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Question Paper Code : 31216

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fifth Semester

Electronics and Communication Engineering

EC 1303 — TRANSMISSION LINES AND WAVEGUIDES

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are the conditions for a perfect line? What is a flat line?

2. Give the relationship between the input impedance and characteristic impedance of an infinite line.

3. How can smith chart be used as an admittance chart?

4. State the expressions for inductance L and capacitance C of a open wire line.

5. Write down the relationship between guide wavelength and cut-off wavelength.

6. What is a TEM wave or principal wave?

7. For an air filled copper X-band waveguide with dimension a = 2.286 cms and b = 1.016 cms, determine the cut-off frequencies for TE_{11} and TM_{11} modes.

8. Which are the non-zero field components for the TE_{10} and TM_{11} mode in a rectangular waveguide?

9. What are the disadvantages if the resonator is made using lumped elements at high frequencies?

10. Why is TM01 mode preferred to the TE01 mode in a circular waveguide?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A lossy cable which has $R = 2.25\,\Omega/\text{m}$, $L = 1.0\,\mu\text{H/m}$, $C = 1\text{pF/m}$ and G = 0 operates at f = 0.5 GHz. Find the attenuation constant of the line. (6)

(ii) Develop the differential equations governing the voltages and current at any point on a uniform transmission line. Solve these to obtain the voltage and current in terms of the load current and voltage. (10)

Or

(b) (i) Derive an expression for input impedance of a transmission line. Assume the length of the line as 'l', characteristic impedance Z_0 and terminal impedance Z_R. (8)

(ii) Derive the conditions to be satisfied for a distortionless line. (8)

12. (a) (i) A transmission line of length $0.40\,\lambda$ has a characteristic impedance of 100 Ω and is terminated in a load impedance of 200+j180 Ω, Find the

(1) Voltage reflection coefficient

(2) Voltage standing wave ratio

(3) Input impedance of the line (10)

(ii) Describe an experimental setup for the determination of VSWR of an RF transmission. (6)

Or

(b) (i) A line of $Z_0 = 300\ \Omega$ is connected to a load of 73 Ω, for a frequency of 40 MHZ. Find the length and the location of the nearest load of a single stub to produce an impedance match. (8)

(ii) What are impedance matching devices? Write short notes on eighth line and half line. (8)

13. (a) (i) When a wave 6 GHz is to be propagated between two parallel conducting plates separated by 60 mm, find the modes that will propagate through the guide. (8)

(ii) Derive the field expressions for TEM waves guide by a parallel conducting plane. (8)

Or

(b) (i) Define wave impedance. Obtain the expressions for wave impedance of TE, TM and TEM waves in two conducting planes. (10)

(ii) The parallel plate waveguide has plate separation 1 cm and filled with a perfect dielectric of dielectric constant 9. Find the cutoff frequencies and next higher TM modes.

14. (a) (i) Find the broad wall dimension of a rectangular waveguides when the cut-off frequency for TE_{10} modes (1) 3GHz (2) 30GHz (6)

(ii) Prove that TEM wave does not exist in hollow waveguides. (5)

(iii) Explain how various modes can be excited in a rectangular waveguide. (5)

Or

(b) (i) A hollow rectangular waveguide operates at f = 1GHz and it has the dimensions of 5 × 2 cm. Check whether TE_{21} mode propagates or not. (6)

(ii) Derive the expressions for the field components of TE_{10} waves in a rectangular waveguide. Sketch the field distributions. (10)

15. (a) (i) A copper walled rectangular cavity resonator is structured by 3 × 1 × 4 cm and operates at the dominant modes of TE and TM. Find the resonant frequency and quality factor. The conductivity of copper is 5.8×10^7 mho/m. There is air inside the cavity. (8)

(ii) Derive the expressions for the field components of TM waves in a circular waveguide. (8)

Or

(b) (i) Derive the expressions for the resonant frequencies of TE and TM waves in a circular cavity resonator. (8)

(ii) Determine the size of a circular waveguide required to propagate TE11 mode if $\lambda_c = 8$ cm ($\rho_{11} = 1.841$) (3)

(iii) Derive an expression for the quality factor Q of microwave cavities. (5)

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