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**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**

**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE WITH IT**

**2ND YEAR 1ST SEMESTER 2016/2017 ACADEMIC YEAR**

**MAIN CAMPUS**

**COURSE CODE: SPH 202**

**COURSE TITLE: ELECTRICITY AND MAGNETISM II**

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

**DATE: 20/04/16 EXAM SESSION: 9.00 – 11.00 AM**

**TIME: 2 HOURS**

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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.**

**INSTRUCTIONS TO CANDIDATES**

Answer all questions in section A and any **TWO** questions from section B.

Question **ONE** carries **30** marks while all the other questions carry **20** marks each.

You may use the following constants:

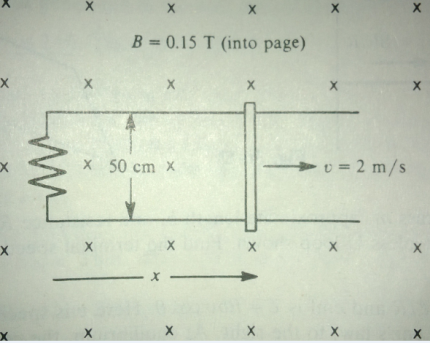
εo = 8.85 x 10-12 F/m; μo = 4πx10-7Tm/A; c = 3.0 x 108 m/s; Zo = 377Ω, Electron charge, e = 1.6 x 10-19C; Rest mass of an electron, Me = 9.1 x 10-31kg, Rest mass of a proton Mp = 1.672 x 10-27kg ; Resistivity of copper ρ = 1.7 x 10-8 , ,

**SECTION A**

1. Define pointing vector **1mk**
2. Define the term ‘resonance frequency’ **1mk**
3. State the Lorentz force law for a charged particle moving in a magnetic field only **1mk**
4. Distinguish between hard and soft magnetic materials **1mk**
5. Calculate the amplitude of the household 240V supply. **2mks**
6. Distinguish between Faradays Law and Ampere’s Law **2mks**
7. State any three properties of electromagnetic waves **2mks**
8. State Lenz's law. **2mks**
9. An electron in the ground state of the hydrogen atom has an orbital angular momentum of

4.10 x 10-34J·s. Find the orbital magnetic moment. **3mks**

1. A square loop of wire 75mm on a side lies with its plane perpendicular to a uniform magnetic field of 0.8 T.
   1. Find the magnetic flux through the loop **2mks**
   2. If the coil is rotated through 900 in 0.015s in such a way that there is no flux through the loop at the end, find the average e.m.f induced during the rotation. **3mks**
2. Sunlight strikes earth with an average intensity of 1400W/m2. Find the peak electric and magnetic fields. **4mks**
3. As shown in the figure 1, a metal rod makes contact with a partial circuit and completes the circuit. The circuit area is perpendicular to a magnetic field with B = 0.15T. If the resistance of the total circuit is 3Ω, how large a force is needed to move the rod as indicated with a constant speed of 2m/s? **6mks**



*Figure 1*

**SECTION B**

**QUESTION TWO (20 MARKS)**

1. An AC voltage source has an output of ∆*v* = (2.00 x 102 V) sin 2πft. This source is connected to a 1.00 x 102 Ω resistor. Find the r.m.s voltage, r.m.s current in the resistor and the average power delivered to the circuit. **4mks**
2. A 240V, 700Hz a.c. generator is in series with a 15Ω resistor, a 10μF capacitor and a 0.01H inductor (of negligible internal resistance).
3. Sketch the phase diagram for the circuit **1mk**
4. What is the Impedance, Z of the circuit **5mks**
5. The potential difference across each component **5mks**
6. The phase angle, φ **3mks**
7. The resonant frequency of the circuit **2mks**

**QUESTION THREE (20 MARKS)**

1. Define the term ‘self-induction’ **2mks**
2. Find the direction of the current in the resistor in the Figure 2
3. At the instant the switch is closed **1mk**
4. After the switch has been closed for several minutes, **1mk**
5. At the instant the switch is opened **1mk**



*Figure 2*

1. Calculate the inductance of an air-core solenoid containing 300 turns if the length of the solenoid is 25.0 cm and its cross-sectional area is 4.00 cm2 **3mks**
2. Calculate the self-induced e.m.f in the solenoid of (b) above if the current it carries is decreasing at the rate of 50.0 A/s **4mks**
3. A conducting rod of length l moves with a constant velocity v, perpendicular to an infinitely long, straight wire carrying a current I, as shown in the Figure 3 below. What is the e.m.f generated between the ends of the rod? **3mks**



*Figure 3*

1. Find the inductance of a uniformly wound solenoid having N turns and length l. Assume that l is much longer than the radius of the windings and that the core of the solenoid is air. **5mks**

**QUESTION FOUR (20 MARKS)**

1. Show that E = Emsin (kz - ωt) is a wave moving in the positive z direction. Express k and w in terms of the wavelength, *λ*, and the frequency, *f* and find their relationship to the velocity. **5mks**
2. An alternating voltage is represented by the expression v = 35 sin (314.2t) volt. Determine
   1. The maximum value **1mk**
   2. The frequency **2mks**
   3. The period of the waveform **2mks**
   4. The value 3.5ms after it passes through zero, going positive. **2mks**
3. Three alternating currents are specified below. Determine the frequency, and for each current, determine its phase angle, and amplitude. **8mks**

**QUESTION FIVE (20 MARKS)**

1. A circular loop of wire of radius a is placed in a uniform magnetic field, with the plane of the loop perpendicular to the direction of the field, as shown in Figure 4.



*Figure 4*

The magnetic field varies with time according to B = Bo+ bt where Boand b are positive constants.

1. Calculate the magnetic flux through the loop at t = 0 **3mks**
2. Calculate the induced e.m.f in the loop. **3mks**
3. What is the induced current and its direction of flow if the overall resistance of the loop is R? **3mks**
4. Find the power dissipated due to the resistance of the loop **2mks**
5. A current of 5.00mA flows into a 10.0pF capacitor with circular plates of radius 3.00cm.

Find

The displacement current, **1mk**

the rate of change of the electric flux, **4mks**

the rate of change of electric field, **2mks**

the magnetic field 3.00cm from the center of the plates **2mks**