Register Number: …….

B.E. DEGREE EXAMINATIONS: NOV/DEC 2010

Fifth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

U07EC504: Transmission Lines and Waveguides

Time: Three Hours **Maximum Marks: 100**

Answer All Questions:-

PART A (10*1=10 Marks)

1. A very lossy π/4 long, 50 ohm transmission line is open circuited at the load end. The input impedance measured at the other end of the line is approximately

   A) 0 B) 50 ohm C) ∞ D) none of the above

2. A transmission line whose characteristic impedance is a pure resistance

   A) must be a lossless line B) must be a distortionless line

   C) may not be a lossless line D) none of the above

3. When VSWR is 3, the magnitude of the reflection coefficient will be

   A) 1/4 B) 1/3 C) 1/2 D) 1

4. The magnitude of the reflection coefficient of a transmission line in terms of the load and Characteristics impedance is given by

   A) $\rho = \left[\frac{Z_L + Z_0}{Z_0 - Z_L}\right]$ B) $\rho = \left[\frac{Z_L Z_0}{Z_0 - Z_L}\right]$ C) $\rho = \left[\frac{Z_L - Z_0}{Z_0 + Z_L}\right]$ D) $\rho = \left[\frac{Z_L - Z_0}{Z_0 Z_L}\right]$

5. Assuming perfect conductor of a transmission line, pure TEM propagation in an air filled rectangular waveguide

   A) Coaxial line B) air filled cylindrical wave guide

   C) parallel thin wire line in air D) semi infinite parallel plate wave guide

6. When electromagnetic waves are propagated in a waveguide

   A) they travel along the broader walls of the guide

   B) they are reflected from the walls but do not travel along them

   C) they travel through the dielectric without touching the walls

   D) they travel along all four walls of the waveguide

7. Phase velocity 'Vp' and group velocity Vg in a waveguide are related as (C is velocity of light)

   A) $VpVg=C^2$ B) Vp+Vg=C C) Vp/Vg =constant D) Vp+Vg= constant

8. The cutoff wavelength λc for TE_{20} mode for a standard rectangular waveguide is

A) 2/a B) 2a C) a D) $2a^2$

9. In a circular waveguide with radius 'r', the dominant mode is

A) TM_{01} B) TE_{01} C) TM_{11} D) TE_{11}

10. A cavity resonator can be represented by

A) an LC circuit B) an LCR circuit C) a lossy inductor D) a lossy capacitor

PART B (10 x 2 = 20 Marks)

11. Define reflection factor and reflection loss.
12. Determine the Reflection coefficient of a transmission line when Z_R=200 ohms and $Z_0 = 692\angle -12^\bullet$ ohms.
13. Why Short Circuited stub is preferred over open Circuited stub?
14. Design a quarter wave transformer to match a load of 200 Ω to a source resistance of 500 Ω. The operating frequency is 200MHz.
15. What are the characteristics of TEM waves?
16. Define the terms phase velocity and group velocity.
17. A circular waveguide is operated at 11 GHz has the internal diameter of 4.5 cm. Find the cut off frequency for TE_{01} mode [$(ha)_{01}$=3.832].
18. Show graphically attenuation Vs frequency characteristics in a rectangular waveguide.
19. What is the cutoff wavelength of TE_{10} mode and what is the dominant mode in circular waveguide?
20. Define the Quality factor of a resonator.

PART C (5 x 14 = 70 Marks)

21. a) (i) Explain the different types of distortions in a transmission line and also derive the condition for a distortion less transmission. (6)

(ii) A line has R=10.4 Ω/km, L=3.67 mH/km, G=$0.8*10^{-6}$ mho/km and c=0.00835μf/km. Determine the characteristic impedance, propagation constant and sending end current for f=1000 Hz, Es =1.0 volts and length=100km. (8)

(OR)

b) (i) A cable has been uniformly loaded by an inductance such that ωl>>R. assuming leakage conductance to be nil, deduce an expression for attenuation and phase constant without neglecting R. (8)

(ii) Derive the equation for attenuation, phase constant and velocity of propagation of telephone cable. (6)

22. a) A lossless transmission line with characteristic impedance of 50 ohms is terminated in a load 50+j50 ohms. Using smith chart find the following.

(i) VSWR

(ii) Magnitude and angle of voltage reflection Coefficient.

(iii) Load admittance

(iv) Reflection Coefficient at a distance of $\lambda/4$ from the load

(v) Position of the first voltage minimum & maximum from the load.

(OR)

b) (i) Describe single stub matching of a transmission line. (8)

(ii) Design a single stub match for a load of 150 +j 225 ohms for a 75 ohms line at 500MHz using smith chart. (6)

23. a) Derive the components of electric and magnetic field strength between a pair of parallel perfectly conducting planes of infinite extent in the 'Y' and 'Z' directions. The planes are separated in X direction by 'a' meter.

(OR)

b) (i) A pair of perfectly conducting planes are separated by 8cm in air. For a frequency of 500 MHz with TM_{10} mode excited, find cut-off frequency, phase shift, phase velocity and group velocity. (8)

(ii) Derive the expression for wave impedance of TE & TM waves between parallel plates and draw the graph impedance Vs Frequency. (6)

24. a) (i) Derive the formula for the attenuation constant losses in an a x b rectangular waveguide for the TM_{11} mode. (10)

(ii) Explain why TEM is not possible in rectangular waveguide. (4)

(OR)

b) Explain the method of excitation of TM_{11}, TE_{11}, TE_{10} and TE_{20} in rectangular waveguide.

25. a) Derive the expression for TM wave components in circular waveguides using Bessel function.

(OR)

b) Derive an expression of unloaded Q of a rectangular cavity (axbxc) excited in TE_{101} mode for c>a>b.Under what condition this Q is maximum.

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