JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

BACHELOR OF SCIENCE IN CONSTRUCTION MANAGEMENT WITH IT

BACHELOR OF SCIENCE RENEWANLE ENERGY WITH IT

1ST YEAR 2ND SEMESTER 2021/2022 ACADEMIC YEAR

MAIN CAMPUS

RESIT/SPECIAL

COURSE CODE: SPB 9102

COURSE TITLE: PHYSICS II

EXAM VENUE: **STREAM: (BED SCI.)**

DATE: **EXAM SESSION:**

TIME: 2 HOURS

Instructions:

1. **Answer question 1 (compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

You may use the following constants:

Electronic charge $e = 1.6 \times 10^{-19} C$,
Permeability of free space $\mu_0 = 4\pi \times 10^{-7}\ N/A^2$
Unified atomic mass unit $1u = 1.6606 \times 10^{-27} kg = 931MeV$,
Mass of a proton $M_P = 1.007267u$,
Mass of a neutron $M_n = 1.008665u$,
Becquerel $1Bq = 1\ decay/Sec$,
Curie $1Ci = 3.70 \times 10^{10} Bq = 3.70 \times 10^{10}\ decay/Sec$,
Rydberg constant $R = 1.097 \times 10^{7} m^{-1}$,
Speed of light $c = 3.0 \times 10^{8}\ m/s$.

Question one (30 Marks)

(a)

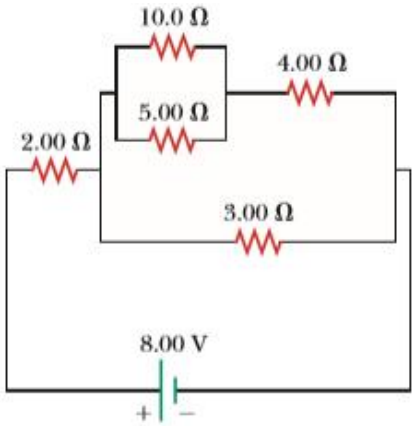
i) A torroid of length 100cm has 1500 turns and cross sectional area of 60cm^2. If it carries a current of 1.5A, compute B and H giving the appropriate units for each. (2 marks)

ii) (ii) If the total flux density B in the torroid mentioned in (a)(i) above is measured to be$3.83 \times 10^{-3} T$, Find the magnetization M, the relative permeability μ_r and the magnetic moment, *m* for the whole torroid due to surface current. (5 marks)

(b)

i) Why is it possible for a bird to sit on a high-voltage wire without being electrocuted? (1 mark)

ii) Consider the circuit shown below.



i) Find the voltage across the 3.00 Ω resistor. (3 marks)
ii) Find the current in the 3.00 Ω resistor (2 mark)

(c) Draw the variation of the magnetic intensity B with the applied field H for a typical magnetic material taken through a complete cycle of magnetization. Use the diagram to define,

i) Saturation point for the material

ii) Remanance

iii) Coercive force of the specimen (4 marks)

(d) With the help of a well labeled diagram, show that the current density J in a wire of cross-sectional area,A and n free electrons per unit volume which are drifting with a velocity V is $J = \text{neV}$
(3 marks)

(e) What are the majority and minority charge carriers in a p-type semiconductor? Where do the minority carriers come from? (2 mark)

(f) Define the half-life of a radioactive sample. How long does it take for 60% of a sample of radon to decay? Half-life of radon is 3.8 days (4 marks)

Question Two (20 Marks)

(a)

i) Show that the work done in increasing the charge in a capacitor C which is connected to a potential difference V is $\delta W = V\delta Q$ (5 marks)

ii) A 370 μF capacitor in a photoflash unit is charged to a potential difference of 330 V. How much charge and energy is stored on the capacitor . (5 marks)

(b) When an R-L-C circuit is driven in resonance, what is the impedance? (2 mark)

(c)

i) With the aid of clearly labeled diagrams distinguish between concave and convex lenses.
(2 marks)

ii) A converging lens has two surfaces with radii of curvature$R_1 = 80\text{cm}$ and $R_2 = 36\text{cm}$to the left of the lens for which n=1.63. Find the power of the lens**.**
(2 marks)

iii) Why is that white light sources are not used in Young's double slit experiment
(2 mark)

(d) Explain why n-p-n transistors are most widely used and especially so for high frequency applications as opposed to p-n-p transistors (2 mark)

Question Three (20 Marks)

(a) A $10\mu F$ capacitor is connected into a charging circuit with a power supply of 12V and a resistor of100Ω. Find,

i) The time constant for the circuit

ii) The maximum charge on the capacitor

iii) If the charge on the capacitor at any given time t is,$Q = Q_0\left(1 - e^{\frac{-t}{RC}}\right)$, how long does it take for the capacitor to be charged to 90% of its maximum charge?

(8 marks)

(b) An L-R-C series circuit has a resistance $R = 250\Omega$, inductance $L = 0.60H$ and capacitance $C = 3.50\mu F$is connected to a voltage source$V(t) = 150\sin(377\,\text{rad}/s)t$. Determine the,

i) Impedance Z.

ii) Phase angleφ.

iii) Current in the circuit i(t).

iv) Current at t=1.24s.

v) Potential drops $V_R(t)$, $V_L(t)$ and $V_C(t)$ (12 marks)

Question Four (20 Marks)

a)

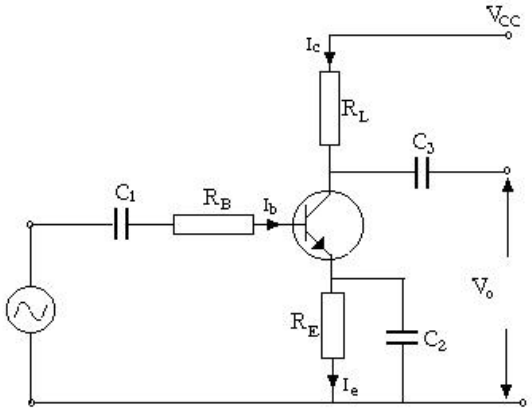
i) Distinguish between intrinsic and extrinsic conduction in semiconductors. (2 mark)

ii) Explain the terms donor impurity and acceptor impurity**.** (2 mark)

iii) Explain the effect of an increase in temperature on intrinsic conduction. (2 mark)

iv) How does this differ from the effect of an increase in temperature on a metallic conductor? (2 mark)

b) The diagram below shows a common emitter transistor connection. Given R_B=1MΩ, V_{BB}=30V, V_{CC}=30V, R_E=10KΩ, R_C=5KΩ and β=100. Calculate I_e , I_c , I_b , V_c ,



V_e and V_{ce}.

(10 marks)

c) Sketch the circuit diagram of a full wave rectifier and explain how it operates. Show the input and output waveforms (2 marks)

Question Five (20 Marks)

(a)

i) Define the focal point of a spherical mirror (2 mark)

ii) An object is placed 20cm from a diverging lens of focal length 15cm. Calculate the image position and magnification (5 marks)

(b) With the aid of a clearly labeled diagram, show that the magnification of an astronomical telescope at normal adjustment is $M = \frac{f_0}{f_e}$, where f_0 is the focal length of the objective lens and f_e is the focal length of the eye piece lens. (5 marks)

(c) i) Using a well labeled diagram, show that the condition for minima in a single slit experiment is $a\sin\theta = m\lambda$ where a is the size of the slit, λ is the wavelength of the light used and m is the order of the spectra. (5 marks)

i) A single slit has a width of $2.1 \times 10^{-6}m$ and is used to form a diffraction pattern. Find the angle that locates the second dark fringe when the wavelength of the light used is 430nm. (4 marks)