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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2015

Electronics & Communication Engineering

(COMMUNICATION ENGINEERING & SIGNAL PROCESSING)

07EC6249 RF System Design

Max. Marks : 60 Duration: 3 Hours

Answer all six questions. Part 'a' of each question is compulsory.
Answer either part 'b' or part 'c' of each question

MODULE I

1. (a) Define characteristic Impedance of a transmission line ? Derive an equation for characteristic impedance related with the primary constants of the transmission line ?

4 Marks

Answer b or c

(b) What is a lossless transmission line ? Show that the impedance of a lossless transmission line at maximum voltage or minimum current is $Z(l) = Z_0 \frac{1+|\Gamma_L|}{1-|\Gamma_L|}$

5 Marks

(c) The VSWR of a lossless, 75Ω transmission line is 4.Calculate the impedance at the voltage maximum and minimum in the standing wave pattern along the line.

5 Marks

MODULE II

2. (a) Explain the steps to find VSWR using Smith chart ?

4 Marks

Answer b or c

(b) Show that in a smith chart the constant reactance circles is given by the equation $(\Gamma_r - 1)^2 + \left(\Gamma_i - \frac{1}{x}\right)^2 = \left(\frac{1}{x}\right)^2$ which represents a group of circles with center $\left(1, \frac{1}{x}\right)$ and radius $\frac{1}{x}$

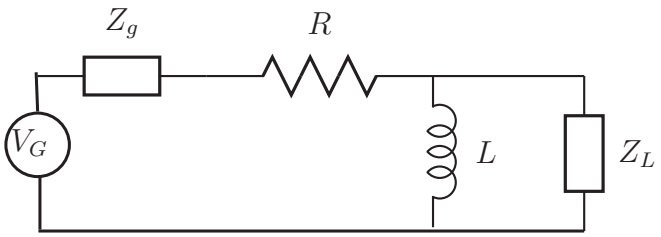
5 Marks

(c) Consider the following transmission line of length l with characteristic impedance Z_0 connected to a load impedance Z_L.
Using smith chart describe how to find the following :
(i) The SWR on the line
(ii) The reflection coefficient at the load
(iii) The load admittance
(iv) The input impedance of the line

5 Marks

MODULE III

3. (a) Consider the following RF High pass filter :



Find the insertion loss of the above filter

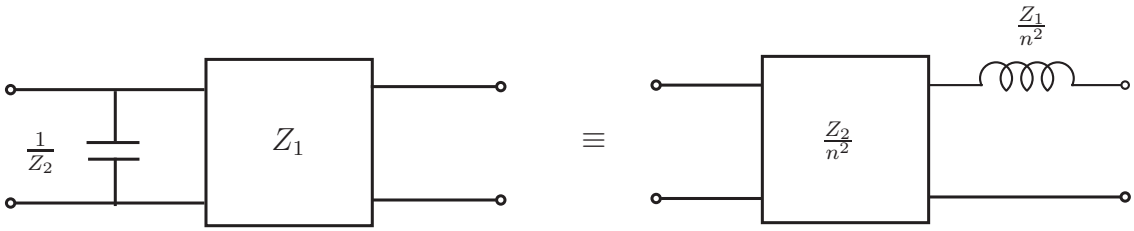
4 Marks

Answer b or c

(b) Consider an RF Filter which is obtained by cascading two two-port networks with individual scattering matrices [S^A] and [S^B]. Find the overall S_{21} parameter of the RF Filter.

5 Marks

(c) Consider the Kuroda's Identity shown below :



Using ABCD parameters of two circuits show that the two circuits are identical if we choose $n^2 = 1 + \frac{Z_2}{Z_1}$

5 Marks

MODULE IV

4. (a) Explain how a single stub open circuited series matching network is designed using smith chart ?

4 Marks

Answer b or c

(b) Show that for a single stub open circuited series matching network the length of the stub l_1 from the load where the stub is to be connected is given by $\frac{l_1}{\lambda} = -\frac{1}{2\pi}\tan^{-1}\left(\frac{B_L}{2Y_0}\right)$ for $G_L = Y_0$ where $Y_L = G_L + jB_L$.

5 Marks

(c) Explain how double stub short circuited shunt matching network is designed using smith chart ?

5 Marks

MODULE V

5. (a) Consider a single stage RF amplifier as a two port network.

Show that the Power Gain, $G = \frac{P_L}{P_{in}} = \frac{|S_{21}|^2\left(1-|\Gamma_L|^2\right)}{|1-S_{22}\Gamma_L|^2\left(1-|\Gamma_{in}|^2\right)}$

5 Marks

Answer b or c

(b) Show that the input stability circle represented in a complex Γ plane is of the form $|\Gamma_S - C_S| = |R_S|$ where center $C_S = \frac{(S_{11}-\Delta S_{22}^*)^*}{|S_{11}|^2-|\Delta|^2}$ and radius $R_S = \frac{S_{12}S_{21}}{|S_{11}|^2-|\Delta|^2}$ where $\Delta = S_{11}S_{22} - S_{12}S_{21}$

7 Marks

(c) Design a single section quarter wave transformer to match a 10Ω load to a 50Ω line at $f_0 = 3$ GHz.What would be the reflection coefficient corresponding to a SWR of 1.5 ?

7 Marks

MODULE VI

6. (a) Describe the basics of RF Oscillator ?

5 Marks

Answer b or c

(b) Explain a single ended Mixer ?

7 Marks

(c) Describe a negative resistance oscillator ? Find the conditions for steady state oscillations ?

7 Marks