



NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi-Abuja

FACULTY OF SCIENCES
DEPARTMENT OF MATHEMATICS

Course Code: MTH417

Course Title: Electromagnetic Theory

Credit Unit: 3

Time Allowed: 3 Hours

Total: 70 Marks

Instruction: Answer Question One and Any Other Four Questions

QUESTION 1

- A (i) State the Maxwell's integral equations and their respective governing law **(4 marks)**
(ii) Relate Gauss's divergence theorem to the first two of Maxwell's equations **(3 marks)**
- B (i) Use the third Maxwell's equations to derive the three dimensional wave equation for the electric field (\vec{E}) components **(5 marks)**
(ii) Similarly, derive the wave equation for the magnetic field **(5 marks)**
- C. Using the Maxwell's macroscopic equation, establish the energy theorem in Maxwell's theory **(5 marks)**

QUESTION 2

- A. Highlight the electric field components for waves on boundaries **(3 marks)**
B. Derive the reflection and refraction at a boundary between dielectrics equation **(5 marks)**
C. Derive the equation for reflection and refraction at the surface of a conductor **(4 marks)**

QUESTION 3

- A. Obtain the last two Maxwell's equations using Stokes theorem **(4 marks)**
B. Enumerate the four Maxwell's macroscopic equations **(4 marks)**
C. Highlight the Maxwell equations for the electric and magnetic fields in a charge free vacuum region **(4 marks)**

QUESTION 4

- A. Establish the electromagnetic boundary conditions for normal component of \vec{B} (6 marks)
- B. Summarize the general conditions on electric and magnetic fields at the boundary between two materials by stating respectively
- (i) the boundary conditions
 - (ii) where it is derived from
 - (iii) where it is applied to (6 marks)

QUESTION 5

- A. State four constitutive equations for the electromagnetic theory relations (2 marks)
- B. Establish the momentum theorem in Maxwell's theory (10 marks)

QUESTION 6

- A. By continuity equation, give the electric charge conservation law equation (2 marks)
- B. Derive the Lorentz transformation equation (10 marks)