M.Sc. 3rd Semester Examination, 2019

ELECTRONICS

(*Electromagnetic Theory and Radiation Systems*)

PAPER — ELC-301

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer any *four* questions : 2×4

   (*a*) Deduce the expression of equation of continuity.

(b) A 100Ω transmission line is terminated by 125Ω load. Find reflection-coefficient and Voltage Standing Wave Ratio (VSWR).

(c) A loss less transmission line is terminated with a 100 Ω load. If the SWR on the line is 1.5, find two possible characteristic impedance of the line.

(d) Draw E and H plane radiation patterns of a half-wave dipole antenna.

(e) What do you mean by plane wave ?

(f) Derive the expressions of β for loss-less transmission line ? Show all steps.

(g) Determine the propagation constant γ for a material having $\mu_r = 1$, $\varepsilon_r = 8$ and $\sigma = 0.25$pS/m at 1.6MHz.

(h) Define the primary and secondary parameters of a transmission lines.

(*Continued*)

2. Answer any *four* questions : 4 × 4

(a) Draw the lumped parameter equivalent circuit of two wire transmission line and deduce Telegrapher's equation. 4

(b) Deduce expressions for the complex dielectric constant of ionosphere. 4

(c) Find the condition for which a line becomes distortion less. 4

(d) A transmission line of electrical length $l = 0.3\lambda$ terminated with a complex load impedance as shown in figure below. Find 2 + 2

(i) Reflection co-efficient

(ii) Input impedance to the line.

$z_0 = 100\Omega$

$z_L = 60 + 75 j$

(*Turn Over*)
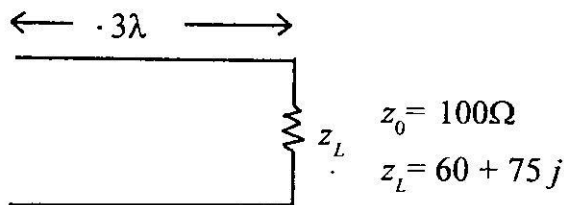
(e) A rectangular wave guide has the following characteristics. 2 + 2

$$a = 1 \cdot 5 \text{ cm}, \ b = 3 \cdot 0 \text{ cm}, \ \mu_R = 1, \ \epsilon_r = 1$$

   (i)   Find cut-off frequency for TE_{10} and TM_{11} mode.

   (ii) Guided wave length and z_0 of the line.

(f) (i)   Write the integral form of Maxwell's equations.

   (ii) What is the contribution of Maxwell in the field of electromagnetic ? 2 + 2

(g) (i)   What is the role of an antenna in modern communication system ?

   (ii) What are the difference between wire dipole and Hertzian dipole ? 2 + 2

(h) (i)   Write down the role of the ionosphere.

   (ii) What is skip distance ? Give example. 2 + 2

3. Answer any *two* questions : 8×2

(a) Use Smith chart to find the following quantities for the transmission line circuit shown in figure below :
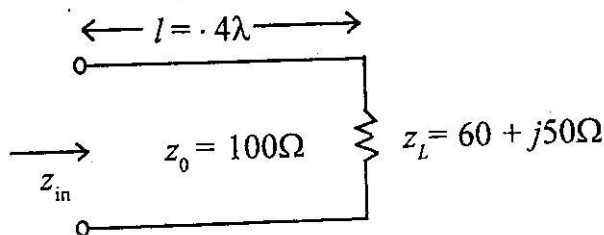
(i) SWR on the line.

(ii) Input impedance of the line.

(iii) Distance from the load to the first voltage minima.

(iv) Reflection co-efficient on the line. 2×4

(b) Show that field components of a propagating electromagnetic wave inside a guided wave structure in TEM mode are   8

$$E_x = \frac{\beta}{\omega \in} C\, e^{-j\beta z}, \quad H_y = C\, e^{-j\beta z}, \quad C = \text{Constant}.$$

(*Turn Over*)

(c) Deduce expressions for E_θ and H_ϕ for the radiation from Hertzian dipole. What are electrostatic field, Induction field and radiation field?   5 + 3

(d) (i)   What is a quarter wave transmission line? Write down its application.

(ii) A 90m long loss-less transmission line with $Z_0 = 85\Omega$ operating at 3·6 MHz is terminated with a load $Z_L = 180 + j\,160\Omega$. If $u = 0.8c$ on the line, find

   (I)   The reflection coefficient Γ

   (II) The standing wave ratio s

   (III) The input impedance Z_{in}

   (IV) The input impedance Y_{in}.   4 + 4

[*Internal Assessment*—10 Marks]

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