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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG

EC 6503/TRANSMISSION LINES & WAVEGUIDES (REGULATION 2013)

III YEAR/ V SEMESTER

UNIT WISE EXPECTED QUESTIONS FOR UNIVERSITY EXAMINATIONS

UNIT-1

TRANSMISSION LINE THEORY

Part-A

1. What is frequency distortion?

2. Find the attenuation and phase shift constant of a wave propagating along the line whose propagation constant is 1.048×10^{-4} 88.8^{0}.

3. Define phase distortion?

4. What is meant by inductance loading of telephone cables?

5. What is the relationship between characteristic impedance and propagation constant?

6. What is meant by distortion less line?

7. **Define propagation constant and characteristic impedance of a transmission line.**

8. Define cutoff wave length.

9. Define wavelength of the line?

10. What is the significance of the reflection co efficient?

11. What is meant by infinite line?

12. Write the expressions for the phase constant and velocity of propagation for telephone cable?

13. Define propagation constant. [MAY/JUN-2013]

14. A transmission line has Z o = 745∠12° Ω and is terminated in ZR = 100 Ω. Calculate the reflection loss in dB.

15. Find the reflection coefficient of a 50Ω transmission line when it is terminated by a load impedance of 60+j40Ω.

16. Define reflection loss.

PART-B

1. i) Discuss in detail about inductance loading of telephone cables and derive the attenuation constant, phase constant and velocity of signal transmission for the uniformly loaded cable.

ii) Explain in detail about the reflection on a line not terminated in its characteristics impedance.

2 (i) A transmission line operating at 500 MHz has Z_0=80Ω, α= 0.04 N p/m, β=1.5 rad /m. Find the line parameter series resistance (R Ω/m), series inductance (L H/m), shunt conductance (G mho/m) and capacitance between conductors (C F/m).

ii) A distortion less transmission line has attenuation constant $\alpha=1.15\times10^{-3}$ N p/m, and capacitance of 0.01 n F/m. the characteristic resistance L/C=50Ω find the resistance inductance and conductance per more of the line.

3. Derive the general transmission line equation for the voltage and current at any point on a line.

4 (i) write a brief note on frequency and phase distortion.

ii) the characteristics impedance of a 805m-long transmission line is 94∟ -23.2^{0}Ω the attenuation constant is 74.5×10^{-6} N p /m. and the phase shift constant is 174×10^{-6} rad /m at 5KHz calculate the line parameters R,L,G and C per meter and the phase velocity on the line.

5.(i) Derive expression for the attenuation and phase constant of transmission line in constant R,L,G and C.

ii) The constants of a transmission line are R= 6ohms/km, L=2.2m H/km, C=0.005×10^{-6} and G=0.25×10^{-6} mho/km. Determine the characteristics impedance and propagation constant at 1000 Hz.

6. (i) Derive the expression for the input impedance of a transmission line. Hence obtain the input impedance for a loss less line.

ii) Write a short note on reflection factor and reflection loss.

7. (i) Derive the expression for the input impedance of a loss less line.

(ii) Draw the L-type equivalent circuit model of a two-conductor transmission line and derive the transmission line equations.

8 (i) Discuss the reflection coefficient of different transmission lines.

ii) A transmission line operating at 10^6 rad /s has α= 8 d B/m, β= 1 rad/m. and z_0= 60+ j40ohms, and is 2meter long. The line is connected to a source of 10 v, Z g=40ohms and terminated by a load of 20 + j50ohms. Determine the current at the middle of the line.

9. i)A low loss transmission line of 100 ohms characteristic impedance is connected to a load of 200ohm. Calculate the voltage reflection coefficient and the standing wave ratio.

ii) Discuss the theory of open and short circuited lines with voltage and current distribution diagram and also get the input impedance expression.

10. (i) A transmission line has the following per unit length parameters : L = 0.1μ H, R =5 ohms, C = 300 pF and G = 0.01 mho. Calculate the propagation constant and characteristic impedance at 500 MHz.

(ii) Derive the conditions required for a distortion less line.

UNIT-II

HIGH FREQUENCY TRANSMISSION LINES

PART A

1. Find the VSWR and reflection coefficient of a perfectly matched line with no reflection from load?
2. **List the parameter of the co axial cable.**
3. Give the minimum and maximum value of SWR and reflection coefficient.
4. Why is quarter wave line called as copper insulator?
5. A low loss line has a characteristic impedance of 400ohms determine the SWR if the receiving end impedance is 650-j475Ω.
6. **Write the expressions for the input impedance of open and short circuited dissipation less line.**
7. Distinguish between series and shunt stubs?
8. List the procedural steps to find the impedance from the given admittance using smith chart.
9. How can distortion be reduced in a transmission line?
10. A transmission line has Z0=745 ∠ 12degree ohms and is terminated is Zs=100ohms calculate the reflection loss in db.
11. When does a finite line appear as an infinite line?
12. If a line is to have neither frequency nor delay distortion how do your relate attenuation constant and velocity of propagation to frequency?
13. Draw the equivalent circuit of a unit length of a transmission line?
14. **Find the reflection co efficient of the 50 ohm Transmission line when it is terminated by the load impedance of 60+j40 ohm. [MAY/JUN-2013]**
15. List parameters of the open wire line at High frequency.
16. A line having characteristics impedance 50 ohm is terminated in the load impedance 75+ j75 ohms. Determine the reflection co efficient.
17. A 50 Ω coaxial cable feeds a 75 + j20 Ω dipole antenna. Find reflection coefficient and standing wave ratio.
18. At a frequency of 80 *MHz,* a lossless transmission line has a characteristic impedance of 300 Ω and a wavelength of 2.5 m. Find L and C.

PART B

1. i) Derive the expression that permit easy measurement of power flow on a line of negligible losses.

ii) Derive the expression for input impedance of open and short circuited lines.

2. Discuss the various parameters of open wire and co axial lines at radio frequency.

3. Explain the open & short circuit lines for radio frequency line.

4. Derive the expressions for the input impedance of the dissipation less line. Deduce the input impedance of open and short circuited dissipation less line.

5. Derive the voltage and current on dissipation less line.

6. Derive the expression for standing wave ratio.

UNIT-III
IMPEDANCE MATCHING IN HIGH FREQUENCY LINES
Part-A

1. What is Impedance matching?
2. **What is smith chart? [Nov-2007]**
3. **Give two applications of smith chart? [May-2007]**
4. **Design a quarter wave transformers to match a load of 200 ohms to a source resistance of 500 ohms. The operating frequency is 200 MHZ. [May/June 2013] [Nov/Dec- 2006]**
5. **Distinguish between series stub and shunt stub. [Apr-2010]**
6. Give the expression for the single stub matching and double stub matching?
7. Give examples for stub matching?
8. What is relationship between single stub matching and double stub matching?
9. Express standing wave ratio in terms of a reflection coefficient.
10. **What are the applications of the quarter wave line?[Apr/May 2011,R8]**
11. **Define standing wave ratio? [MAY/JUN-2013]**
12. for the line of zero dissipation. What will be the values of attenuation constant and characteristics impedance?
13. **Mention the disadvantage of single stub matching. [May/June, 2014]**
14. **Mention the significance of λ/4 line. (Nov/Dec 2012, R8)**
15. **Distinguish between single stub matching and double stub matching.**
16. **What are small and zero dissipation lines?**
17. Write the relationship between SWR and reflection coefficient?
18. A lossless line has a characteristic impedance of 400 ohms. Determine the standing wave ratio if the receiving end impedance is 800 +j 0.0 ohms.
19. Write the expressions for the input impedance of open and short circuited dissipation less line.
20. Write the expression for VSWR in terms of (a) the reflection coefficient (b) VSWR in terms of z_L and z_0 .

Part- B

1. i) Discuss the application of quarter wave line in impedance matching and copper insulator.

ii) A 30 m long lossless transmission line with characteristic impedance Z_0 of 50Ω is terminated by a load impedance ZL=60 + j 40Ω The operating wavelength is 90 m. Find the reflection coefficient, standing wave ration and input impedance using SMITH chart.

2. A 50 Ω transmission line is connected to a load impedance ZL= 60+j80Ω. The operating frequency is 300MHz A double stub matching an eight of a wave length apart is used to match the load to the line find the required lengths of the short circuited stubs using SMITH chart.

3. i) A 75 Ω lossless transmission line is to be matched to a resistive load impedance of ZL=100Ω via a quarter wave section find the characteristic impedance of the quarter wave transformer.

ii) A 50Ω lossless transmission line is terminated in a load impedance of ZL=(25+j50)Ω Use the SMITH chart to find

(1). Voltage reflection coefficient.

(2). VSWR

(3). Input impedance of the line given that the line is 3.3 wavelength long and.

(4). Input admittance of the line.

4. A 50 Ω lossless line feeder line is to be matched to an antenna with ZL=(75-j20)Ω at 100MHz using single stub . Calculate the stub length between the antenna and stub using SMITH chart.

5. i) Discuss the operation of a quarter wave line and illustrate its application.

ii) A lossless line in air having a characteristic impedance of 300 ohms is terminated by unknown impedance. The first voltage minimum is located at 15 cm from the load the standing wave ratio is 3.3. Calculate the wavelength and terminating impedance.

6. A load having an impedance (450-j600) ohms at 10MHz is connected to a 300ohms line calculate the position and length of a short circuited stub to match this load to the line using SMITH chart.

7. i) A 100 + j50ohms is connected to a75 ohms lossless line. Find the reflection coefficient, load admittance and input impedance at the generator using smith chart.

ii) Explain the realization of quarter wave transformer.

8. Explain the technique of single stub matching and discuss operation of quarter wave transformer.

9. (i) Draw and explain the principle of double stub matching.

(ii) 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.

10. i) Discuss double stub matching.

ii) Show that the incident and reflected waves combine to produce a standing wave.

11. Explain the application of smith chart A 30 m long loss less transmission line with Z0=50ohms operating at 2 MHz is terminated with a load Z_L=60+j40ohms. Find the reflection coefficient y, the standing wave ratios and the input impedance.

UNIT IV
PASSIVE FILTERS
Part -A

1. A constant-K T-section high pass filter has a cutoff frequency of 10 KHz. The design impedance is 600 ohms. Determine the value of L. [MAY/JUN-2013]

2. What are the advantages of m-derived filters?

3. What are the disadvantages of m-derived filter?

4. What is the significance of propagation constant in symmetrical network?

5. Write the disadvantages of constant k filter?

6. What is constant K filter? Why it is called prototype filter section?

7. Define symmetrical network?

8. Brief notes on filter fundamentals?

9. Give the reason for impossibility of Filter design?

10. Define Low pass filter?

11. Write down the relationship between Low pass filter and High pass filter?

12. Write down the equation for characteristic impedance of symmetric network?

13. Write notes on composite filter?

14. What is meant by Band elimination filter?

15. Define band pass filter.

16. Brief notes on m derived sections?

17. Define cutoff frequency.

18. What is the difference between active filter and passive filter?

19. State the characteristics of the ideal filters.

20. Draw a simple Band-pass filter network and give the values of circuit elements.

21. Design a prototype low pass filter T section of design impedance Ro =500Ω and cutoff frequency fc=2000Hz

Part-B

1. Derive the relevant equation of m-derived low pass filter and design m-derived T-type low pass filter to work into load of 500ohms with cut off frequency at 4kHz and peak attenuation at 4.15kHz.

2. Explain the structure and application of crystal filter design a low pass filter with cut off frequency 2600 Hz to match 550 ohms use one derived section with infinite attenuation at 2850Hz.

3. i) Derive the equation for the characteristics impedance of symmetrical T and Π networks.

ii) Discuss the properties of symmetrical network in terms of characteristics impedance and propagation constant.

4. With suitable filter section design constant K low pass and high pass filter.

5. Calculate the values of the inductor and capacitor of a prototype constant k low pass filter composed of Π section to operate with a terming load of 600ohms and to have a cut off frequency of 3 KHz. Construct a band stop constant k filter?

6. (i) Discuss the characteristics of symmetrical network?

(ii)Design an m derived T section low pass filter having cut off frequency fc= 1000Hz design impedance Rk=600ohms and frequency of infinite attenuation f∞=1050 Hz.

7. Design a m-derived T-section low pass filter having a cutoff frequency (fc) of 5000 Hz and a design impedance of 600 ohms. The frequency of infinite attenuation is 1.25 fc.

8 (i) Design a constant-K T-section bandpass filter with cutoff frequencies of 1 KHz and 4 KHz. The design impedance is 600 ohms.

(ii) Draw a constant-K T-section band elimination filter and explain the operation with necessary design equations.

9. Design a constant K band pass filter deriving expressions for the circuit components. A constant High pass filter cut off frequency of 2300 Hz. The load resistance is 500 ohm. Calculate the values of the components used in filter.

10. Design a composite High pass filter to operate into the load of 600 ohm and have a cutoff frequency of 1.2Khz. The filter is have one constant k section, one m derived section with f infinity =1.1KHz and suitably terminated half section.

11. Derive the relevant equation of m-derived LPF & HPF filters for both (T & π) sections.

UNIT V

WAVE GUIDES AND CAVITY RESONATORS

Part -A

1. Define the quality factor of cavity resonator?
2. What is cavity resonator?
3. Why is the Bessel function of the second kind (Neumann's function) not applicable for the field analysis inside the circular wave guide?
4. Distinguish between wave guides and cavity resonator.
5. Define a cavity resonator and also give its application.
6. **Write the expression for the wave of TE and TM waves between parallel planes.**
7. Why should we take the cylindrical co-ordinate system to solve the field equation for a circular guide?
8. List out the parameters describing the performance of the resonator.
9. Compare transmission line and wave guide.
10. An air filled resonant cavity with dimension a=5cm, b=4cm, c=10 cm is made of copper find the resonant frequency for lowest order mode.
11. A rectangular waveguide of cross section 5cm×2cm is used to propagate TM11 mode at 10 GHz determine the cut off frequency.
12. What is the need for guide termination?
13. Write the expression for the wave impedance and guide wavelength for TEM mode?
14. What is the dominant mode of a rectangular waveguide? Why?

15. Calculate the cutoff wavelength for the TM11 mode in a standard rectangular waveguide if a = 4.5 cm.
16. Give the applications of cavity resonators.
17. What is the dominant TE and TM mode in rectangular waveguide?
18. How to design an air filled cubical cavity to have its dominant resonant frequency at 3 GHz?
19. Write Bessel's functions of first kind of order zero?
20. Mention the applications of cavity resonators?
21. **Define TE, TM waves & TEM waves.**
22. For a frequency of 6 GHz and plane separation of 3 cm, find the group and phase velocities for the dominant mode.
23. Define wave impedance and write an expression for wave impedance of TE waves in rectangular waveguide.
24. Define phase velocity and group velocity.
25. What is evanescent mode?
26. Which is the dominant mode in circular waveguide? Why?

PART-B

1. i) Derive the expression for TM wave components in wave guides using Bessel function.
ii) Write the brief note on excitation of modes in circular wave guides.

2. Derive the equation for Q-factor of rectangular cavity resonator for TE_{101} mode.

3. i) Derive the TM wave components in circular wave guide using Bessel function?
ii) Calculate the resonant frequency of an air filled rectangular resonator of dimensions a=3cm, b=2cm, d=4cm operating in TE_{101} mode.

4. i) Derive the solution of field equation using cylindrical co-ordinates.
ii) Draw the field configuration of different TM and TE modes for a circular guide.

5. i) A circular air filed copper cavity is excited in the TM_{010} mode at 9.375 GHz. The cavity has ratio length radius = 1.5. Find the Q-factor.
ii) Derive expressions for the field components existing in a rectangular cavity.

6. Discuss the propagation of TM waves in a rectangular waveguide with relevant expression for the field components.

7. i) Explain the field components of the TE waves in a rectangular cavity resonator with relevant expression.
ii) Calculate the cutoff wavelength, guide wavelength and characteristic wave impedance of a circular wave guide with an internal diameter of 4 cm for a 10 GHz signal propagated in it in the TE_{11} mode.

8. A rectangular wave guide with dimension a=2.5cm, b=1cm is to operate below 15 GHz How many TE and TM modes can the wave guide transmit if the guide is filed with a medium characterized by $\sigma=0$, $\epsilon=4\epsilon_0$, $\beta r=1$? Calculate the cutoff frequency of the modes.

9. Explain in detail:
i) Excitation of wave guides.
ii) Resonant cavities.

10.(i) Discuss the propagation of TM waves & TE waves in a parallel planes with relevant expressions and diagrams for the field components.
(ii) A rectangular waveguide measuring a = 4.5 cm and b = 3 cm internally has a 9 GHz signal propagated in it. Calculate the guide wavelength, phase and group velocities and characteristic impedance for the dominant mode.