The LNM Institute of Information Technology, Jaipur

Electronics and Communication Engineering Department

Engineering Electromagnetics(ECE335)

Exam Type: Mid Term **Academic Year:** 2017-18 **Semester:** ODD

Degree: B.Tech ***Programme:*** ECE ***Year:*** 2nd and 3rd

Time : 90 minutes **Date:**28/09/2017 **Full Marks:** 50

	CO1	CO2	CO3	CO4	CO5
Questions	*1,2,5a*	*3,4,5b,5c,6*	-	-	-
Marks	*20*	*30*	-	-	-
Marks/Max Marks (%)	*40*	*60*	-	-	-

Instruction: No query will be entertained during examination. If you think any data is missing, assume suitable values. *Write answer to all parts of question in same place. Write Roll no on top right corner of the smith chart. You can solve question by Smith Chart also.*

[Q1]. (a) In the following circuit interconnenction between Two Port Networks T_1 and T_2 is shown. Find ratio between V_1 and V_2.

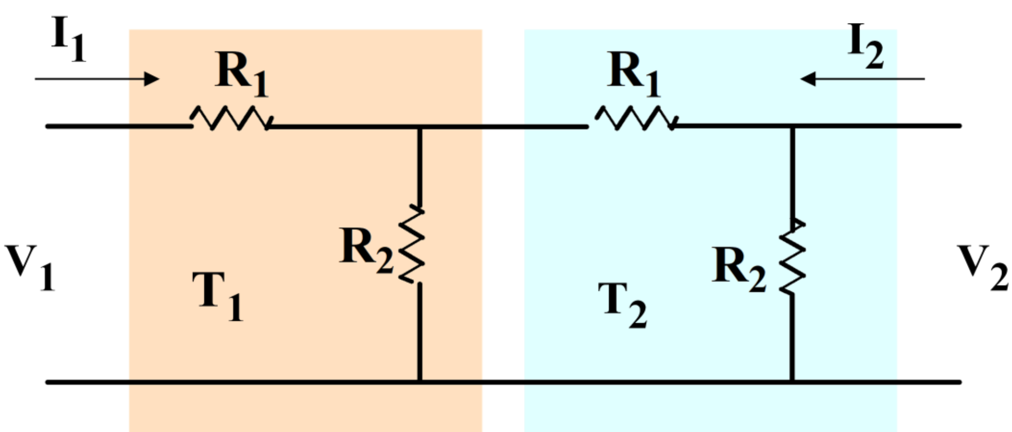


Figure 1. Cascaded Two Port Network

(b) Given Z_0 equal to 50 Ω, find S_{11} and S_{22} for the circuit given in figure 2.

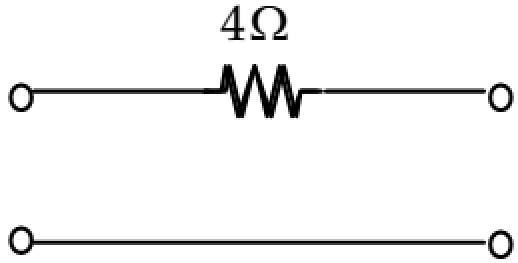
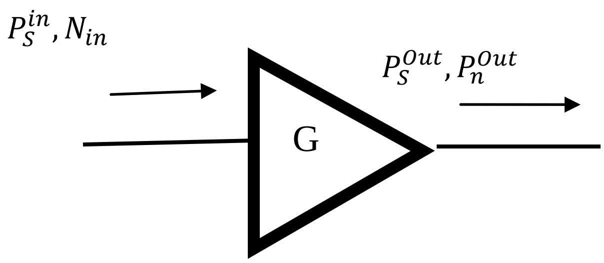


Figure 2. Circuit for question 1b

[3+3+2+2=10]

[Q2]. (a) A signal with power 3mW is distorted by noise with power -30dBm. What is the signal to noise Ratio(SNR) in dB.
(b) Prove that Noise Figure of a system as represented in following figure is given by,

$$F = \left(1 + \frac{T_e}{T_{in}}\right)\Bigg|_{T_{in}=290K}$$



[2+3+3=8]

[Q3]. (a) In the circuit given in figure 3, calculate maximum power output from source with impedence Z_S that can be absorbed into load.
(b) The power flow into a one-port circuit can be written in the following form $P_{in} = P_{AVS} - P_r$, where P_{AVS},is the avialbale power from the source. Assume source is sinusoidal and in steady state. If the source has a real resistance Z_0 and it emanting complex power, then show that

$$P_r = P_{avs}\left|\frac{Z_{in} - Z_0}{Z_{in} + Z_0}\right|^2$$

(c) If $P_{AVS} = P_{Load}$, find S_{11} for the circuit in figure 3.

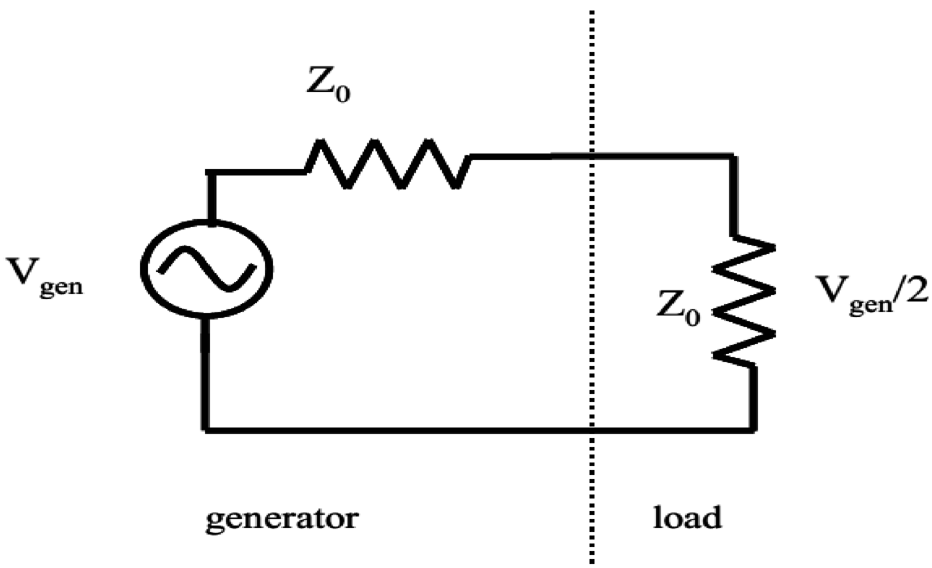
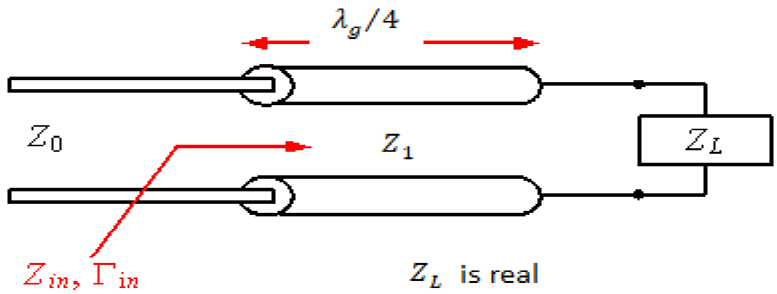


Figure 3. Circuit for Question 3.

[2+2+2=6]

[Q4]. (a) Derive the input impedence formula for a lossless transmission line.
(b) Find the input impedence for the transmission line given below.



(c) A unknown load connected to a slotted air line , produces a SWR ,S=2 by the standing wave indicator and minimas are found at 14cm, 22cm,30 cm..on the scale. when the load is replaced by a short circuit, the minimas are at 19cm,27cm, 35cm .. If Z_0 is 50 Ω, calculate the value of Z_L.

[4+3+3=10]

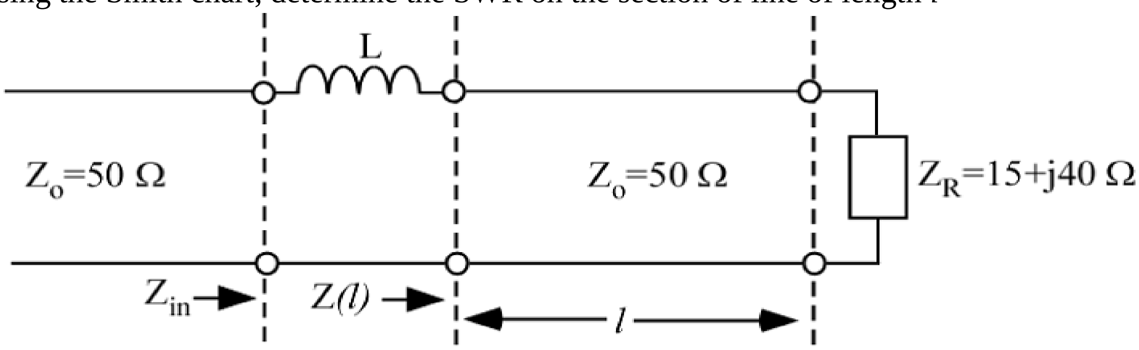
[Q5]. The input impedance of a short-circuited lossy transmission line of length 1.5 m (< λ/2) and a characteristic impedance of 100 Ω (approximately real) is 40 - j280 Ω.
(a) Find α and β of the line.
(b) Determine the input impedance if the short-circuit is replaced by a load resistance

$$Z_L = 50 + j50\,\Omega.$$

(c) Find the input impedance of the short-circuited line for a line length of 0.15 λ.

[2+2+2=6]

[Q6.] Consider the lossless transmission line network shown below. The operating frequency is 2000 MHz and the propagation velocity on the transmission line is 0.3 m/ns.
(a) Using the Smith chart, determine the SWR on the section of line of length *l*

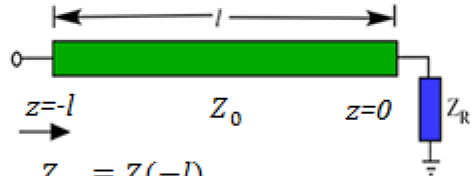


(b) Using the Smith chart find two values for the length *l* such that *Z(l)* is equal to $Z_0 \pm jX$.
(c) Determine the value of series inductance *L* and the proper length of the transmission line section (l_1 or l_2) that insures $Z_{in} = Z_0$
(d) Match a load impedance $Z_L = (100 + j80)$ - Ω to a line with characteristic impedance Z_0 = 75 - Ω using a shunt single-stub tuner. Find solution using a short-circuited stub.

[2+2+2+4=10]

Formula sheet

Transmission line equations



$Z_{in} = Z(-l)$

$$\Gamma(-l) = \Gamma_R e^{-j2\beta l} = \frac{Z_R - Z_0}{Z_R + Z_0} e^{-j2\beta l}$$

$$Z(-l) = Z_0 \left[\frac{Z_R + jZ_0 tan\beta l}{Z_0 + jZ_R tan\beta l}\right]$$

$$V(z) = V_+ e^{-j\beta z}\left[1 + \Gamma_R e^{+2j\beta z}\right]$$

$$Z(z) = Z_0 \frac{1 + \Gamma(z)}{1 - \Gamma(z)} \qquad \Gamma(z) = \frac{Z(z) - Z_0}{Z(z) + Z_0}$$

$$I(z) = \frac{V_+}{Z_0} e^{-j\beta z}\left[1 - \Gamma_R e^{+2j\beta z}\right]$$

$$\beta = \frac{2\pi}{\lambda} = \frac{\omega}{v}$$

$$\Gamma_{in} = \Gamma_{short} e^{-j2\beta\ell} e^{-2\alpha\ell} \qquad \Gamma_{in} = \Gamma_L e^{-2\alpha\ell} e^{-j2\beta\ell}$$

$$\Gamma_{in} = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} \qquad \Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0}$$

If there is a replacement of load then

$$\Gamma_{in}^2 = \frac{\Gamma_L}{\Gamma_{short}} \Gamma_{in}^1$$

S parameter :

$$S_{ij} \overset{\text{def}}{=} \left.\frac{b_i}{a_j}\right|_{a_i=0}$$