NATIONAL OPEN UNIVERSITY OF NIGERIA
Plot 91, Cadastral Zone, Nnamdi Azikwe Expressway, Jabi, Abuja.

FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS
September Examination 2020_1

Course Code: MTH 417
Course Title: Electromagnetic Theory
Credit Unit: 3
Time Allowed: 3 Hours
Instruction: Attempt Number One (1) and Any Other (4) Questions

1. (a) What forms the basis of classical electrodynamics, classical optics and electric circuits?

   (3 marks)

   (b) Describe the combined force law known as Lorentz force **(4 marks)**

   (c) State the four fundamental constitutive relationships to describe the response of a medium to a variety of electromagnetic input. **(4 marks)**
   (d) Define each of the following:
   (i) Gauss's law **(4 marks)**
   (ii) Ampere's law **(3 marks)**
   (iii) Faraday's law **(4 marks)**

2. (a) Define Maxwell's macroscopic equations **(3 marks)**
   (b)In the mid -1800's, the theories of electricity and magnetism were united by James Clerk Maxwell in four equations. State them! **(6 marks)**
   (c) Differentiate between Source and Sink in relation to net change inside a surface.

   (3 marks)

3. (a) Differentiate between the dielectric constant and magnetic permeability **(4 marks)**
   (b) State the Gauss's divergence theorem and Stokes **(8 marks)**

4. (a) State the kinetic energy of a particle. **(4 marks)**

   (b) How are Maxwell's equations used to show wave motion? **(8 marks)**

5. (a) Describe briefly the reflection and refraction at a boundary between dielectrics.

(10 marks)

(b) Using a simple equation, describe the energy theorem in Maxwell's theory **(2 marks)**

6. (a) Define each of the following:
   (i)   Electric field energy   **(2 marks)**
   (ii)   Magnetic field energy   **(2 marks)**
   (iii)   Power flux   **(2 marks)**
   (b) State the momentum theorem in Maxwell's theory in a vacuum.   **(3 marks)**
   (b) Briefly describe the refractive index in a medium.   **(3 marks)**