KENYA MEDICAL TRAINING COLLEGE
NYERI CAMPUS
DEPARTMENT OF RADIOGRAPHY AND IMAGING

2021/2022 ACADEMIC YEAR
SEMESTER 1 MID-SEMESTER EXAM

CLASS: SEPT 2021
MODULE: MEDICAL PHYSICS AND CHEMISTRY (1112)
DATE: 7th DECEMBER, 2021
TIME: 08:30-10:30 HRS

INSTRUCTIONS

1. You are allowed **TWO HOURS** for answering **ALL** the **FOUR** questions of this paper.
2. You should write legibly and avoid irrelevant matters.
3. Questions not numbered or wrongly numbered will not be marked.
4. You are advised to read the questions carefully and illustrate your answers by diagrams where necessary.
5. Marks indicated alongside the questions are for your guidance in planning your answers.
6. **DO NOT** write your name on any question paper/answer sheet. Instead write your College Number.

QUESTION ONE

1. What is an inductor **(2 marks)**
2. State three factors affecting inductance of an inductor **(3 marks)**
3. Step by derivation show that the energy stored in an inductor is given as

$$U = \frac{1}{2} Li^2$$ **(10 marks)**

4. Imagine that an inductor of 200 mH connected across a supply of 9V is passing a current of 2A. When the current is switched off, it collapses to zero in 10 ms, what would be the emf generated across the coil **(4 marks)**

5. Define the following terms as used in electromagnetic induction

   (i) Retentivity **(2 marks)**

   (iii) Coercive field **(2 marks)**

   (iv) Permeability **(2 marks)**

QUESTION TWO

1. State the Heisenberg uncertainty principle and write the mathematical equation **(3 marks)**

2. The position of an electron in an atom is to be determined to the precision of 0.02 nm. Estimate the uncertainty involved in the velocity of an electron. Take $h = 6.626 \times 10^{-34}$ Js ; Mass of an electron = 9.11×10^{-31} kg **(4 marks)**

3. Discuss the Bohr theory of atomic structure **(6 marks)**

4. Discuss Bohr theory and state how his limitation was resolved **(8 marks)**

5. State the four quantum numbers that can be used to describe the state of an electron in an atom **(4 marks).**

QUESTION THREE

1. (i) Define geometric unsharpness as used in medical imaging **(2 marks)**

   (ii) Calculate the geometric unsharpness when using an X-ray generator with a 3mm spot size and the test component is 100 cm from the x-ray tube and 50 cm from the detector. **(4 marks)**

2. State and explain heat transfer via convection and conduction **(4 marks)**

3. With reference to physics what is your understanding of
   (i) Alternating current **(2 marks)**

   (ii) Direct current **(2 marks)**

   (iii) Current **(2 marks)**

   (iv) Ohms law **(2 marks)**

4 (i) What is the effect on resistance of a length of wire if the thickness is increased? **(2 marks)**

(ii) An X-ray generator is supplied with 240V and draws 50A of current. What is the consumed power? **(5 marks)**

QUESTION FOUR

1. Find the resistance of a spool of copper wire, 500 m long with a diameter d of 0.644 mm (Take $\rho = 1.72\ x10^{-8}\ \Omega m$ **(4 marks)**
2. Show that power supplied by battery is given by $P = IV$ **(5 marks)**
3. Define work, energy and power **(6 marks)**
4. Three resistors $R_1 = 20.0\ \Omega$, $R_2 = 30.0\ \Omega$, and $R_3 = 40.0\ \Omega$ are connected in parallel to a 6.00-V battery

   (i) Find the equivalent resistance of the circuit **(2 marks)**
   (ii) Find the total current coming from the battery **(2 marks)**
   (iii) Find the current through each resistor **(6 marks)**