



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

**FACULTY OF SCIENCES**  
**DEPARTMENT OF MATHEMATICS**  
**2023\_2 EXAMINATIONS**

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**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) Define each of the following:
  - i. Electric field energy **(2 marks)**
  - ii. Magnetic field energy **(2 marks)**
  - iii. Power flux **(2 marks)**(b) Describe briefly the reflection and refraction at a boundary between dielectrics.  
**(8 marks)**
- (c) Using a simple equation, describe the energy theorem in Maxwell's theory. **(2 marks)**
- (d) State the momentum theorem in Maxwell's theory in a vacuum. **(3 marks)**
- (e) Briefly describe the refractive index in a medium. **(3 marks)**
2. (a) State the kinetic energy of a particle. **(4 marks)**
- (b) How are Maxwell's equations used to show wave motion? **(8 marks)**
3. (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)**
4. (a) Differentiate between the dielectric constant and magnetic permeability **(4 marks)**
- (b) State the Gauss's divergence theorem and Stokes **(8 marks)**

5. (a) State Faraday's law **(4 marks)**
- (b) What forms the basis of classical electrodynamics, classical optics and electric circuits? **(3 marks)**
- (c) Describe the combined force law known as Lorentz force **(5 marks)**
6. (a) State each of the following:
- (i) Gauss's law **(4 marks)**
- (ii) Ampere's law **(4 marks)**
- (b) State the four fundamental constitutive relationships to describe the response of a medium to a variety of electromagnetic input. **(4 marks)**