COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications Engineering
Lecturer: Associate Prof. Dr. Hussein Hamed Ghouz
Course: Microwave Technology
Course Code: EC546 **Time : 60 Min.**
Date : Sat., Nov., 8, 2015 **Total Marks : 30**

7TH Exam Version(A): *Answer All Questions*

Q1: A transmission line section of length ℓ and characteristic impedance $\mathbf{Z_1}$ is connected between the source of impedance $\mathbf{Z_o}$ and load impedance $\mathbf{Z_L}$ as shown in **Fig.1**.

1. Calculate the numerical values of Z_{in}, Γ_{in}, and SWR_{in} for the following transmission line lengths (assume $\mathbf{z_o}$=75 and $\mathbf{Z_L}$=215Ω):

A1. $\ell=\lambda/8$ **A2.** $\ell=2\lambda/8$ **A3.** $\ell=3\lambda/8$ **A4.** $\ell=4\lambda/8$

2. If this transmission line section is used as a matching transformer to match the load $\mathbf{Z_L}$ to $\mathbf{Z_o}$ at frequency $\mathbf{f_o}$, find Z_1, $|\Gamma_{in}(\theta)|$ and the fractional bandwidth "$\mathbf{\Delta f/f_o}$" assume, $\ell=\lambda/4$, SWR_{max}=1.5 and $\mathbf{f_o}$=5.0 GHz. Sketch roughly $|\Gamma_{in}(\theta)|$.

Q2: Design three sections binomial matching transformer to match 215Ω load impedance to 75Ω transmission line at frequency $\mathbf{f_o}$=5.0 GHz. Assume the maximum voltage standing wave ratio SWR_{max} required not exceed than **1.5**. Find $|\Gamma_{in}(\theta)|$, and then, calculate the fractional bandwidth. Compare your result to two sections Cheybschveff for the same design.

Q3: Given the load impedance $\mathbf{Z_L}$=215 – j75 Ω. Use a proper matching method to match the given load to the source impedance ($\mathbf{z_o}$=75 Ω) at frequency $\mathbf{f_o}$=5.0 GHz assume SWR_{max}=1.5.

Q4: A two port network has a given scattering matrix [**S**] as shown in **Fig.2**. The input and output ports are connected to transmission lines of equal characteristic impedances and different lengths.

a. Find the total scattering matrix [**S'**] then, check the reciprocity and lossless conditions
b. Find the return loss seen at port **1'** if port **2'** is short circuit
c. Find the insertion return losses seen at port **1'** when port **2'** is matched
d. Find the return loss seen at port **1** when port **2** is open circuit

GoodLuck

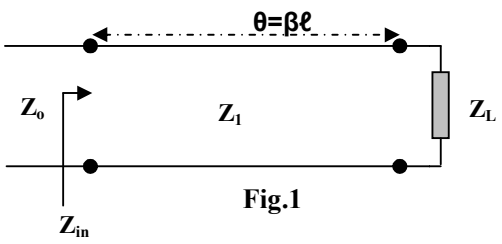

Fig.1

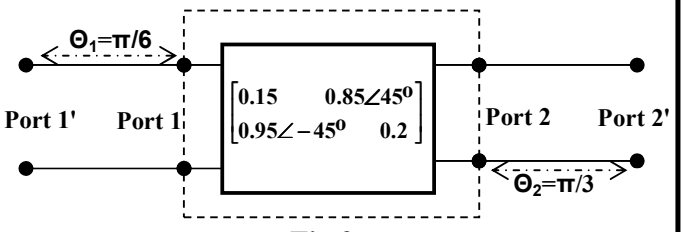

Fig.2

$\mathbf{T_2(x)=2x^2-1}$ $\mathbf{2xos^2(x))=(1+cos(2x))}$