

**B.E DEGREE EXAMINATIONS: NOV/DEC 2014**

(Regulation 2009)

Fourth Semester

**ELECTRONICS AND COMMUNICATION ENGINEERING**

ECE108: Transmission Lines and Waveguides

*(smith chart must be provided if necessary)*

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. When VSWR is equal to zero, this means
  - a) that no power is applied
  - b) that the load is purely resistive
  - c) that the load is a pure reactance
  - d) that the load is opened
2. The standing wave ratio is equal to \_\_\_\_\_ if the load is properly matched with the transmission line.
  - a) Infinity
  - b) 0
  - c) -1
  - d) 1
3. A radio transmission line of 300 ohms impedance is to be connected to an antenna having an input impedance of 150 ohms. What is the impedance of a quarter-wave matching line?
  - a) 212 ohms
  - b) 250 ohms
  - c) 200 ohms
  - d) 150 ohms
4. What causes the attenuation present in a waveguide?
  - a) The air dielectric filling the guide
  - b) The coating of silver inside
  - c) Losses in the conducting walls of the guide
  - d) Radiation loss
5. Transmission lines when connected to antennas have
  - a) capacitive load
  - b) resistive load whose resistance is greater than the characteristic impedance of the line
  - c) resistive load whose resistance is less than the characteristic impedance of the line
  - d) resistive load at the resonant frequency

6. If the SWR on a transmission line has a high value, the reason could be
- a) An impedance mismatch between the line and the load      b) That the line is non-resonant
- c) a reflection coefficient of zero at the load.      d) That the load is matched to the line
7. Waveguides are used mainly for microwave transmission because
- a) They are bulky at lower frequencies      b) Losses are heavy at lower frequencies
- c) They depend on straight line propagation.      d) No generators are powerful enough to excite them.
8. For maximum absorption of power at the antenna, the relationship between the characteristic impedance of the line  $Z_o$  and the load impedance  $Z_L$  should be
- a)  $Z_o = Z_L$       b)  $Z_o > Z_L$
- c)  $Z_o < Z_L$       d)  $Z_o = 0$
9. The inner dimensions of a rectangular waveguide are 1.75 cm by 3.5 cm. The cutoff wavelength for the dominant mode is
- a) 1.75 cm      b) 3.5 cm
- c) 7.0 cm      d) 0.4375 cm
10. \_\_\_\_\_ are transmission lines which can convey electromagnetic waves only in higher order modes?
- a) Coaxial cables      b) Twisted pairs of telephone wire
- c) Power cables      d) Waveguides

**PART B (10 x 2 = 20 Marks)**

11. How to avoid frequency distortion that occurs in the line?
12. When reflection occurs in a line?
13. What are standing waves? Write the relation between SWR and reflection coefficient.
14. Why double stub matching is preferred over single stub matching?
15. For an open wire overhead line  $\beta=0.04$  rad/km. Find the wavelength and velocity at a frequency of 1600 Hz. Hence calculate the time taken by the wave to travel 90 km.
16. What are the methods used for constructing a resonator?
17. Mention the dominant modes in rectangular and circular waveguides.
18. List the application of waveguides.
19. Define Quality factor of a resonator.
20. What is an evanescent mode?

**PART C (5 x 14 = 70 Marks)**

21. a) Obtain the expression for current and voltage at any point along a line which is terminated in  $Z_0$ .

**(OR)**

- b) (i) Explain in detail about the waveform distortion and also derive the condition for distortion less line. (10)
- (ii) A cable has an attenuation of 3.5 dB/km and a phase constant of 0.28 rad/km. If 3 Volts are applied to the sending end, what will be the voltage at point 10 km down the line when the line is terminated in its characteristic impedance? (4)

22. a) (i) Discuss Quarter-wave line in impedance matching and its application. (7)
- (ii) Derive the relation between standing wave ratio and reflection coefficient. (7)

**(OR)**

- b) A R.F. transmission line has characteristic impedance of  $55 \Omega$ . It is terminated in a load impedance of  $(115+j75) \Omega$ . What is reflection coefficient in polar form? What is the standing wave ratio? At what distance from the load will the first maximum and minimum of voltage will occur? If the line is  $1.183 \lambda$  long, what will be the input impedance? Work out this problem by smith chart.

23. a) Derive expressions for the field components of an electromagnetic wave propagating between a pair of perfectly conducting planes.

**(OR)**

- b) For a frequency of 6000 MHz and plane separation of 7cm, find the following for  $TE_{01}$  mode. (i) Critical frequency (ii) phase constant (iii) attenuation constant and phase constant for  $f=0.8f_c$   
(iv) attenuation constant and phase constant for  $f=1.25f_c$   
(v) Critical wavelength.

24. a) Derive the complete solution for the electric and magnetic fields in  $TE_{m,n}$  wave in rectangular waveguides.

**(OR)**

- b) (i) Explain the wave impedance of a rectangular wave guide and derive the expression for the wave impedance of TM waves. (7)
- (ii) A  $TE_{10}$  mode is propagated through a waveguide with  $a=10\text{cm}$  at frequency  $2.5\text{ GHz}$ . Find  $\lambda_c, V_p, V_g, \lambda_g, Z_{0(TE)}$  and  $\beta$ . (7)

25. a) Obtain the field components of electric and magnetic field components for TM waves in a circular waveguide.

**(OR)**

- b) List the applications of cavity resonators and also derive the quality factor of Rectangular cavity resonator.

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