^{-12} m given that the magnitude of their charges is equal to that of an electron. **(3 marks).**

(e) Differentiate between soft and hard x-rays. **(2 marks)**

(f) Determine the standard value of the following carbon coded resistor
  (i) Red – Yellow – blue – Silver. **(2marks)**
  (ii) White –green – violet - red . **(2marks)**

(g) A charge has a mass of 1.85 x10^{-27} kg, what maximum speed does it attain in falling through a potential of 3000 V. **(3marks)**

(h) A naturally occurring radioactive nuclide undergoes a series of transformation before one final stable product is obtained .Explain giving an example. **(3 marks)**

(i) Show that if two resistors are connected in series then they are potential dividers. **(3marks)**

QUESTION 2 (20 marks)

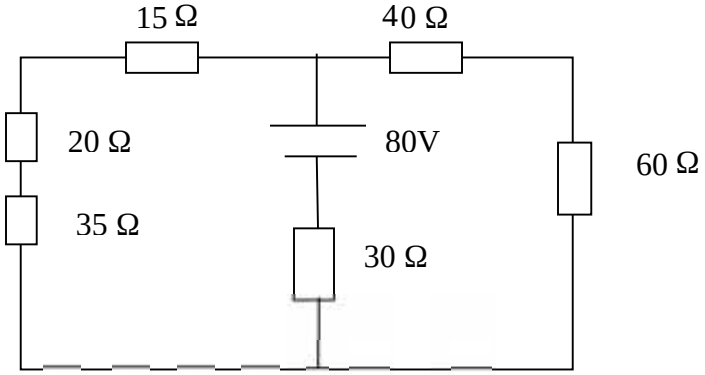
(a) State

(i) Ohm`s law. (1mark)

(ii) Lenz`s law. (1 mark)

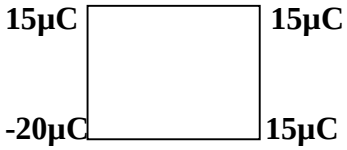
(iii)Kirchhoff's loop law. (1 mark)

(b) In the circuit below calculate the current through each resistor and the potential difference across each resistor. **(7 marks)**



(c) Show that if three resistors with resistance R_1,R_2,and R_3 are connected in parallel then their total resistance R_T is given by $\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$. **(5marks)**

(d) Three positive charges each of 15μC and one negative charges of -20 μC are fixed at the corners of a square of sides 80cm.Determine the potential (V) at the centre of the square**. (5marks)**



QUESTION 3 (20 marks)

(a) State

(i) Coulombs law of electrostatics **(1mark)**

(ii) Two types of capacitors. **(2marks)**

(iii)Two uses of dielectrics**. (2 marks)**

(b) A capacitor of plate area $250cm^2$ has a dielectric 1.5mm thick. If the dielectric constant is three and the capacitor is connected across 1500 V direct current, determine

(i) the capacitance of the capacitor. **(3 marks)**

(ii) electric flux density in the dielectric. **(2 marks)**

(iii) electric field strength in the dielectric. **(2marks)**

(c) An 120μF capacitor is charged to a potential of 300V.The terminals of the charged capacitor are then disconnected and connected to 80μF capacitor, determine

(i) the final p.d across each of the capacitors. **(3 marks)**

(ii) the change in energy in the two systems i.e original and final system**.(5 marks**)

QUESTION 4 (20 marks)

(a) State

(i) Two uses of X-rays. **(1 mark)**

(ii) Two uses of radio – activity. **(1 mark)**

(iii)Two radiations occurring in natural radio activity**.(1mark)**

(b) Calculate the shortest wavelength present in the radiation from an X-ray machine whose accelerating potential is 90,000V. **(4marks)**

(c) In an archeological expedition, charcoal from an ancient fire-pit was excavated. The sample showed a carbon 14 activity count of 10.8 counts per gm per minute absolute activity of carbon 14 in a living tree is independent of the species and its 15.3 counts per gm per minute. Estimate the age of the charcoal sample. **(4 marks)**

(d) A certain radioactive atom has a mass of 19.013a.m.u.Determine its binding energy if it has a mass number of twenty and atomic number of eleven. **(4 marks)**

(e) Explain briefly how x-rays are produced. **(5 marks)**

QUESTION FIVE (20 marks)

(a) State

(i) two ways in which magnetic flux linkage can be changed. (**2 marks)**

(ii) Faraday`s Law of electromagnetic induction. **(2 marks)**

(b) (i) Show that the current at any time in R-L d.c circuit is given by $i = \frac{V}{R}\left(1 - e^{\frac{-Rt}{L}}\right)$.**(7 marks)**

(ii) An R-L d.c circuit consists a 50mH inductor ,a 5Ω resistor and a 12 V battery. The switch is closed at $t = 0$ seconds. Determine the current in the circuit at $t = 2.5 \times 10^{-3}$ seconds. **(3 marks)**

(c) The resistance of a coil of aluminum wire at 18℃ is 200Ω. The temperature of the wire is increased and the resistance rises to 240Ω. If the temperature coefficient of resistance of aluminum is 0.0039/℃ at 18℃ , determine the temperature to which the coil has risen. **(4 marks)**