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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)**

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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)**