DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

EXAMINATIONS 2019/2020

BACHELOR OF SCIENCE IN ELECTRIC AND ELECTRONIC ENGINEERING (EEE) AND TELECOMMUNICATIONS AND INFORMATION ENGINEERING (TIE)

SPH 1222 **PHYSICS II**

Date: **Time:**

Instructions

1. Answer **QUESTION ONE** and any other **two questions**
2. Use standard notation and SI units only
3. No casual free-hand diagrams

Some useful constants

(1)	Charge of an electron	=	1.6×10^{-19} C
(2)	Resistivity of nichrome	=	1.2×10^{-6} Ω.m
(3)	Speed of light	=	3×10^{8} m/s
(4)	Mass of Proton	=	1.0073 a.m.u
(5)	Mass of Neutron	=	1.0087 a.m.u
(6)	1 a.m.u	=	931MeV
(7)	Plank`s constant	=	6.63×10^{-34} J.s
(8)	1 a.m.u	=	1.66×10^{-27} kg
(9)	Permitivity of free space	=	8.85×10^{-12} F/m
(10)	Mass of an electron	=	9.1×10^{-31} kg
(11)	Temperature coefficient of resistivity of copper= $3.86 \times 10^{-3} K^{-1}$		

QUESTION ONE COMPULSORY (30 marks)

(a) Define the following terms:

(i) Binding energy **(1 mark)**
(ii) Electric potential (V) **(1 mark)**
(iii)Current density **(1 mark)**
(iv) Capacitance **(1 mark)**

(b) A conductor 1.8 m long carries 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 VDC supply .Calculate the energy stored in the capacitor* **(3 marks)**

(d) Calculate the magnitude of the electric force between two alpha particles 5.3 x 10 $^{-11}$ m apart **(3 marks)**

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

(f) (i) *Determine the standard value of the following carbon coded resistor : Red-violet-orange-silver* ***(2 marks)***

(ii) Give the colour code for a 5.6 kΩ - resistor ***(2 marks)***

(g) *What maximum speed does attain an alpha particle when it travels through a pd of 3000 V from rest.* **(3 marks)**

(h) A naturally occurring radioactive nuclide undergoes β^- decay. What are the particles products of such transformation? Give an example **(3 marks)**

(i) Show how two resistors connected in series constitute a potential divider and give the expression for such a divider. **(3marks)**

QUESTION 2 **OPTIONAL** **(20 marks)**

(a) State

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

(ii) Joule-Lenz`s law. **(1 mark)**

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

(b) *A starter motor in a car draws 220 A of current from the 12 V battery for 1.2s.*

(i) How much charge is pumped by the battery?

(ii) How much electric energy is supplied by the battery? **(4 marks)**

(c) *If 46 m of nichrome wire is to have 10Ω of resistance; what diameter wire should be?* **(3 marks)**

(d) Find the equivalent resistance of three resistors R_1, R_2, and R_3 when they are connected in parallel (**4 marks)**

(e) *The resistance of a conductor is 19.8 Ω at 15^0 C and 25 Ω at 85^{0}C. What is the temperature coefficient of resistivity of the material?* **(3 marks)**

(f) Show that A^2 X Ω = W **(3 marks)**

QUESTION 3 **OPTIONAL** **(20 marks)**

(a) Define the following terms:

(i) Permittivity

(ii) Dielectric strength

(iii) One Farad **(3 marks)**

(b) *Three positive charges each of 15μC and one negative charge of - 20 μC are fixed at the corners of a square of sides 80cm. Determine the electric potential at the centre of the square.* **(3 marks)**

(c) State
(i) Coulomb's law of electrostatics **(2 mark)**
(ii) Two types of capacitors. **(2 marks)**
(iii)Two uses of dielectrics**.** **(2 marks)**

(d) *A capacitor of plate area* $250cm^2$ *has a dielectric 1.5mm thick. If the dielectric constant is 3 and the capacitor is connected across 1500 VDC, determine*
(i) The capacitance of the capacitor. ***(3 marks)***
(ii) The electric energy stored in the capacitor ***(3 marks)***
(iii) The electric field strength in the dielectric. **(2 marks)**

QUESTION 4 **OPTIONAL** **(20 marks)**

(a) Explain
(i) Two uses of radioactivity **(1 mark)**
(ii) Gamma spectroscopy **(1 mark)**
(iii)Two radiations occurring in natural radioactivity **(1mark)**

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

(c) A radioactive isotope of mercury, Hg^{197} *decays into gold* Au^{197} *with a disintegration constant of 0.0108* h^{-1}.
(i) Calculate its half-life
(ii) What fraction of the sample will remain at the end of 10 days? **(4 marks)**

(d) *A certain radioactive atom has a mass of 19.7013 a.m.u. Determine its binding energy if it has a mass number of twenty and atomic number of eleven.* **(4 marks)**

(e) With the aid of a simplified labeled diagram, explain briefly how X-rays are produced. **(5 marks)**

QUESTION FIVE **OPTIONAL** **(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) *A uniform magnetic field points North; its magnitude is 1.5 T. A proton with kinetic energy* $8.0X10^{-13}J$ *is moving vertically downward in this field. What is the force acting on it?* **(4 marks)**

(c) (i) Show that the current at any time in R-L DC circuit is given by $I = \frac{V}{R}\left(1 - e^{\frac{Rt}{L}}\right)$ **.(3 marks)**

(d) *An R-L d.c circuit consists of 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*. **(4 marks)**

(e) *A 30 cm- long solenoid has 1200 turns. Determine the magnetic flux density inside the solenoid if the current is 2A.* **(3 marks)**

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