NATIONAL OPEN UNIVERSITY OF NIGERIA
Plot 91, Cadastral Zone, Nnamdi Azikiwe Express Way, Jabi-Abuja
FACULTY OF SCIENCES
January\February Examination 2018

Course Code: MTH417
Course Title: Electromagnetic Theory I
Credit Unit: 3
Time Allowed: 3Hours
Total Marks: 70%

INSTRUCTION: ANSWER QUESTION ONE(1) AND ANY FOUR (4) QUESTIONS (TOTAL = 5 QUESTIONS IN ALL)

1(a) State the Maxwell's equations in a vaccum and in a conducting **(3marks each=6marks)**

(b) Define Average potential **(2marks)**

(c) The wave equation in a source free can be expressed as (i) $\nabla^2 E = \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2}$ **(2marks)**

(d) Define the following terms: waveguide and resonant cavity **(2marks each=4marks)**

(e) State Stoke's theorem **(2marks)**

(f) Explain the term "electrical ϕ" **(2marks)**

(g) State Gauss divergence theorem **(4marks)**

2(a) What is a line of force? **(2marks)**

(b) Show that $\nabla X\, E = {}^{-1}/_{c}\, \frac{\partial B}{\partial t}$ **(10marks)**

3 Find the magnetic induction B and appropriate condition on both E and B to satisfy Maxwell's equations, if in a region of empty charges, current and magnetic induction induced and electric E $E_x = 0, E_y = xzh(t), E_z = xyh(t)$ **(12marks)**

4(a) Use the Maxwell's equation to show that $\nabla^2 H = \frac{1}{c^2}\frac{\partial^2 H}{\partial t^2}$ **(3marks)**

(b) The homogeneous wave equation as $\nabla^2 E + k^2 E = 0$ and $\nabla^2 H + k^2 H = 0$, hence solve equation in (b) above **(9marks)**

5(a) Derive an equation for transerve magnetic waves in a rectangular waveguide and solve the equation subject to the boundary conditions

$E_x = (0, y) = 0, E_y = (a, y) = 0$ and $E_z = (x, 0) = 0, E_z = (x, b) = 0$ **(8marks)**

(b) Obtain:

(i) the cutoff frequency **(2marks)**

(ii) the cutoff wavelength and the lowest mode (5marks) **(2marks)**

6 (a) Explain the term "Force of attraction between two charges" **(3 marks)**

(b) Find the electric field between co-axial cylindrical capacitors given as $\upsilon = \begin{Bmatrix} \upsilon_0, \rho = a \\ 0, \rho = b \end{Bmatrix}$, also find the electric flux density $\vec{D}$ and the capacitance. **(9marks)**