Ser. No. EDU 130/18

GARISSA UNIVERSITY

UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE SECOND SEMESTER EXAMINATION

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCE

FOR THE DEGREE OF BACHELOR OF SCIENCE (COMPUTER SCIENCE)

COURSE CODE: PHY 111

COURSE TITLE: BASIC PHYSICS II

EXAMINATION DURATION: 3 HOURS

DATE: 19/04/18 **TIME: 09.00-12.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of FOUR (4) printed pages ***please turn over***

USE THE FOLLOWING CONSTANTS WHERE NECESSARY:

Speed of light $c = 3.0 \times 10^{8}\ m/s$; Charge of an electron $e = 1.6 \times 10^{-19}\ C$

Permittivity of free space $\varepsilon_o = 8.854 \times 10^{-12}\ F/m$;Permeability of free space $\mu_o = 4\pi \times 10^{-7}\ T.m/A$

Mass of neutron $M_n = 1.672 \times 10^{-27}\ kg = 939.6\ MeV/C^2 = 1.00865\ u$

Mass of proton $M_p = 1.672 \times 10^{-27}\ kg = 1.00727\ u$; Mass of ${}^{2}_{1}H = 3.345 \times 10^{-27}\ kg$, Mass of ${}^{3}_{1}H = 5.008 \times 10^{-27}\ kg$; Mass of ${}^{4}_{2}He = 6.647 \times 10^{-27}\ kg$; One atomic mass unit $u = 1.66 \times 10^{-27}\ kg = 931\ MeV/C^2$

Stefans constant $\sigma = 5.670 \times 10^{8}\ w/m^2.k^4$

QUESTION ONE (COMPULSORY)

(a) (i) Define the term magnetic field **[1 mark]**

(ii) A rectangular coil of wire is situated in a constant magnetic field whose magnitude is 0.5 T. if the coil has an area of $2 \times 10^{4}\ cm^2$, determines the magnetic flux for a 60^o orientation. **[2 marks]**

(b) A toroid core has N = 1200 turns, length L = 80cm, cross-sectional area A = 60cm^2, current I = 1.5A. Calculate the value of B. Assume an empty core **[2 marks]**

(c) Derive an expression for the total capacitance for two parallel plate capacitors connected in series with no dielectric material between the plates. **[3 marks]**

(d) (i) Distinguish between p-type and n-type semiconductors. **[1 mark]**

(ii) Sketch the circuit diagram for a half-wave rectifier and explain how it operates. **[2 marks]**

(e) Mention two uses of a cathode ray oscilloscope. **[2 marks]**

(f) i) State the Kirchhoff's current law and Kirchhoff's voltage law. **[2 marks]**

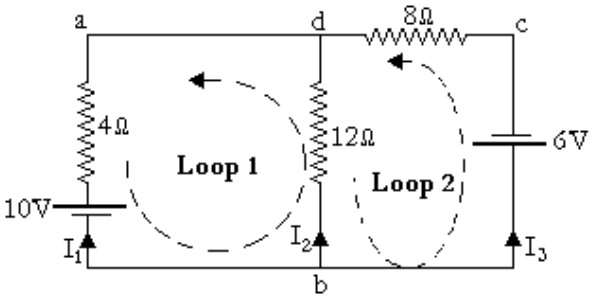

Figure 1

ii) Consider the following circuit. Calculate the current I_1, I_2 and I_3 in the circuit of figure 1.

[5 marks]

(g) (i) Explain how the intensity of x-rays can be increased; hence distinguish between soft and hard x-rays. **[2 marks]**

(ii) Consider a sample with N undecayed nuclei. Show that for such a sample, the number of nuclei remaining after a time t is given as $N = N_o e^{-\lambda t}$ where the symbols have their usual meaning. **[3 marks]**

QUESTION TWO

(a) (i) An electron has velocity $v = 10^6 \hat{j}\ m/s$ in a field $B = 5 \times 10^{-2} \hat{k}$ Tesla. Calculate the force acting on the electron. Draw a diagram to show the direction of the force relative to B and v. **[3 marks]**

(ii) A specimen of iron is uniformly magnetized by a magnetic field of strength 200 Am^{-1}. If the magnetic flux density in the specimen is 0.1 T, find the relative permeabi μ_r of the iron. **[3 marks]**

(b) A lamp with a 40-watt bulb is plugged into 120-V rms outlet. Determine:

(i) The rms peak currents through the lamp **[3 marks]**

(ii) The resistance of the lamp **[2 marks]**

(c) i) What is magnetic hysteresis? **[1 mark]**

ii) Sketch a typical hysteresis curve and explain its shape. **[2 marks]**

iii) State what can be deduced from the curve in (ii) about the magnetic properties of the material? **[1 mark]**

QUESTION THREE

(a) Starting with an intrinsic semiconductor, describe briefly how a p-type semiconductor can be made. **[3 marks]**

(b) Draw a circuit that can be used to investigate the p-n junction diode characteristics. Sketch the diode characteristics. **[2 marks]**

(c) With the help of a diagram, explain briefly how full-wave rectification is achieved in a bridge rectifier circuit. Sketch the input and output waveforms. **[3 marks]**

(d) Use diagrams to show how a p-n-p transistor may be constructed from two diodes **[2 marks]**

(e) Using a diagram, explain how Fresnel diffraction can be converted to Fraunhofer's diffraction. Indicate the type of lens to be used. **[3 marks]**

(f) In Young's double slit experiment, two slits spaced 0.2 mm apart are focused to Produce the third bright fringe at a point 7.5 mm from the central fringe on a screen at a distance of 1 m away. Find the wavelength of light used **[2 marks]**

QUESTION FOUR

(a) (i) With the help of a diagram, derive an expression for the impedance Z, of an inductor L, and a resistor R connected in series to an alternating voltage. **[4 marks]**

(ii) Determine the expression for the resonant frequency f_o in a series RLC circuit **[3 marks]**

(iii) Sketch the variation of impedance Z, Inductive reactance χ_L, resistance R and capacitive reactance χ_C, with the frequency of the supply, for RLC series circuit.[2marks

(b) A series RLC circuit has the following elements: R = 100 Ω, C = 20 μF and L = 0.35 H. The circuit is connected to an a.c. source of V_{Max} = 240 V and a frequency of 50 Hz. Calculate the following.

i. Inductive reactance **[2 marks]**

ii. Capacitive reactance **[2 marks]**

iii. Impedances of the circuit **[2 marks]**

QUESTION FIVE

(a) With the aid of a diagram of a spherical mirror derive the mirror formula **[6 marks]**

(b) A pencil is placed 10 cm in front of 15 cm focal length concave mirror. Determine the location of the image and state whether the image is real or virtual, erect or inverted and calculate the lateral magnification. **[4 marks]**

(c) A thin lens is constructed such that the radii of the first and second surfaces are 20 cm and 10 cm respectively, and that the glass has an index of refraction of 1.50 for light of wavelength $589 \times 10^{-9} m$. Determine the corresponding focal length of this lens **[2 marks]**

(d) In a Young's slits experiment, the separation of four bright fringes is 2.5mm when the wavelength used is 6.2×10^{-7}m. The distance from the slits to the screen is 0.8m. Calculate the separation of the two slits. **[3 marks]**

QUESTION SIX

(a) (i) State the three Bohr postulates. **[3 marks]**

(ii) What is the energy of a photon that will raise the hydrogen atom from its ground state to the n=4 excited state? **[2 marks]**

(b) (i) Describe any three uses of x-rays. **[3 marks]**

(ii) A radioactive element has a decay constant $\lambda = 1.36 \times 10^{-11}\ s^{-1}$, determine how long it takes for its mass to reduce from 2g to 1g **[2 marks]**

(c) Show that the energy of an electron is given by $E = -\frac{me^4}{8\varepsilon_o^2 n^2 h^2}$ (where n = 1,2,3…….)

[5 marks]