



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY  
SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES  
UNIVERSITY EXAMINATION FOR THE DIPLOMA IN LABORATORY SCIENCE  
TECHNOLOGY (SCIENCE)  
2<sup>ND</sup> YEAR 2<sup>ND</sup> SEMESTER 2023/2024 ACADEMIC YEAR  
MAIN  
REGULAR**

---

**COURSE CODE: SLD 1203**

**COURSE TITLE: PHYSICS TECHNIQUES III**

**EXAM VENUE:**

**STREAM: EDUCATION**

**DATE:**

**EXAM SESSION:**

**TIME: 2:00 HRS**

---

**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.**
- 4 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  $1u = 1.6606 \times 10^{-27} kg = 931 MeV$ ,*

*Mass of a proton  $M_p = 1.007267u$ ,*

*Mass of a neutron  $M_n = 1.008665u$ ,*

*Becquerel  $1Bq = 1 decay/Sec$ ,*

Curie  $1\text{Ci} = 3.70 \times 10^{10}\text{Bq} = 3.70 \times 10^{10}\text{ decay/Sec}$ ,  
Rydberg constant  $R = 1.097 \times 10^7\text{m}^{-1}$ ,  
Speed of light  $c = 3.0 \times 10^8\text{ m/s}$ .

### QUESTION ONE (30 MARKS)

- a) Define the following terms (3 marks)
- Magnetic materials
  - Magnetisation
  - Magnetic force
- b) Ohm's law
- c) Distinguish between full wave and half wave rectification (3 marks)
- d) i) State any three differences between electric and magnetic field lines (3 marks)
- (ii) A point charge of  $+3.0 \times 10^{-6}\text{C}$  is  $12.0\text{ cm}$  distance from a second point charge of  $-1.50 \times 10^{-6}\text{C}$ . Calculate the magnitude of the force on each charge. (4 marks)
- e) What is half life? (2 marks)
- f) State the three types of radiations (3 marks)
- g) An x-ray tube operated at d.c potential difference of  $40\text{kV}$  produces heat at the target at the rate of  $720\text{W}$ . Assuming  $0.5\%$  of the energy of the incident electrons is converted into x-rays, calculate the number of electrons per second striking the target (4 marks)
- h) Highlight any three uses of the CRO (3 marks)
- i) Draw the variation of the magnetic intensity  $\mathbf{B}$  with the applied field  $\mathbf{H}$  for a typical magnetic material taken through a complete cycle of magnetization. Use the diagram to define,
- Saturation point for the material
  - Remanance field.
  - Coercive force of the specimen (5 marks)

### QUESTION TWO (20 MARKS)

- a) With the aid of a schematic set-up of a cathode ray oscilloscope, discuss its working principle. (8 marks)
- b) Give any three uses of cathode ray oscilloscope. (3 marks)
- c) Differentiate between hard and soft ferromagnetic materials. Give examples (3 marks)
- d) Give an account of the domain theory of magnetisation (2 marks)

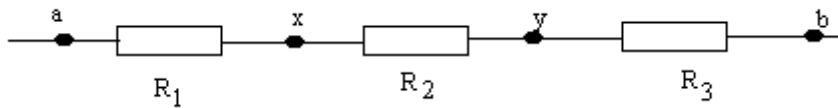
e) Show that the reciprocal of equivalent capacitances in series is given by

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \quad (4 \text{ marks})$$

**QUESTION THREE (20 MARKS)**

- a) With aid of a diagram describe the electromagnetic spectrum. (4 marks)
- b) What is meant by magnetic hysteresis? Sketch a typical hysteresis curve and explain. What can be deduced from this about the magnetic properties of the material? (8 marks)
- c) What are the desirable magnetic properties for the material of (i) the core of an electromagnet and (ii) a permanent magnet? (2 marks)
- d) Distinguish between Diamagnetism, Paramagnetism and Ferromagnetism (3 marks)

Consider the resistors  $R_1$ ,  $R_2$  and  $R_3$  connected as shown above. If the current  $I$  is flowing through the circuit between points a and b, determine the effective resistance across ab. (3 marks)



**QUESTION FOUR (20 MARKS)**

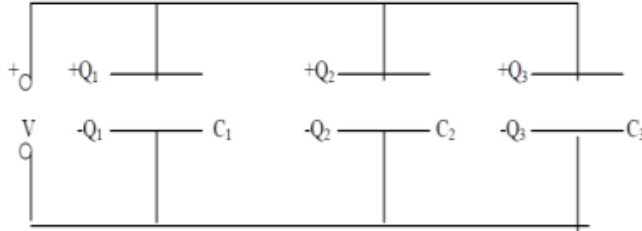
- (a) Define the term radioactivity (2 marks)
- (b) By denoting the number of nuclides in a radioactive decay process at time  $t_0 = 0$  by  $N_0$  and the number of nuclides at the present time  $t$  by  $N'$  obtain the expression connecting  $N$  and  $N_0$ . (5 marks)
- (c) Determine the number of years it takes for 60 % of a given mass of a radio-isotope whose half-life is 6 years to decay. (4 marks)
- (d) With aid of a diagram describe how x-ray can be produced (5 Marks)
- f) Highlight any four uses of x-rays (4 marks)

**QUESTION FIVE (20 MARKS)**

- a) With aid of a diagram describe the hysteresis loop through a magnetization cycle.

(5 marks)

- b) Consider capacitors  $C_1$ ,  $C_2$  and  $C_3$  arranged in parallel as shown above. The applied p.d  $V$  is same across each but the charges are different. Compute the effective capacitance for the network shown below. (4 marks)



- c) (i) What is wave rectification? (2 marks)  
(ii) With aid of a diagram describe Half-wave rectification (3 marks)  
d) State the Kirchhoff's Laws (2 Marks)

- e) Consider the following circuit. Calculate the current  $I_1$ ,  $I_2$  and  $I_3$  in the above circuit. (4 marks)

