Bago University
Department of Physics
First Semester Examination, March 2019

Third Year (BSc)
(Physics Specialization)

Phys 3107
Electromagnetic Wave Theory
Time Allowed: (3) Hours

Answer any Six questions.

1 (a) Derive the Lorentz equation and draw the Lorentz force diagram.

(b) The electron in a hydrogen atom executes uniform circular motion around the proton with a speed of $2.2\times10^{6}\,\mathrm{m\,s^{-1}}$ in an orbit of radius $5.3\times10^{-11}\,\mathrm{m}$. (i) If the hydrogen atom is placed in a magnetic field of flux density $0.1\,\mathrm{Wb\,m^{-2}}$, with the plane of the orbit perpendicular to the field, calculate the ratio of the electrostatic force between electron and proton to the magnetic force on the electron. (ii) How will the magnetic force affect the motion of the electron?

2 (a) Derive the magnetic field at a point P which is the distance 'a' from the conductor carrying current is 'i'.

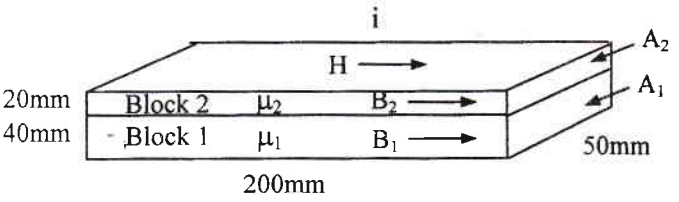
(b) A magnetic field of magnitude $5\times10^{-4}\,\mathrm{T}$ is to be produced at a distance of 7cm from a long straight wire. (i) What current is required to produce this field? (ii) With the current found in (i) what is the magnitude the field at a distance of 20cm from the wire?

3 (a) Explain paramagnetic, diamagnetic, ferromagnetic and nonmagnetic materials.

(b) A solenoid 50cm long and 2cm in diameter is wound with 4000 turns of wire. Compute the magnetic flux density at the center of the air core when a current of 0.25A exists in the winding.

4 (a) Explain what you understand by hesteresis, magnetic domain? What is curie point?

(b) Find the total reluctance and permeance between the ends of the parallel-connected rectangular iron blocks shown in figure. The permeability of each block is uniform, The value in block 1 being $\mu_1 = 500\,\mu_0$ and in block 2 being $\mu_2 = 2000\,\mu_0$.



5 (a) Describe magnetic susceptibility and permeability of materials in terms of $\vec{B}$, $\vec{H}$ and $\vec{M}$.

(b) Find the potential between the parallel-plates capacitor by using Laplace's equation. Plates are infinite in extent and are separated by a distance x.

6 (a) Write down the Laplace's equation in rectangular coordinate, cylindrical coordinate and spherical coordinate.

(b) In a one dimensional device the charge density $\rho = \rho_0\left(\frac{x}{x_1}\right)$. If $E=0$ at $x=0$ and $V=0$ at $x=x_1$, find "V".

7 (a) State Lenz's law. What is a transformer? Name two types of transformer.

(b) How many turns are required for a square loop 100mm on a side to develop a maximum emf of 10mV rms? If the loop rotates $30\,\mathrm{rad\,s^{-1}}$ in the earth's magnetic field? Take $\vec{B} = 60\,\mu\mathrm{T}$.

8 (a) State Stokes' theorem. Compare the electric and magnetic field relation for the time-changing situations.

(b) A 3-turn loop with $0.5\,\mathrm{m^2}$ area situated in air has a uniform magnetic field normal to the plane of the loop. (i) If the flux density changes $5\,\mathrm{mT\,s^{-1}}$, what is the emf appearing at the terminals of the loop? (ii) If the emf at the loop terminals is 100mV, what is the rate of change of the magnetic field?