EE 301: Quiz-1

Instructions: This is a closed book quiz. The duration of this quiz is one hour. Most questions are based on reasoning and concepts discussed in class. In case of reasoning questions, you need to describe your answer via simple mathematical models. **The maximum score is 30.**

Useful Relations and important conventions:

1) Voltage reflection coefficient at the load end and the voltage standing wave ratio (VSWR) of the transmission line:

$$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0}$$

2) Impedance transformation for a lossless line:

$$Z(l) = \frac{V(l)}{I(l)} = Z_0[\frac{Z_L + jZ_0 \tan(\beta l)}{Z_0 + jZ_L \tan(\beta l)}],$$

$$\beta = \frac{2\pi}{\lambda} = \omega\sqrt{LC}, Z_0 = \sqrt{\frac{L}{C}}$$

QUESTIONS

1) There are two short answer questions. One or more than one answer may be correct. Your brief reasoning should be included for your answer choice.

(i) Which of the following are <u>not true</u> about the input impedance Z_{in} of a lossless line?

a) $Z_{in} = -jZ_0$ for a shorted line with length $l = \lambda/8$.

b) $Z_{in} = j\infty$ for a shorted wire with length $l = \lambda/4$.

c) $Z_{in} = jZ_0$ for an open line with length $l = \lambda/2$.

d) $Z_{in} = Z_0$ for a matched line.

e) At a half-wavelength from the load, $Z_{in} = Z_L$, and repeats for every half-wavelength thereafter.

(ii) Identify which of the following functions do not represent waves:

a) $50\exp(j\omega(t-3z))$ b) $\sin(\omega(10z+5t))$ c) $(x+5t)^2$ d) $\cos^2(y+5t)$ e) $\cos(5y+2x)$

[3+3=6]

2) Sketch with reasoning, the standing wave patterns along the transmission line for various cases of the load impedance.

[5]

3) (a) Show using impedance transformation that the unknown matching impedance of a quarter wave transformer is given by $Z_{01} = \sqrt{Z_0 Z_L}$, where Z_{01}, Z_0 and Z_L are the impedances of the quarter wave transformer, the line and the load respectively.

[3]

(b) Sketch the standing wave pattern before and after the impedance matching along the line.

[3]

4) Assume that the load impedance is $R_L = Z_0/2$. What resistance Z_Q can you put in parallel with the line $\lambda/4$ in front of the load to eliminate reflections on the generator side of that resistance?

[4]

5) A transmission line of length L is connected in between an ideal **dc voltage** source (no input impedance) with voltage V_0 and a matched load $Z_L = Z_0$. At $t = 0$ the voltage source is turned on. Assume that the signal velocity along the line is v.

a) Sketch the voltage across the load V_L as a function of time.

[2]

b) Now assume that the load is not matched such that $Z_L = R_L \neq Z_0$. Explain qualitatively what happens at the load end and at the generator end with time.

[2]

c) Sketch the voltage across the load V_L as a function of time.

[3]

d) What happens to the voltage across the load V_L after in steady state?

[2]