B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fifth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1305 — TRANSMISSION LINES AND WAVEGUIDES

Time: Three hours

Maximum: 100 marks

PART A — (10 x 2 = 20 marks)

Answer ALL questions.

1. Define propagation constant of a transmission line.
2. Calculate the characteristic impedance of a transmission line if the following measurements have been made on the line Zoc= 550 /__-60 degree ohm and Z sc = 500/__30 degree.
3. What are the applications of the quarter—wave line?
4. A 50 ohm line is terminated in load ZR =90+j60 ohm. Determine the reflection coefficient.
5. What are the characteristics of principal wave?
6. Define the cut—off frequency of a guide.
7. A rectangular waveguide with dimensions a = 8.5 cm and b = 4.3cm is fed by 5 GHz carrier. Will a TE11 mode be propagated?
8. Define wave impedance and write the expression for wave impedance of TE waves in rectangular guide.
9. What are the applications of cavity resonators?
10. Write Bessel's function of first kind of order zero.

PART B — (5 x 16 = 80 marks)

11. (a) (i) Derive the expressions for the input impedance of a transmission line. (10)

(ii) A cable has the following parameters:

R: 48.75 ohm/km, L: 1.09 mH/km, G: 38.75 MU/km and C: 0.059 uf/km.

Determine the characteristic impedance, propagation constant and wavelength for a source of f: 1600 Hz and Es: 1.0 volts. (6)

Or

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

(ii) A transmission line has the following parameters per km R: 15 ohm, C: 15 uf, L: 1 mH and G: 1 uU. Find the additional inductance to give distortion-less transmission. Calculate attenuation and phase constant for the loaded line. (8)

12. (a) (i) Deduce the expression for constant — S circle for the dissipation-less line and explain. (8)

(ii) A transmission line is terminated in ZL. Measurements indicate that the standing wave minima are 102 cm apart and that the last minimum is 35 cm from the load end of the line. The value of

standing wave ratio is 2.4 and R0 :250 ohm. Determine wave length and load impedance. (8)

Or

(b) (i) Explain the procedure of double stub matching on a transmission line with an example. (8)

(ii) Determine the length and location of a single short circuited stub to produce an impedance match on a transmission line with R0 of 600 Q and terminated in 1800 Q. (8)

13. (a) (i) Derive the expressions for the field components of TM waves between parallel plates, propagating in Z direction. (10)

(ii) For a frequency of 6 GHz and plane separation = 7 cm. Find the following for the TE1o made z

(1) Cutoff frequency

(2) Phase and group velocity. (6)

Or

(b) (i) Explain wave impedance and obtain the expressions of wave impedance for TE and TM waves guided along parallel planes, Also sketch the variation of wave impedance with frequency. (10)

(ii) For a frequency of 5 GHz and plane separation of 8 cm in air, find the following for TM mode (6)

(1) Cut-off wave length

(2) Characteristic impedance and

(3) Phase constant.

14. (a) (i) Obtain the solution of Electric and Magnetic fields of TM waves guided along rectangular wave guide. (10)

(ii) A rectangular waveguide measures 3 >< 4.5 cm internally and has a 10 GHz signal propagated in it. Calculate the cut-off wavelength, the guide wavelength and the characteristic wave impedance for the TE mode. (6)

Or

(b) (i) Discuss the attenuation of electromagnetic wave s guided along rectangular waveguide. (8)

(ii) What are the dimensions of a waveguide with the following specifications?

(1) At a frequency of 9959.5 MHz, the guide wavelength for TE mode is 87.57% of the cut-off wavelength

(2) TEao and TEiz mode have the same cut-off frequency. (8)

15. (a) (i) Determine the solution of electric and magnetic fields of TM waves guided along circular waveguide. (10)

(ii) A circular waveguide has an internal diameter of 4 cm. For a 10 GHZ signal propagated in it in the TEn mode, calculate cut—off wavelength, guide wavelength and characteristic impedance. Uhm: 1.84 (6)

Or

(b) (i) Obtain the expression for resonant frequency of circular cavity resonator. (8)

(ii) Calculate the resonant frequency of a rectangular resonator of dimensions a: 3 cm, b: 2 cm and d = 4 cm if the operating mode is TEioi. Assume free space within the cavity. (8)