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Question Paper Code : 73454

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fifth Semester

Electronics and Communication Engineering

EC 2305/EC 55/10144 EC 504 — TRANSMISSION LINES AND WAVEGUIDES

(Regulations 2008/2010)

(Common to PTEC 2305 – Tranmission Lines and Waveguides for B.E. (Part-Time) Fourth Semester – Electronics and Communication Engineering – Regulations 2009)

Time : Three hours Maximum : 100 marks

(Smith Chart is to be provided)

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. A constant-k T section high pass filter has a cutoff frequency of 10 kHz. The design impedance is 600 ohms. Determine the value of L.

2. Define propagation constant of a Transmission Line.

3. Write the need for inductance loading of telephone cables.

4. A transmission line has a characteristic impedance of 400 Ω and is terminated by a load impedance of $(650 - j475)$ Ω. Determine the reflection coefficient.

5. Express standing wave ratio in terms of a reflection coefficient.

6. Mention the application of quarter wave line.

7. A wave is propagated in the dominant mode in a parallel plane waveguide. The frequency is 6 GHz and the plane separation is 4 cm. Calculate the cutoff wavelength and the wavelength in the waveguide.

8. Give the equations for the propagation constant and wavelength for TEM waves between parallel planes.

9. A rectangular waveguide with a 5 cm × 2 cm cross is used to propagate TM_{11} mode at 10 GHz. Determine the cut off wave length.

10. Mention the applications of resonant cavities.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw and explain the design and operation of m-derived T-section bandpass filter with necessary equations and diagrams. (8)

(ii) Design constant-K bandstop filters (both T and π -sections) for the cutoff frequencies of 2 KHz and 6 KHz. The design impedance is 500 Hz. (8)

Or

(b) (i) Explain the principle and operation of crystal filters with neat diagrams. (10)

(ii) Design an m-derived low pass filter with a cutoff frequency of 2 KHz. Design impedance is 500 Ω and m = .04. Consider a π -section for your calculation. (6)

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

Or

(b) For a transmission line terminated in Z_0, prove that $Z_0 = \sqrt{Z_{SC} \cdot Z_{OC}}$. The following measurement are made on a 25 km line at a frequency of 796 Hz. $Z_{SC} = 3220 \angle -79.29^\circ\ \Omega$, $Z_{OC} = 1301 \angle 76.67^\circ\ \Omega$. Determine the primary constants of the line.

13. (a) (i) Derive an expression for the input impedance of dissipationless lines. Deduce the input impedance of open and short circuited dissipationless lines. (10)

(ii) A lossless line in air having a characteristic impedance of 300 Ω is terminated in unknown impedance. The first voltage minimum is located at 15 cm from the load. The standing wave ratio is 3.3. Calculate the wavelength and terminated impedance. (6)

Or

(b) (i) Discuss the principle of double- stub matching with neat diagram and expressions. (8)

(ii) A 300 ohm transmission line is connected to a load impedance of $(450 - j\ 600)\ \Omega$ at 10 MHz. Find the position and length of a short circuited stub required to match the line using Smith chart. (8)

14. (a) Derive the expression for the field strengths for TE wave between a pair of parallel perfectly conducting planes of infinite extent in the Y and Z directions. The plates are separated in X direction by 'a' meter. (16)

Or

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

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

(1) Cut-off frequency

(2) Phase constant

(3) Attenuation constant and phase constant for $f = 0.8\ f_c$

(4) Cut-off wavelength. (8)

15. (a) A rectangular wave guide with dimensions a = 2.5 cm, b =1 cm is to operate below 15 GHz. How many TE and TM modes can the waveguide transmit if the guide is filled with a medium characterized by $\sigma = 0$, $\epsilon = 4\epsilon_0$, $\mu_r = 1$? Calculate the cutoff frequencies of the modes.

Or

(b) Explain in detail

(i) Excitation of wave guides (8)

(ii) Resonant cavities. (8)
