



**DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY**

**University Examinations 2015/2016**

**FIRST YEAR SEMESTER II EXAMINATION FOR THE DEGREE OF BACHELOR OF  
SCIENCE IN**

**CIVIL ENGINEERING, MACHATRONICS ENGINEERING,**

**ELECTRICAL AND ELECTRONIC ENGINEERING, MECHANICAL ENGINEERING,**

**GEOSPATIAL INFORMATION SCIENCE & GEOMATIC ENGINEERING & GEOSPATIAL  
INFORMATION SYSTEMS.**

**SPH 2171/: PHYSICS II/SPH 2174 PHYSICS FOR ENGINEERS II**

**DATE: 13<sup>TH</sup> APRIL 2016**

**TIME: 11AM-1PM**

---

**Some useful constants**

- (a) *Charge of an electron*  $e = 1.6 \times 10^{-19} \text{ C}$
- (b) *speed of light*  $C = 3 \times 10^8 \text{ m/s}$
- (c)  $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$
- (d) Mass of proton = 1.0073 a.m.u
- (e) Mass of Neutron = 1.0087 a.m.u
- (f) 1 a.m.u = 931 MeV
- (g)  $h = 6.626 \times 10^{-34} \text{ Js}$
- (h) 1 a.m.u =  $1.66 \times 10^{-27} \text{ Kg}$
- (i)  ${}^1_1\text{H} = 1.0078 \text{ a.m.u}$
- (j)  ${}^7_3\text{Li} = 7.0016 \text{ a.m.u}$
- (k)  $\frac{h}{mc} = 0.0242 \text{ \AA}$

### Instructions

Answers question one and any other two questions.

### Question one (30 marks)

(a) Define the following terms

- i. Drift velocity . (1 mark)
- ii. The potential(V). (1 mark)
- iii. Atom . (1 mark)

(b) A parallel plate capacitor with a dielectric whose thickness is 0.15mm has a p.d of 60V applied across the arrangement. Calculate the electric field intensity between the plates .( 3 marks).

(c) Outline how you can verify Ohm`s law ,giving all the circuit diagrams required.( 3 marks)

(d) The resistance of a conductor at °C is 140Ω.If the temperature coefficient of resistance of the conductor at 0°C is 0.004264/°C,determine its resistance at 70°C. ( 3marks)

(e) State three factors that determine the force on a current carrying conductor in a magnetic field. ( 3 marks)

(f) Show that  $N = N_0 e^{-\lambda t}$  where the symbols have their usual meaning. ( 4 marks)

(g) Tritium is an unstable isotope of hydrogen  ${}^3_1\text{H}$  if its 3.011 a.m.u. Determine its binding energy. ( 3 marks)

(h) Write an equation showing how a proton changes to a neutron. ( 2marks)

(i) State three uses of radio activity. ( 3marks)

(j) List three similarities between magnetic field lines and electric field lines ( 3marks)

### Question two (20 marks)

(a) State

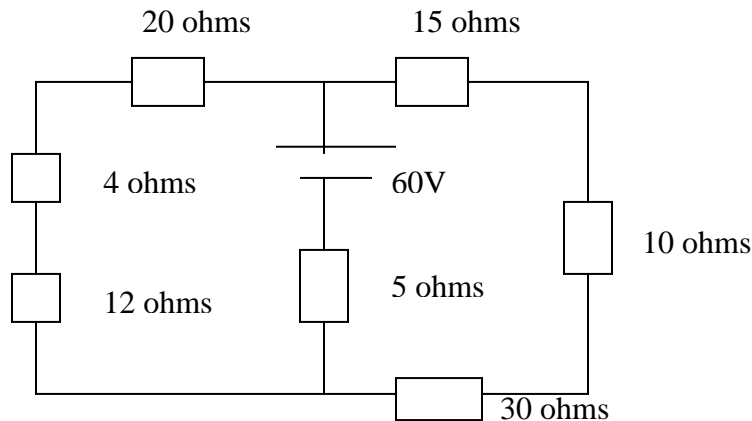
- (i) Kirchoff`s current law. ( 1mark)
- (ii) Lenz`s law. ( 1 mark)
- (iii)Farady`s laws of electromagnetic induction. ( 1 mark)

(b) (i) Show that the electric current through a cylindrical conductor is given by  $I = nqvA$  where all the symbols have their usual meaning. ( 5 marks)

(ii) A given electric bulb is labeled 100W 0.9A.Calculate the number of charges passing its cross-section in 1.5 hours. ( 3 marks)

(c) State three factors that affect resistance ( 3 marks)

(d) Determine the current through each of the resistors (6 marks)



**Question three (20 marks)**

(a) Show that for parallel plate capacitor with dielectric as free space is given as

$$C = \frac{\epsilon_0 A}{d} \quad \text{where A is area of plate and d the plates separation distance.} \quad (5 \text{ marks})$$

(b) Three charges  $-3.2 \times 10^{-6} C$ ,  $-4 \times 10^{-6} C$  and  $+5 \times 10^{-6} C$  are placed at the points (0,7), (10,0) and (-6,0) respectively. Calculate the electric field at the point (0,0), all units are in metres. (5 marks)

(c) State two uses of capacitors. (2 marks)

(d) Three capacitors  $3 \mu F$ ,  $6 \mu F$  and  $18 \mu F$  are connected across a 20V d.c in series. Calculate the total charge stored by the system. (4 marks)

(e) Two capacitors  $C_1$  and  $C_2$  when connected in series results in a total capacitance of  $2 \mu F$  and while connected in parallel results in a total of capacitance of  $9 \mu F$ . Find the possible values of the two capacitors. (4 marks)

**Question four (20 marks)**

(a) State two types of radioactivity. (2 marks)

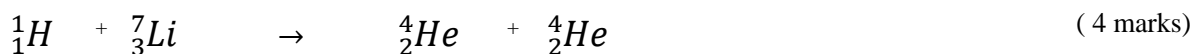
(b) The half-life of a certain element is  $4.5 \times 10^8$  years. Calculate its decay constant. (3 marks)

(c) Write an equation for a general particle when it undergoes a beta decay. (3 marks)

(d) Differentiate between nuclear fission and nuclear fusion. (2 marks)

(e) Sketch and explain a graph of Binding energy per nucleon against mass number. (4 marks)

(f) Calculate the binding energy released in the following reaction



(g) State two dangers of radioactive radiations. ( 2 marks)

**Question five (20 marks)**

(a) State four properties of X-rays. (4 marks)

(b) Determine the energy in electron volts of a photon having a wavelength of  $9 \times 10^{-10} m$ . ( 3 marks)

(c) An electron falls through a p.d of  $10^7 V$ . Calculate

(i) The energy given up by the electron. ( 3 marks)

(ii) The frequency of the electromagnetic radiation produced. ( 3 marks)

(d) Differentiate between X-rays and Gamma rays. ( 2marks)

(e) An X-ray of  $1.5 \times 10^{-10} m$  is incident on a target. Calculate

(i) the wavelength of the scattered photon at  $\theta = 90^\circ$ . ( 2 marks)

(ii) the energy of the scattered electron. ( 3 marks)