



## Transmission Lines and Antennas (2016503)

Groups 1-2, 2012-1

### Exercises on Transmission Lines

#### 1 Pozar, 2.9

A lossless transmission line is terminated with a  $100\Omega$  load. If the SWR on the line is 1.5, find the two possible values for the characteristic impedance of the line.

#### 2 Pozar, 2.10

Let  $Z_{sc}$  be the input impedance of a length of an arbitrary transmission line when the other end is short-circuited, and let it be  $Z_{oc}$  when it is open-circuited. Derive an expression for the characteristic impedance of the cable in terms of these.

#### 3 Pozar, 2.16

For a purely reactive load impedance of the form  $Z_L = jX$ , show that the reflection coefficient magnitude  $\Gamma$  is always unity. Assume the characteristic impedance  $Z_0$  is real.

#### 4 Pozar, 2.17

Consider the transmission line circuit shown in Fig. 1. Compute the incident power, the reflected power, and the power transmitted into the infinite  $75\Omega$  line. Show that power conservation is satisfied.

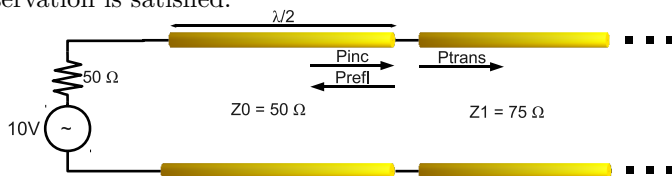


Figure 1: Circuit for power calculations.

#### 5 Variation of Pozar, 2.22

Using the formulas for the input impedance of a terminated transmission line, find the shortest lengths of a short-circuited  $75\Omega$  line to give the following input impedance:

1.  $Z_{in} = 0$
2.  $Z_{in} = \infty$
3.  $Z_{in} = j75\Omega$
4.  $Z_{in} = -j50\Omega$
5.  $Z_{in} = j10\Omega$

#### 6 (Pozar, problem 2.26)

For the  $\lambda/4$  transformer in Fig. 2 derive expressions for  $V^+$  and  $V^-$  in terms of the incident voltage amplitude  $V^i$ .

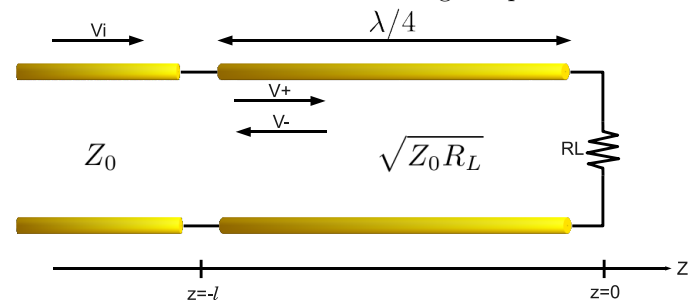


Figure 2: Quarter-wavelength transformer.

#### 7 (Pozar, problem 2.30)

A  $50\Omega$  transmission line is matched to a 10 V source and feeds a load  $Z_L = 100\Omega$ . If the line is  $2.3\lambda$  long and has an attenuation constant  $\alpha = 0.5\text{dB}/\lambda$ , find the powers that are delivered by the source, lost in the line, and delivered to the load.

### References

- [1] D. M. Pozar, *Microwave Engineering*. John Wiley & sons, 1998.
- [2] R. E. Collin, *Foundations of Microwave Engineering*. IEEE press, 2001.