C 3192

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fifth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1305 — TRANSMISSION LINES AND WAVE GUIDES

(Common to B.E. (Part-Time) Fourth Semester Regulation 2005)

Time : Three hours Maximum : 100 marks

(Two nos. of SMITH CHART can be provided.
Use separate Smith Chart for Prob. No. 12 (a) (ii) and 12 (b))

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is frequency distortion?

2. Calculate the load reflection coefficient of an open and short circuited line.

3. Find the VSWR and reflection coefficient of a perfectly matched line with no reflection from load?

4. Name few applications of half-wave line.

5. What is the cut-off frequency of TEM wave?

6. Give the expression that relates phase velocity (V_p), group velocity (V_g) and free space velocity (C).

7. Why the TE_{10} wave is called as dominant wave in rectangular wave guide?

8. How the TE_{10} mode is launched or initiated in rectangular wave guide using a probe?

9. Define the quality factor of a cavity resonator.

10. What is cavity resonator?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Discuss in detail about Inductance loading of Telephone cables and derive the attenuation constant (α), phase constant (β) and velocity of signal transmission (v) for the uniformly loaded cable. (10)

(ii) Explain in detail about the reflection on a line not terminated in its characteristic impedance (Z_0). (6)

Or

(b) (i) A transmission line operating at 500 MHz has $Z_o = 80\,\Omega$, $\alpha = 0.04$ Np/m, $\beta = 1.5$ rad/m. Find the line parameters series resistance ($R\ \Omega/m$), series inductance (L H/m), shunt conductance (G mho/m) and capacitance between conductors (C F/m). (10)

(ii) A DISTORTION LESS transmission line has attenuation constant (α) 1.15×10^{-3} Np/m and capacitance of 0.1 nF/m. The characteristic resistance $\sqrt{(L/C)} = 50\,\Omega$. Find the resistance, inductance and conductance per meter of the line. (6)

12. (a) (i) Discuss the application of Quarter-wave line in impedance matching and copper insulators. (6)

(ii) A 30 m long lossless transmission line with characteristic impedance (Z_0) of 50 Ω is terminated by a load impedance (Z_L) = 60 + j40 Ω. The operating wavelength is 90m. Find the reflection coefficient, Standing Wave Ratio and input impedance using SMITH chart. (10)

Or

(b) A 50 Ω transmission line is connected to a load impedance (Z_L) = 60 + j80 Ω. The operating frequency is 300MHz. A DOUBLE stub tuner spaced an eighth of a wave length apart is used to match the load to the line. Find the required lengths of the short circuited stubs using SMITH chart.

13. (a) (i) 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. (10)

(ii) Derive the wave impedance for TE waves between parallel planes. (6)

Or

(b) (i) Discuss the characteristics of TE and TM waves and also derive the cut off frequency and phase velocity from the propagation constant. (8)

(ii) A parallel perfectly conducting plates are separated by 7 cm in air and carries a signal with frequency (f) of 6GHz in TE_1 mode. Find

(1) The cut-off frequency (fc),

(2) Phase constant,

(3) Attenuation constant and Phase constant for f = 0.8 fc and

(4) Cut off wavelength. (8)

14. (a) Derive the field configuration, cut off frequency and velocity of propagation for TM waves in rectangular wave guide.

Or

(b) A TE_{10} wave at 10GHz propagates with the velocity of 2×10^8 m/sec in a brass $\sigma_c = 1.57 \times 10^7$ s/m — rectangular wave guide with inner dimensions a = 1.5 cm and b = 0.6 cm, which is filled with polyethylene $\varepsilon_r = 2.25$, $\mu_r = 1$. Calculate the Phase constant, Guide wave length, Phase velocity, Wave impedance. Which signal among the two separate signals with frequency of 5 GHz and 15 GHz will be supported by the rectangular wave guide for propagation through it?

15. (a) (i) Derive the TM wave components in circular wave guides using Bessel function. (12)

(ii) Calculate the resonant frequency of an air filled rectangular resonator of dimensions a = 3 cm, b = 2 cm and d = 4 cm operating in TE_{101} mode. (4)

Or

(b) Derive the Q-factor of a rectangular cavity resonator for TE_{101} mode.

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