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Analog Communications and Transmission Line Theory (CT215)
End-Semester Examination

Open Books and Open Notes Online Examination
Do not take help from others

Date: 2nd July 2020 **Time: 10:00 to 11:30am**

Answer all questions

Section A

Answers to following quiz-type questions can be 1 letter or few words or 1 or 2 lines. All questions are of 5 marks.

1. A transmission line is having length (l) equal to half-wavelength ($\lambda/2$) or integer multiples of half-wavelength (m $\lambda/2$). β is the phase constant. What is the input impedance (Z_{in}) in terms of load impedance (Z_L)? Indicate whether Z_{in} is independent of characteristic impedance (Z_0) or dependent on Z_0. Indicate whether Z_{in} is frequency independent or dependent on frequency.

2. An ideal two-conductor transmission line is terminated with a short circuit. The length of line is 0.25 times the wavelength at the signal frequency. Characteristic impedance is 75 Ω. Indicate value of the magnitude of input impedance (a) 75 Ω, (b) infinity (c) $75\sqrt{3}$ and (d) $75 / \sqrt{3}$.

3. Impedance inversion property in transmission line theory is given by $\overline{Z_{in}} = 1 / (\overline{Z_L})$. $\overline{Z_{in}}$ is normalized input impedance and $\overline{Z_L}$ is normalized load impedance. Indicate whether impedance inversion is obtained with (a) a short-circuited line or (b) an open-circuited line or (c) a quarter-wavelength line or (d) a half-wavelength line.

4. The input impedance of an open-circuited ideal two-conductor transmission line is 260 Ω and the input impedance when line is short-circuited is 87 Ω. Characteristic impedance of the line is nearest to (a) 110 Ω, (b) 120 Ω, (c) 150 Ω and (d) 173 Ω.

5. For impedance matching, short-circuited stubs are preferred as compared with open-circuited stubs. This is due to open-circuited stubs are (a) more difficult to make and connect or (b) made of transmission line with different characteristic impedance or (c) liable to radiate or (d) incapable of giving full range of reactances. Indicate your choice.

6. What are the advantages of using Smith chart as compared to calculations in transmission line theory?

7. For impedance matching in transmission line theory using quarter-wave transformer, state two limitations.

8. What are important applications of Smith chart for solving transmission line problems?

9. In Smith chart, there are two scales wavelength towards generator (wtg) and wavelength towards load (wtl). These scales show distances on transmission line in terms of wavelengths. Why these scales are from 0 to 0.5 wavelength?

10. In Smith chart, there are two ways to measure magnitude of reflection coefficient $|\Gamma|$ on transmission line. What are these two ways?

11. What are advantages of using short-circuited stub method as compared with quarter-wave transformer method for matching load to transmission line?

12. In matching using short-circuited stub, why Smith chart is used as admittance chart for calculation of stub length and distance to stub?

13. What changes are required in Smith chart used as impedance chart for use as admittance chart?

14. In case of passive microwave circuits and subsystem, what are ranges of values for r and x in Smith chart? Normalized load impedance $z_L = r + j\,x$.

15. What are directions of increase in distances (in terms of wavelength) along wtg and wtl circles in Smith chart?

16. There is only one straight line on Smith chart. What is the value of x circle for only straight line in Smith Chart?

17. Why transient analysis is important in study of transmission line?

18. What is the main application of voltage reflection diagram and current reflection diagram in transient analysis of transmission line?

19. For a lossless transmission line of length l terminated by matched load ($R_L = Z_0$), a battery of voltage V_o is switched at time t=0. Sketch voltage at load as a function of time. v is velocity of wave propagation.

20. If case of low-loss or lossy transmission lines propagating pulses, what is the effect of dispersion?

21. Why open two-wire line use is restricted below 500 MHz? What is the familiar form of open two-wire line?

22. The velocity factor of a transmission line (a) depends on the dielectric constant of the material used or (b) increases the velocity along the transmission line or (c) is governed by skin effect or (d) is higher for solid dielectric than for air. Which one of these four choices are true?

23. The mode of propagation in stripline and microstrip line are TEM and quasi-TEM modes, respectively. Explain why these modes are different?

24. What are advantages of circular waveguide as compared with coaxial line?

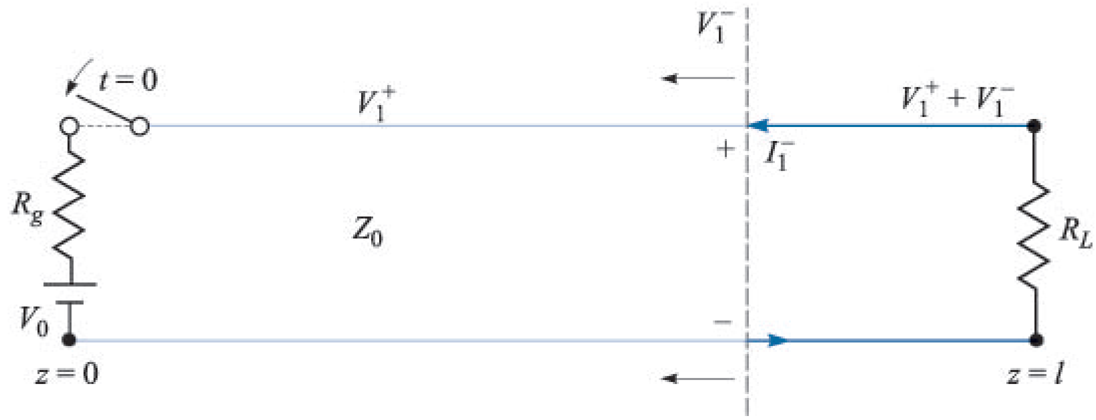
25. What are disadvantages of rectangular and circular waveguides as compared with coaxial line?

Section B

1. A lossless transmission line of length 2 cm is terminated by load impedance $Z_L = 30 + j\,50$ ohms. Transmission line has following parameters. Characteristic impedance (Z_0) = 100 ohms and operating frequency = 750 MHz. Calculate input impedance at 2 cm from the load. Show all steps in calculations. Do not use Smith Chart in this problem. You have to use calculator. (10 marks)

2. A lossless line of length 25 meters is terminated in a load $Z_L = 40 + j\,30\ \Omega$. It is operating at 10 MHz. Capacitance per unit length and inductance per unit length of the transmission line are 40 pF/m and 300 nH/m, respectively. Determine the input impedance at source and reflection coefficient at the load (Γ_L). Show all steps in calculations. Do not use Smith Chart in this problem. You have to use calculator. (10 marks)

3. In the figure shown below, $R_L = Z_o = 50\ \Omega$ and $R_g = 25\ \Omega$. Determine and plot the voltage at the load resistor and the current in the battery as functions of time by constructing appropriate voltage and current reflection diagrams. (10 marks)



4. For the transmission line and the source voltage shown in figure shown below, sketch the voltage at the load V_L as a function of time, for $0 < t < 16\ \mu s$. In this figure, R_C is characteristic impedance of transmission line and u is velocity of wave propagation which is 200 meters per μs. In this problem, source resistance $R_S = R_g = 0$.