

FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
2009/10 HARMATTAN SEMMESTER EXAMINATION MAY, 2010

COE 405: FIELDS AND WAVES IN COMMUNICATIONS

TIME ALLOWED: 3 Hrs

INSTRUCTION: Answer any 5 questions

1a. Define the following terms: (i) Electric flux density (D) (ii) Electric field density (E) (iii) Voltage Standing Wave Ratio (VSWR) (iv) Lossless line.

b. Show that for a coaxial transmission line of length "L" and radii "a" and "b" that the flux linkage is given by $\phi = (\mu IL / 2\pi) \ln(b/a)$ Wbs, and hence find the inductance.

2a. State the Maxwell's equations for E, H, B and D in integral form and explain each of them.

b. Derive an expression for continuity equation for time-varying field.

3. Using the Maxwell's equations in the integral form, explain what happens at the boundary surface between different media.

4a. As the EM wave propagates through space from their source to distant receiving points, there is a transfer of energy from the source to the receiver. Starting from Maxwell's equation

$$\text{Curl } H = \delta D / \delta t + J$$

Derive an expression for the total instantaneous power from the source.

b. What is the use of the expression in Communications Engineering?

5a.

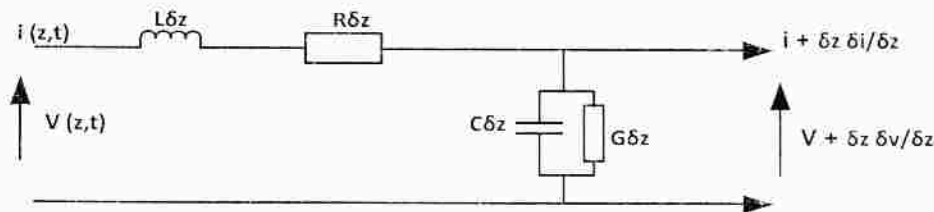


Fig 5

Consider an elementary length of a transmission line shown in Fig 5. Show that the equation for V is given by

$$\delta^2 V / \delta z^2 = RGV + (RC + LG) \delta V / \delta t + LC \delta^2 V / \delta t^2. \quad \text{State any assumptions made.}$$

b. What is the common name for this equation?

6a. What do you understand by the term "Waveguide"?

b. Derive an expression for the cut-off wavelength of a rectangular waveguide.

c. State 2 fundamental differences between the behavior of waveguides and ordinary transmission lines.

7a. Define the following terms: (i) Group Velocity (ii) Phase velocity

b. A signal of frequency 10GHz is to be propagated in a waveguide whose wall separation is 6cm. what is the greatest number of half waves of electric intensity which it will be possible to establish between the two walls (i.e. the largest value of m)? Calculate also the guide wavelength for this mode of propagation.