



Arab Academy for Science & Technology  
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EC443 EM Transmitting Media

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Problems Set #3

"Graphical Solution for Transmission Line Problems"

**P3.1** A lossless line having an air dielectric has a characteristic impedance of  $400 \Omega$ . The line is operating at 200 MHz and  $Z_{in} = 200 - j200 \Omega$ . Use analytical methods & the Smith chart to find: (a) S, (b)  $Z_L$ , if the line is 1 m long; (c) the distance from the load to the nearest voltage maximum.

**P3.2** The normalized load on a lossless transmission line is  $2 + j1$ . the wavelength of the signal is 20 m. Let  $l = 20$  m and make use of the Smith chart to find: (a) the shortest distance from the load to a point at which  $Z_{in} = r_{in} + j0$ , where  $r_{in} > 1$ ; (b)  $Z_{in}$  at this point. (c) the line is cut at this point and the portion containing  $Z_L$  is thrown away. A resistor  $r = r_{in}$  of part (a) is connected across the line. What is the S on the remainder of the line? (d) what is the shortest distance from this resistor to a point at which  $Z_{in} = 2 + j1$  ?

**P3.3** A  $300 \Omega$  transmission line is short-circuited at  $z = 0$ . A voltage maximum equals 10 v is found at  $z = -25$  cm, and the minimum voltage equals zero at  $z = -50$  cm. Use the Smith chart to find  $Z_L$  (WITH THE SHORT CIRCUIT REPLACED BY THE LOAD) if the voltage readings are:

- (a)  $V_{max} = 12$  v at  $z = -5$  cm, and  $V_{min} = 5$  v.
- (b)  $V_{max} = 17$  v at  $z = -20$  cm and  $V_{min} = 0$  v.

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**Homework Assignment:**

**H3.1** The characteristic admittance ( $Y_0 = 1/Z_0$ ) of a lossless transmission line is 20 mS. The line is terminated in a load  $Y_L = 40 - j20$  mS. Make use of the Smith chart to find: (a) S. (b)  $Y_{in}$  if  $l = 0.15\lambda$ ; (c) the distance in wavelengths from  $Y_L$  to the nearest voltage maximum.

**H3.2** The wavelength on a certain lossless transmission line is 10 cm. If the normalized input impedance is  $Z_{in} = 1 + j2$ , use the Smith chart to determine:

- (a) S
- (b)  $Z_L$  if the line length is 12 cm.
- (c)  $X_L$  if  $Z_L = 2 + jX_L$  where  $X_L > 0$ .

Good Luck ☺