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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

EC8651–TRANSMISSION LINES
&
RF SYSTEMS
(Regulation 2017)

UNIT – 1 Transmission Line Theory

Part – A

1) Define Characteristic Impedance.
2) Find the characteristic impedance of a line at 1600 Hz if Zoc =750∠-30°Ω and Zoc=600∠-20°Ω
3) State the condition for a distortion less line?
4) Give the Campbell's formula for a uniformly loaded line?
5) Define Propagation Constant.
6) Give the relation between Reflection factor & Reflection loss?
7) Define Reflection loss & insertion loss.

Part – B

1) Derive the transmission line equation and hence obtain expressions for voltage and current on a transmission line.
2) Derive the equation of attenuation constant and phase constant of transmission line in terms of line constants R,L,C and G
3) Prove that an infinite line equal to finite line terminated its characteristic impedance
4) Explain in detail about the wave form distortion and also derive the condition for distortion less line
5) i) Explain in detail the reflection on a line not terminated by its characteristic Impedance Z_0.

   ii) The constants of a transmission line are R=6Ω/km, L=2.2mH/km,C=0.005μF/km & G=0.25x10^{-3}/km. Calculate the Z_0, attenuation constant & phase constant at 1000Hz.
6) A Generator of 1 V, 1000 Hz supplies power to a 100 km open wire line terminated in Z0 and having the following parameters: R = 10.4 Ohm/km, G = 0.8 x 10-6 mho/km, L= 0.00367 henry/m and C = 0.00835 μF/km. Find the characteristic impedance(Z0), propagation constant(γ), attenuation constant (α),phase shift constant(β), velocity of propagation(v) and wavelength(λ). Also find the sending end current, receiving end current and received power.

UNIT - 2 High Frequency Transmission Lines

Part – A

1) Give the minimum and maximum values of SWR and Reflection Coefficient.
2) Write the expression for standing wave ratio in terms of reflection co efficient
3) Write the equations of Voltage and Current on the dissipation less line.
4) For the line of zero dissipation, what will be the value of attenuation constant and Characteristic Impedance?
5) Write the Expression for input impedance of open and short circuited dissipation less line.
6) List the Parameters of the open wire line at high frequencies.
7) What is mean by Reflection Loss?
8) What are the assumptions to simplify the analysis of line performance at high frequencies?

Part – B

1) Derive the Transmission line equations at radio frequencies (open wire & Co axial line parameters)

2) Discuss in detail about the voltage and current on the dissipation less line

3) Derive the expression for power and find the input impedance of dissipation less line, when the load is short circuited, open circuited and for a matched line.

4) A lossless line in air having a characteristic impedance of 300Ω is terminated in unknown impedance; the first voltage minimum is located at 15cm from the load. The standing wave ratio is 3.3. Calculate the wavelength and Terminated Impedance.

5) A 50Ω loss line transmission line is connected to a load composed of 75Ω resistor in series with a capacitor of unknown capacitance. If at 10 MHz, the voltage standing wave ratio on the line was measured as '4'. Determine the capacitance 'C'?

6) A 30m long lossless transmission line with Z_0 = 50W operating at 2MHz is terminated with a load Z_L = 60+j40. If u = 0.6C on the line.

Note: (where 'C' is Velocity of light and 'u' is Phase velocity)

Find i) Reflection Co-efficient (G)

ii) Standing wave Ratio (S)

iii) The Input Impedance (Z_{in})

UNIT – 3 Impedance Matching in High Frequency Lines

Part – A

1) What is Impedance Matching and state the need for impedance matching.
2) What is Stub Matching? Name the impedance matching devices.
3) Explain the significance of smith chart.
4) List the applications of a quarter wave line.
5) What is impedance matching in stub?
6) Write down the Expression to determine the position of Stub?
7) Write down the Expression to determine the length of Stub?

Part – B

1) Explain the significance of smith chart and its applications in a transmission lines.

2) A single stub is to match a load 400Ω line to a load of 200-j100Ω. The wave length is 3m. Determine the position and length of the short circuited stub.

3) A 300Ω transmission line is connected to a load impedance of (450-j600)Ω at 10MHz. Find the position and length of short circuited stub required to match the line using smith chart.

4) Explain the technique of impedance matching by stubs and discuss the operation of quarter wave transformer

5) Explain the procedure for obtaining the smith chart using R and X circles.

6) Determine the following

   i) Standing wave Ratio (SWR)

   ii) Load Impedance (Z_L)

   iii) Distance between load and the first voltage minimum along the transmission line for a line with a characteristic impedance of 300Ω and terminated in a load of 175+j207Ω. An electrical signal of 200 MHz is transmitted along the line in free space.

UNIT – 4 Waveguides and cavity Resonators

Part – A

1) What are rectangular wave guides

2) Write the expression for cutoff wavelength of the wave which is propagated in between two parallel planes.

3) What are the dominant mode and degenerate modes in rectangular wave guides

4) Justify, why TM_{01} and TM_{10} modes in a rectangular wave guide do not exist.

5) Give the expression for wave impedance and power transmission in TE & TM waves in a rectangular wave guide

6) Calculate the cut-off frequency of a rectangular wave guide whose inner dimension are a= 2.5cm & b=1.5cm operating at TM_{10} mode

7) State the relation between the attenuation factor for TE waves and TM waves for parallel plate waveguide.

Part – B

1) Briefly explain about general wave behavior along uniform guiding structures, TE, TM & TEM waves.

2) A rectangular air filled copper waveguide with dimension 0.9 inch X 0.4 inch cross section and 12 inch length is operated at 9.2Ghz with a dominant mode. Find cut off frequency, guide wavelength, Phase velocity, characteristic impedance and the loss

3) Derive an expression for the transmission of TM waves between parallel perfectly conducting planes for the field components

4) An air filled circular waveguide having an inner radius of 1 cm is excited in dominant mode at 10Ghz. Find a) cut off frequency of the dominant mode at 10 Ghz b) Guide wave length c) wave impedance. Also find the bandwidth for operation in the dominant mode.

5) Write Bessel's differential equation & derive the TE Wave components in circular wave guides.

6) A TE_{10} wave at 10 GHz propagates in a brass $\sigma_c = 1.57 \times 10^7$ S/m rectangular wave guide with inner dimensions a= 1.5 cm & b= 0.6 cm, which is filled with $\varepsilon_r = 2.25$, $\mu_r = 1$, loss tangent = $4X\ 10^{-4}$. Determine i) Phase constant ii) Guide wavelength iii) Phase velocity iv) Wave impedance v) attenuation due to loss in the dielectric vi) attenuation due to loss in the guide walls

UNIT – 5 RF System Design Concepts

Part – A

1) What is MESFET? List the different types of FETs used in RF Circuits.
2) What is mean by Unilateral transducer gain G_{TU} & Transducer gain G_T
3) What is the main purpose of LNA & what are the problems arise due to non-linear characteristics of LNA?
4) Define Conduction angle and give its significance in power amplifiers.
5) Define unconditional stability.
6) Give the expression for noise of a two port amplifier.
7) What are multipliers based mixers and mention their types.
8) What are three operating points in MESFET?
9) What are the factors for selecting a matching network?
10) What are the advantages of RF/microwave transistors?

Part – B

1) Briefly explain about design process of RF/Microwave Circuits
2) Give the analysis of frequency response of MESFET, What are its limiting values?
3) Discuss about the basic architecture of RF System and importance of RF Circuit design.
4) Briefly explain about High Electron Mobility Transistor (HEMT) & explain the functionality of HEMT.
5) A Ga As MESFET has the following parameters: $N_D = 10^{16}$ cm^{-3}, d=0.75 μm, W= 10μm, L= 2μm, $\varepsilon_r = 12.0$, $V_d = 0.8$v and $\mu_n = 8500$ cm^2 /vs. Determine a) The Pinch off voltage b) Threshold voltage c) The Maximum Saturation Current I_{DSS}.
6) List and give constructional figures of the different types of FETs based on the way the gate is connected to the conducting channel.
7) What is the importance of RF Circuit design and design consideration steps for RF Systems.
8) i) Write short notes on sub-harmonic mixer and its characteristics
   ii) Explain the behavior of LNA topologies with its design constraints.
9) Derive the equation for power gain, available power gain and transducer power gain.
10) Give the analysis of unconditional stability in RF Amplifier.