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MAIN EXAMINATION

SEPTEMBER – DECEMBER 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF PHYSICS

REGULAR PROGRAMME

PHY 202: ELECTRICITY AND MAGNETISM II

Date: DECEMBER 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and ANY other TWO Questions. Start each question on a new page	

Q1. (a) Define magnetic

(i) Susceptibility

(3marks)

(ii) Permeability

(3marks)

(b) How are magnetic susceptibility measured in practice?

(4marks)

(c) Explain

(i) magnetic flux density B,

(ii) magnetic flux intensity H

(iii) Magnetization M. How are they related to each other?

(8marks)

(d) An electron is traveling to the right with a speed of 8.5 x 10^6 m/s when a magnetic field is turned on. The strength of the magnetic field is 0.050 T, and it is directed into the paper. Describe the path of the electron after the field has been turned on.

(6marks)

(e) Write an expression for the force $\vec{F}$ acting on a particle of charge q, moving with a velocity of v, in the presence of both electric field E

and magnetic field B. Obtain the condition for which the particle moves un deflected through the fields.

(6marks)

Q2. (a) Two tiny conducting balls of identical mass m and identical charge hang from nonconducting threads of length l. Each ball forms an angle θ with the vertical axis. Assume that θ is so small such that $tan\theta \approx sin\theta$

(i) Show that, at equilibrium, the separation between the balls is $r^3 = \frac{q^2 l}{2\pi \varepsilon_0 mg}$

(8marks)

(ii) If $If\ l = 1.2\,x10^2\,cm \wedge m = 1.0\,x10^2\,g \wedge r = 5.0\,cm, what\ is\ q\ ?$

(5marks)

(b) A transformer used to step down ac mains from 240V to the 12V ac needed to operate a doorbell has a 1000 turns in the primary coil.

(i) How many turns are there in the secondary?

(3marks)

(ii) If the resistance introduced in the secondary circuit when the bell is pushed is 20Ω, what are the r.m.s currents in the primary and secondary coils assuming the transformer is 95% efficient?

(4marks)

Q3. a) State Gauss's law for

(i) Electrostatics **(2marks**

(ii) Magnetism

(2marks)

b) An inductor of $30.0\,H$ and a resistor of $6.00\,\Omega$ are connected in series to a battery of $12.0\,V$.

(i) Draw the circuit diagram

(2marks)

(ii) Find the time constant of the circuit

(4marks)

(iii) The switch is closed at $t = 0$. Calculate the current in the circuit at $t = 2.00\,ms$

(4marks)

c) A coil consists of 200 turns of wire. Each turn is a square of side 18 cm, and a uniform magnetic field directed perpendicular to the plane of the coil is turned on. If the field changes from $0 ¿ 0.50\,T \in 0.80\,s$, what is the magnitude of the induced emf in the coil while the field is changing?

(6marks)

Q4. A series AC circuit consists of three components: an EMF source with $\varepsilon = V_0 sin\omega t$, where $V_0 = 110\,V$, a 50 mH inductor, a $50\mu F$ capacitor, and a 20 Ωresistor.

(a) Draw a circuit diagram for this circuit.

(5marks)

(b) What is the impedance for this circuit?

(5marks)

(c) Draw the phasor diagram for the circuit.

(5marks)

(d) At what frequency ωwill the power dissipated in the resistor be the largest?

(5marks)

Q5. a) An electron in a television picture tube moves toward the front of the tube with a speed of $8\,x\,10^6 m\,s^{-1}$along the x- axis. If there is a magnetic field of $0.025\,T$ directed at an angle of $60°$ to the X axis and lying in the XY plane,

(i) Calculate the magnetic force on the electron

(3marks)

(ii) Find a vector expression for the magnetic force on the electron

(7marks)

(b) In order to measure the magnitude of a uniform magnetic field, electrons are accelerated from rest through a potential difference of 350V. Due to the magnetic force exerted on them, the electrons travel in a curved path of radius 7.5 cm. If the magnetic field is perpendicular to them,

(i) What is the magnitude of the field

(5marks)

(ii) What is the angular speed of the electrons?

(5marks)

END