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Question Paper Code : 51213

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Electronics and Communication Engineering

EC 1303 — TRANSMISSION LINES AND WAVEGUIDES

(Regulation 2008)

Time : Three hours Maximum : 100 marks

(Smith chart is to be provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A lossless line has a shunt capacitance of 100 pF/m and a series inductance of $4\,\mu H/m$. Determine the characteristic impedance.

2. For a given length of coaxial cable with a distributed capacitance C = 24.15 pF/m and a distributed inductance L = 483.12 nH/m, determine the velocity of propagation.

3. For a transmission line when the incident voltage is 5V, the reflected voltage is 2 V. Find SWR.

4. Determine the characteristic impedance of a quarter wave transformer to match a 50Ω line to a 150Ω resistive load.

5. Assume a wave is propagates in a parallel plane waveguide. The frequency of the wave is 6000 MHz and the plane separation is 7cm. Calculate the cutoff wavelength of the dominant mode.

6. Define TEM waves.

7. Obtain the expression for cutoff wavelength of a standard rectangular waveguide in TM_{11}, mode.

8. A rectangular waveguide measures 3 × 4.5 cm internally and has a 9 GHz signal propagate in it. Determine the cutoff frequency of the wave guide in TE_{10} mode.

9. What are the disadvantages of circular waveguides?

10. Mentions the applications of cavity resonators.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the transmission line equations and obtain solutions for the voltage and current on a transmission line. (12)

(ii) A transmission line has $R = 2\Omega/m, L = 8nH/m, G = 0.5 \times 10^{-3}$ mhos/m and C = 0.23 pF/m. Determine the phase constant at 1 GHz (4)

Or

(b) (i) Derive the condition for the distortionless operation of a transmission line. (10)

(ii) Discuss the inductance loading of telephone cables. (6)

12. (a) (i) Explain the technique of double stub matching with necessary diagrams and equations. (8)

(ii) The VSWR measured on a line at 300 MHz is 2. If the distance between the load and voltage minimum is 0.8 m, calculate the value of normalized load impedance. (8)

Or

(b) (i) Determine the input impedance and SWR for a transmission line 1.25λ long with a characteristic impedance of 50Ω and a load impedance of $(30+j40)\Omega$ using the Smith chart. (8)

(ii) A single short circuited stub is to match a 40Ω line to a load of $(200-j100)\Omega$. The wavelength is 3m. Find the position and length of the stub required to match the line using relevant formulas. (8)

13. (a) Explain the transmission of TM waves between parallel planes with necessary equations. Discuss the characteristics of TE and TM waves between parallel planes. (16)

Or

(b) (i) Explain briefly the attenuation of TE and TM waves between parallel planes with necessary expressions and diagrams. (10)

(ii) Discuss the velocity of propagation and wave impedances of different modes propagating between parallel planes (6)

14. (a) (i) Describe the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components. (10)

(ii) A rectangular air filled waveguide has dimensions of a = 6cm and b = 4cm. The signal frequency is 3 GHz. Find the cutoff frequency, wavelength in the waveguide and group velocity for the TE_{11} mode. (6)

Or

(b) (i) Discuss the excitation of various modes in a rectangular waveguide. (8)

(ii) A waveguide has an internal breadth a = 3cm and carries the dominant mode of a signal of unknown frequency. If the characteristic wave impedance is 500Ω, determine the unknown frequency. (4)

(iii) Calculate the voltage attenuation provided by 25cm length of waveguide having a =1 cm and b = 0.5 cm in which a 1GHz signal is propagating in the dominant mode. (4)

15. (a) (i) Discuss briefly the propagation of TM waves in a circular waveguide with relevant expressions for the field components. (10)

(ii) A TE_{11} mode is propagating through a circular waveguide. The radius of the guide is 5 cm and the guide contains air dielectric. Determine the cutoff frequency and the wavelength in the guide for an operating frequency of 3 GHz. (6)

Or

(b) Explain the principle and operation of rectangular cavity resonators and explain the Q factor. (16)