Register Number: ………………………

B.E. DEGREE EXAMINATIONS: APRIL/ MAY 2012

Fourth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

ECE108: Transmission Lines and Waveguides

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

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. The inductive loading required to achieve a distortion less line with the line parameters R= 42.1 Ω/km, G = 1.5 μmho/km, C = 0.062 μF/km and L = 1 mH/km.

    a) 1.774H/km   b) 1.74H/km   c) 2H/km   d) 1.074H/km

2. Group velocity is defined by

    a) ω/β b) $2\pi/\beta$ c) γ/β d) $d\omega/d\beta$

3. The value of SWR and Reflection coefficient of a matched load is given by

    a) $(1,0)$ b) $(\infty,1)$ c) $(0,1)$ d) $(1, \infty)$

4. Half wave line can be used as

    a) Impedance inverter   b) one to one transformer   c) coupling device d) copper insulator

5. The cut-off wavelength of a parallel plane guide separated by 5cm operated in TE_{10} mode is

    a) 1m   b) 0.01m   c) 0.1m   d) 0.001m

6. At the cut-off frequency the wave impedance for TM waves becomes

    a) Infinite   b) zero   c) characteristic impedance   d) intrinsic impedance

7. The phase velocity of the wave propagating in the dominant mode inside a rectangular waveguide of dimension 7 x 3.5 cm is

    a) 3.78×10^8m/s   b) 3.08×10^8m/s   c) 3.8×10^8m/s   d) 3×10^8m/s

8. Rectangular Waveguide is a _____ filter

    a) Low pass filter   b) High pass filter   c) Band pass filter   d) Notch filter

9. The dominant mode in the Circular Waveguide is

    a) TE_{01} b) TE_{10} c) TM_{11} d) TE_{11}

10. Cavity resonators can be used as

    a) Microwave oscillators   b) Amplifiers   c) Both a and b   d) Neither a nor b

PART B (10 x 2 = 20 Marks)

11. What is an Infinite line?

12. Calculate the reflection coefficient of a transmission line when $Z_R = 200\Omega$ and $Z_o = 692\angle-12^o\Omega$.

13. Design a Quarter wave transmission line to match a load of 500Ω to a source of 300Ω. The operating frequency is 300MHz.

14. What is stub matching? Mention its advantages.

15. What is meant by intrinsic impedance?

16. What are the properties of TEM waves in guided wave propagation?

17. Why TM_{01} and TM_{10} modes in a rectangular waveguide do not exist?

18. What are degenerate modes is Rectangular Waveguides?

19. A circular wave guide operated T 11GHz has the internal diameter of 4.5cm. For a TE_{10} mode propagation calculate λ and λ_c $((ha)_{01} = 2.405)$.

20. Define Quality factor of a resonator?

PART C (5 x 14 = 70 Marks)

21. a) Obtain the general solution of the transmission line and state its physical significance.

(OR)

b) (i) What is meant by loading? Show that attenuation and velocity are both independent of frequency with inductance loading of telephone cables. (10)

(ii) Find the sending end impedance of the line having $Z_o = 710 \angle 14^o \Omega$, $Z_R = 300 \Omega$, $\gamma = 0.007+j0.0028$ /km and $l = 100$km. (4)

22. a) Originating from the bilinear transformation derive the analytical formulation of the Smith Chart for a lossless transmission line.

(OR)

b) A slotted line measurement of a transmission line with characteristic impedance 60 Ω indicate a VSWR of 4.0 and the location of the first voltage minima of the standing wave pattern to be 0.1λ from the load. Assuming $d_1 = 0.05\lambda$ and $d_2 = 0.375\lambda$ and using Smith Chart find the lengths of the two stubs to achieve a match between the line and load.

23. a) Derive the expression for the field strengths for TM waves between parallel plates propagating in z direction. Sketch the field distribution of E and H fields for TM_{10} mode.

(OR)

b) Prove that the frequency of minimum attenuation due to conductor loss in a parallel plane waveguide for TM mode is $\sqrt{3}\ f_c$ where f_c is the cut off frequency. Also find the expression for minimum attenuation.

24. a) Derive the expression for the field components of TE waves in rectangular waveguide. Sketch the field distributions for the dominant mode.

(OR)

b) Define wave impedance and derive the expression for wave impedance for TE, TM and TEM waves in a rectangular waveguide.

25. a) (i) Derive the expressions for cut-off frequency, phase constant and velocity of propagation of waves in a circular waveguide. (7)

   (ii) Given a circular waveguide of internal diameter 2 cm operating with a 10 GHz signal propagating in dominant mode. Calculate the cut-off frequency, guide wavelength, wave impedance and the bandwidth of operation in dominant mode only. $[(ha)_{11} = 1.841]$. (7)

(OR)

b) Derive the expression for unloaded Q of a rectangular cavity resonator (a x b x d) excited in TE_{101} mode for d>a>b. What is the condition for maximum Q?

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