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10TE54

Fifth Semester B.E. Degree Examination, June/July 2016

Transmission Lines and Waveguides

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Derive the expression for general solution of a transmission line at any point along the line of any length with uniformly distributed constants. **(12 Marks)**

b. Derive equations for filter elements of a low pass constant K filter with symmetrical T-section. **(08 Marks)**

2 a. A generator of 1V, 1 kHz supplies power to a 100 km line terminated by Z_0 and has R = 10.4 Ω/km, L = 0.00367 H/km, G = 0.8×10^{-6} mho/km and C = 0.00835 μF/km. Calculate Z_0, attenuation constant α, phase constant β, wavelength λ, velocity ν, received current, voltage and power. **(06 Marks)**

b. Explain the various distortions that occur when a wave propagates through transmission line. **(04 Marks)**

c. Derive the equation for voltage and current for a high frequency dissipationless line. Draw the voltage and current waveforms for open and short circuit conditions. **(10 Marks)**

3 a. Derive the relationship between standing wave ratio and reflection coefficient. **(06 Marks)**

b. Derive the equations for length and location of single stub matching device in terms of reflection coefficient. **(10 Marks)**

c. What is Smith chart? Discuss the applications and properties of Smith chart. **(04 Marks)**

4 a. Derive the equations for short circuit and open circuit impedances for quarter wave lines and half wave lines of small dissipation. **(10 Marks)**

b. A load of admittance $\frac{Y_R}{G_0} = 1.25 + j0.25$ is connected to the transmission line. Find the length and location of single stub tuner short circuited connected to line. **(10 Marks)**

PART – B

5 a. Explain S-matrix representation of multiport network. **(04 Marks)**

b. State and explain the properties of S-matrix. **(06 Marks)**

c. Two transmission lines of characteristic impedances Z_1 and Z_2 are joined at plane PP^1. Express s-parameters in terms of impedances. **(10 Marks)**

6 a. Describe the properties and characteristics of wave guides. **(06 Marks)**

b. What are microwave cavities? Also show that cavity resonator has only one frequency of resonance for a given mode. **(10 Marks)**

c. Define the following terms with necessary equations:
i) Cutoff frequency of waveguide
ii) Cutoff wavelength of waveguide
iii) Group velocity
iv) Guide wavelength **(04 Marks)**

7 a. Starting from Maxwell's equation derive expression for various field components inside circular waveguide for TE_{mn} wave propagation. **(10 Marks)**

b. A rectangular air filled copper waveguide has dimensions of 4 cm × 2.2 cm and length 8 cm. It operates at 8 GHz with dominant TE_{10} mode. Determine:

i) Cut off frequency ii) Guide wavelength

iii) Phase velocity iv) characteristic wave impedance

v) Total attenuation in dB.

Assume $\sigma = 8.57 \times 10^7$ mho/m for copper. **(10 Marks)**

8 a. With neat sketches, explain working of Gunn diode and its modes of operation. **(10 Marks)**

b. With relevant diagrams, explain IMPATT diode operation and mechanism of oscillation. **(10 Marks)**

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