**LESSON PLAN FOR WEEK TWO ENDING 22ND SEPTEMBER 2023**

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| **THEME:** | Fields |
| **DATE**: | 18 – 09 – 2023 |
| **CLASS**: | SS3 |
| **TIME**: | 08:40am - 09:20am |
| **DURATION** | 40 MINUTES |
| **PERIOD** | 1 |
| **SUBJECT**: | Physics |
| **UNIT TOPIC:** | Simple A.C |
| **LESSON TOPIC:** | Reactance and Impedance |

**SPECIFIC OBJECTIVE**: By the end of the lesson, learners should be able to

1. Define reactance in A.C circuit
2. Draw an A.C circuit containing R, L and C in series
3. Obtain a formula for impedance in an A.C circuit

**INSTRUCTIONAL RESOURCES:** Charts containing the diagrams of A.C circuits containing a series combination of R and L, R and C, R, L and C.

**LESSON PRESENTATION**

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| **STEP 1** | **PREVIOUS KNOWLEDGE:** The students are conversant with resistor(R), inductor (L) and capacitor (C). | | Students recall. |
| **STEP 2** | **EXPLORATION:**  The teacher arouses the students’ interests by telling them that just as resistor, each of capacitor and inductor has the capability to oppose the flow of alternating current. This capability is known as reactance. | | Students make attempt to answer the questions. |
| **STEP 3** | **DISCUSSION:**  **Reactance**  This is the opposition to the flow of current in an A.C circuit containing either a capacitor or an inductor. It is measured in ohms (Ω). If the opposition is offered by a capacitor (or an inductor), it is known as ***capacitive reactance () (or inductive reactance ())*** respectively.  Mathematically, these oppositions are given by:  Also,  **Resistance - Inductance (R - L) Series Circuit**  Suppose, a pure resistance R and a pure inductance is connected in series to a source of alternating e.m.f. Let be the R.M.S value of current flowing in the circuit.  The p.d across the inductor is given by:  **(** leads current by an angle of )  The p.d across R is:  ( is in phase with the current)    AC Inductance and Inductive Reactance in an AC Circuit  From the fig above, it can be deduced that:  Since , we also have  Where z is known as the impedance. The phase angle between current and voltage in an R, L series circuit is given by:  **Resistance – Capacitance (R – C) Series Circuit**  Let a pure resistance (R) and an ideal capacitor (C) be connected in series to the source of alternating e.m.f.  What is RC Series Circuit? Phasor Diagram and Power Curve - Circuit Globe  What is RC Series Circuit? Phasor Diagram and Power Curve ...  The p.d across the capacitor is given by:  **(** lags current by an angle of )  The p.d across R is:  ( is in phase with the current)  It can be deduced that:  This alternating voltage is equivalent to:  Since , we also have  Where z is known as the impedance. The phase angle between current and voltage in an R, L series circuit is given by:  **Series Circuit containing Resistance (R), Inductance (L) and Capacitance (C)**  Consider a circuit containing a Resistance (R), an Inductance (L) and a Capacitance (C) in series as shown in the diagram below.  What is RLC Series Circuit? - Phasor Diagram & Impedance Triangle - Circuit  GlobeWhat is RLC Series Circuit? - Phasor Diagram & Impedance Triangle - Circuit  Globe  If an alternating voltage is put across the circuit, it is observed that a steady state current given by I will flow along the circuit. Thus, the alternating voltage is equivalent to:  It is also given by:  Since,  ***,*** **and**  **,** we also have  Where, Z is the impedance in R, L, C series circuit.  **Impedance in A.C Circuit**  **Impedance** is the overall opposition to flow of alternating current by a mixed circuit containing a Resistor, an Inductor and/or a Capacitor. It is measured in Ohms (**Ω**).  ***Phase*** is the state of vibration of a periodically varying system at a particular time;  In a varying voltage, is applied across an RLC series circuit, the current is found to be out of phase by an angle , i.e  I.  This theory shows that the phase difference between the voltage and the current through an R,L,C series circuit is given by:  Thus  Where  If is positive and lags , and if is negative and leads .  ***The reciprocal of reactance is called susceptance of the A.C circuit and the reciprocal of impedance is called admittance of the A.C circuit. Both, the susceptance and the admittance are measured in mho or ohm-1 or Siemen.***  ***Note the following points***   * + 1. For a resistive circuit, the alternating voltage is in phase with the alternating current. Thus, If , then     2. For an inductive circuit, the alternating current lags alternating voltage by (or the alternating voltage leads the alternating current by ). Thus, if , then     3. For a capacitive circuit, the alternating current leads the alternating voltage by (or the alternating voltage lags the alternating current by ). Hence, if , then     4. For an R,L,C series circuit, the current is the same for all the components of the circuit, and it is in phase with the voltage across R. Using as a reference vector, we have the other voltage vectors as shown in the diagrams below.     Fig 2.4: Vector Diagrams | | Students listen attentively and take down notes. |
| **STEP 4** | **APPLICATION:**  The voltage and current in a circuit are given respectively as: and Determine the:  Frequency of the alternating voltage;  Effective value of the current;  Phase difference between current and voltage;  Reactance of the circuit.  **Solution**  Comparing LHS and RHS, we have  From , it can be deduced that:  and  The phase angle () between current and voltage is obtained by comparing:  and    Reactance of the circuit**Ω** | | Students ask questions on the topic which the teacher answers. |
| **STEP 5** | **EVALUATION:** The teacher evaluates the students using the following:   1. Define reactance in A.C circuit 2. From the graphs of inductive and capacitive circuits, what notable difference can you observe? 3. Mention a formula for impedance in an A.C circuit | | The students answer the questions. |
| **ASSIGNMENT**  A source of e.m.f and frequency is a connected to a series arrangement of a resistor, an inductor and a capacitor. When the current in the capacitor is , the potential difference across the resistor is that across the inductor is . Draw the vector diagram of the potential differences across the inductor, the capacitor and the resistor. Calculate the   * + 1. P.D across the capacitor     2. Capacitance of the capacitor     3. Inductance of the inductor.   **References**  **Extensive physics for Senior Secondary Schools and Colleges, by OSINUBI SAHEED et al. New School Physics for SS2 by M.W ANYAKOHA {Ph D}. Senior Secondary Physics for SS2 by P. N OKEKE et al.** | |  |