EC8651TRANSMISSION LINES AND RF SYSTEMS

IMPORTANT QUESTIONS AND QUESTION BANK

UNIT-1 TRANSMISSION LINES THEORY

2-Marks

1. Define transmission line?
2. List the conditions for distortion less line?
3. How to avoid the distortion that occurs in the line?
4. Choose the properties of infinite line?
5. Discuss the effect of inductance loading of telephone cable?
6. Deduce the relationship between characteristic impedance and propagation constant?
7. Conclude the general equation for the input impedance and transfer impedance of a transmission line?
8. Build the voltage and current equations at any point on a uniform transmission line?
9. Illustrate how practical lines made appear as infinite lines?
10. Sketch the equivalent circuit of a unit length of transmission line?

Part-B

1. Obtain the general transmission line equation for the voltage and current at any point on a transmission line?
2. Outline the expression for the attenuation and phase constants after obtaining an expression for the characteristic impedance?
3. How to solve the Campbell's equation for the loading cables?
4. What is a loading? Specify the types of loading of lines?
5. Explain in detail about the waveform distortion and also derive the condition for distortion less line?
6. Identify the conditions (α, β) required for a distortion less line?
7. A distortion less transmission line has attenuation constant α=1.15×10-2 Np/m, and capacitance of 0.01 nF/m. the characteristic resistance L/C=50Ω. Identify the resistance, inductance and conductance per more of the line?
8. A telephone line has parameters of R = 6.5 Ω/km, L= 0.4 mH/km, C=0.05μF/km and G=0.5 μmho/km. Extend the calculation for finding the input impedance of the line at a frequency of 500 Hz given that the line is very long?
9. A lossless transmission line with Z0 = 75ohm and electrical length l= 0.3 λ is terminated with a complex load impedance of ZR = 40+j20ohm. Estimate reflection coefficient and VSWR of the line?

10. The characteristic impedance of a certain transmission line is 682.5-j195.7 ohm. The frequency of operation is 1 KHz. At this frequency, the attenuation constant in the line was observed to be 0.01 neper/km and phase constant 0.035 radians /km. Prepare the line constants R, L, G and C per km of the line?
11. An open wire line having R=10.15 ohm/km, L = 3.93 mH/km, G=0.29 μmho/km and C=0.00797 μF/km is 100 km long and terminated in Z0. Solve Z0, α, β and γ?
12. The characteristics impedance of a 805m-long transmission line is 94 angle -23.2ºΩ, the attenuation constant is 74.5×10^{-6} Np/m. and the phase shift constant is 174×10^{-6} rad/m at 5KHz. Assess the line parameters R, L, G and C per meter and the phase VELOCITY ON THE TIME?
13. Simplify the expression for input impedance and transfer impedance of transmission lines?
14. Point out the propagation constant of continuously loaded cable?
15. A 2 meterlong transmission line with characteristic impedance of 60+j40 is operating at $=10^6$rad/sec has attenuation constant of 0.921 Np/m and phase shift constant of 0 rad/miff the line is terminated by a load of 20+j50, find the input impedance of this line?

UNIT II - HIGH FREQUENCY TRANSMISSION LINES

2-Marks

1. Define Skin effect?
2. Label the assumptions made for the analysis of performance of the line at radio frequency?
3. Compare the values of SWR for ZR = 0 and ZR = Z0
4. Recognize the dissipation less line with the proper condition?
5. What are nodes and antinodes on a line?
6. Find the nature and value of Z0 for the dissipation less line?
7. Express reflection coefficient in terms of SWR?
8. Predict the expression for input impedance of RF line?
9. Relate the nature of input impedance of open circuited and short circuited and matched load condition for dissipation less line?
10. Solve the terminating load for a certain R.F transmission line which has the characteristic impedance of the line 1200 Ω and the reflection co efficient was observed to be 0.2?

Part-B

1. Derive the expressions for voltage and current at any point on the radio frequency dissipation less line. Obtain the expressions for the same for different receiving end conditions?

2. Brief notes on Standing waves, nodes, standing wave ratio also make relation between the standing wave ratio S and the magnitude of the reflection coefficient?
3. State the condition for the open wire line at high frequencies and derive the parameters?
4. Explain the parameters of open wire line and co axial at RF. Mention the standard assumptions made for radio frequency line. Label the Line constants for zero dissipation?
5. Outline the variation of input impedance along open and short circuit lines with relevant graphs?
6. Explain how the VSWR and wavelength of the line measured in detail?
7. Explain the expressions for the input impedance of the dissipation less line. Deduce the input impedance of open and short circuited dissipation less line?
8. Find the reflection coefficient and voltage standing wave ratio of a line having Ro = 100 ohm, Zr = 100 – j100 ohm?
9. Generalize the expressions for voltage and current at any point on the radio frequency dissipation less line. Obtain expressions for the same for different receiving end conditions?
10. How could you adapt the length of dissipation less line to obtain an inductance of 15μH at 60 MHz frequency with open circuit termination? Given that characteristic impedance of the line 400 ohm?
11. What way would you design the coaxial line at high frequencies? Design a graph to show the variation of R_o for a coaxial line?
12. Find the reflection coefficient and voltage standing wave ratio of a line having Ro = 100 ohm, Zr = 100 – j100 ohm?
13. Draw the standing wave pattern for (a) Open circuited load (b) Short circuited load (c) matched load?
14. Solve the standing wave ratio and reflection co – efficient on a line having Z0 =300ohm and terminated in ZR=300+j400?
15. Derive the line constants of a zero dissipation less line?

UNIT III - IMPEDANCE MATCHING IN HIGH FREQUENCY LINES

2-Marks

1. What is the need for impedance matching?
2. List the requirements of a better transmission line?
3. Interpret the effect of impedance mismatching?
4. Express standing wave ratio in terms of reflection coefficient?
5. Discuss about nodes and anti nodes in a transmission line?
6. Why do standing waves exist on transmission lines?
7. Give the minimum and maximum value of SWR and reflection coefficient?

8. Calculate the standing wave ratio if the reflection co-efficient of a line is 0.3 ∠-66°?
9. A lossless line has a characteristic impedance of 400Ω. Determine the standing wave ratio if the receiving end impedance is 800+j0Ω?
10. List the application of a quarter wave line?

Part-B

1. Consider a line with a load of ZR/RO =2.6+j, which is 28° long. Find the input impedance?
2. Deduce the expression for input impedance of a quarter wave transformer and mention its applications?
3. Design a Quarter wave transformer to match a load of 200Ω to a source resistance of 500Ω which operates at the frequency of 200 MHz?
4. Analyze the transmission line circle diagram by deriving the expression for constant S and constant βs circle?
5. A lossless line with ZO =70Ω is terminated with ZR =115-80jΩ. Wavelength of transmission is 2.5 λ. Using smith chart evaluate the VSWR, reflection coefficient, input impedance and input admittance?
6. Describe the impedance matching technique using single stub and obtain the expression for the stub location and stub length?
7. Consider a line of RO = 55 ohms terminated with 115+j75 ohms. If the total length of the line is 1.183λ, find the reflection coefficient, VSWR, input impedance and admittance?
8. What is the procedure for double stub matching on a transmission line, explain with an example?
9. A UHF lossless transmission line working at 1 GHz is connected to an unmatched line producing a voltage reflection coefficient of 0.5(0.866+j 0.5). Calculate the length and position of the stub to match the line using corresponding equations verify the values using Smith Chart?
10. A transmission line is terminated in ZL. Measurements indicate that the standing wave minima are 102 cm apart and that the last minimum is 35 cm from the load end of the line. The value of standing wave ratio is 2.4 and R0 = 250Ω. Determine frequency, wavelength, Real and reactive components of the terminating impedance. Also Verify the results obtained from equations using the smith chart?
11. A RF transmission line with Zo=300∠0° Ω is terminated in an impedance of 100∠45°Ω. This load is to be matched to the transmission line by using

a short circuited stub. With the help of smith chart, Determine the length and location of the stub?

12. A 50 Ω transmission line feeds an inductive load 35+j35Ω. Analyze and design a double stub tuner to match this load to the line using smith chart. Spacing between the two stubs λ\4?
13. Derive the expression of radius and center for constant R and X circles in Smith Chart?
14. Examine the transmission line to provide an impedance matching using a stub. Obtain the length and location of the stub to provide an impedance match on a line of 600 ohms terminated with 200 ohms. Assuming that the stub is short circuited at one end?
15. Determine length and location of a single short circuited stub to produce an impedance match on a transmission line with characteristic impedance of 600 ohm and terminated in 1800 ohm?

UNIT IV - WAVE GUIDES

2-Marks

1. What are guided Waves? Give examples for guiding structures?
2. Write about Principal wave?
3. Express the dominant mode in the wave propagating in the waveguide?
4. Deduce the expression for cut off frequency when the wave is propagated in between two parallel plates?
5. Examine the Characteristics of TEM waves?
6. Justify, why TM01 and TM10 modes in a rectangular waveguide do not exists?
7. Define cutoff frequency of a waveguide?
8. Illustrate the features of TE and TM mode?
9. Mention about the dominant mode of a rectangular waveguide?
10. Discuss about the dominant mode and degenerate modes in rectangular waveguide?

Part-B

1. Obtain the expression for the field components of an electromagnetic wave propagating between a pair of perfectly conducting plants?
2. Derive the expression for the field strength for TE waves between parallel plates propagating in Z direction?
3. Determine the expression of wave impedance of TE, TM and TEM wave between a pair of Perfectly conducting planes?
4. Illustrate the transmission of TM waves between two parallel perfectly conducting planes with necessary equations and diagram?

5. A pair of perfectly conducting plates is separated by 10cm in air and carries a signal frequency of 6GHz in TE1 mode. Find Cut-off frequency, Angle of incidence on planes, Phase velocity, group velocity, Phase constant, Cut-off wavelength, characteristic wave impedance, and wavelength along guiding walls. Is it possible to propagate TE3 mode?
6. Interpret the propagation of TE waves in a rectangular waveguide with necessary expressions for the field components?
7. Analyze the field configuration, cut off frequency and velocity of propagation for TM waves in rectangular wave guides?
8. A rectangular air filled copper waveguide with dimension 0.9inch x 0.4inch cross section and 12inch length is propagated at 9.2GHz with a dominant mode. Find the cutoff frequency, Guide wavelength, Phase velocity, characteristic impedance and the loss?
9. Using Bessel differential equation Obtain the TM field components in circular waveguides?
10. Analyze the expressions for the transmissions of TE waves in a circular waveguide conducting planes for the field components?
11. An air filled circular waveguide has a radius of 2 cm. Examine the cut off frequency and the phase constant for the dominant mode (p11' = 1.841 and p11 = 2.405.)
12. Obtain the field distribution of transverse and longitudinal components of the electric and magnetic fields in circular waveguide with necessary equations?
13. A rectangular waveguide having TE10 mode as dominant mode is having a cut off frequency of 18 GHz for the TE30 mode. Evaluate the inner broad – wall dimension of the rectangular waveguide?
14. Determine the cut off frequencies of the first two propagating modes of a circular waveguide with a=0.5cm and εr = 2.25 the guide is 50cm in length operating at f=13GHz. Determine the cut off wavelength and propagation constant?

UNIT V - RF SYSTEM DESIGN CONCEPTS

2-Marks

1. List some of the active RF components?
2. Draw the cross section of multi finger Bipolar Junction Transistor?
3. What is called as HBTs?
4. Classify RF field effect transistors based on physical construction?

5. Outline the characteristics of modulation doped field effect transistor?
6. Mention the various types of mixers?
7. Summarize the basic steps in the design process of RF amplifier circuits?
8. Distinguish between oscillator and Mixer?
9. Examine the importance of voltage controlled oscillator in RF system?
10. Interpret the basic parameters of RF amplifier?

Part-B

1. Outline the process to compute the junction capacitance and the space charge region length of a junction semiconductor device?
2. For a Si pn junction the doping concentration are given as NA = 10^{18} $cm^{-3}$and ND =10^{15} cm^{-3} with an intrinsic concentration of ni = 1.5 x $10^{10}cm^{-3}$. Find the barrier voltages for T = 300^{o} K?
3. Considering the electron concentration and hole concentration in a semiconductor as ***n*** and ***p*** respectively infer that ***np*** = $\mathbf{n}_i^2$ where ni is the intrinsic concentration?
4. Discuss about the different operating modes of a bipolar junction transistor with appropriate diagram?
5. Derive the drain saturation voltage and maximum saturation current for a field effect transistor?
6. Compare the field effect transistor with the bipolar junction transistor?
7. Analyze the steps involved to design a low noise amplifier?
8. Interpret the various types of mixers with its principle of operation?
9. Examine the following parameters of Conversion gain, Linearity and isolation of a mixer?
10. Illustrate the design principles of RF amplifier and impedance matching?
11. Write about the method used to design an integer N frequency synthesizer?
12. Determine the transfer function of a voltagecontrolled oscillator?
13. Discuss about input and output stability circles in the complex ΓL and ΓS planes, also derive the condition for unconditional stability?
14. A MESFET operated at 5.7GHz ha the following S parameters: S11=0.5∠-60°, S12=0.02∠0°, S21=6.5∠115° and S22=0.6∠-35°. Determine if the circuit is unconditionally stable and Find

the maximum power gain under optimal choice of reflection coefficients, assuming unilateral design (S12=0)?

15. An RF amplifier has the following S parameters: S11=0.3∠-70°, S21=3.5∠85°, S12=0.2∠-10°, S22=0.4∠-45°. Further Vs=5V∠0°, Zs=40Ω and ZL=73Ω. Assuming Zo=50Ω. Find GT, GTU, GA and G. Also find Power delivered to the load PL, available power from source PA and incident power to amplifier Pinc?
16. Explain the homodyne and heterodyne architecture of RF system? Devise the various stabilization methods for a RF amplifier circuit?