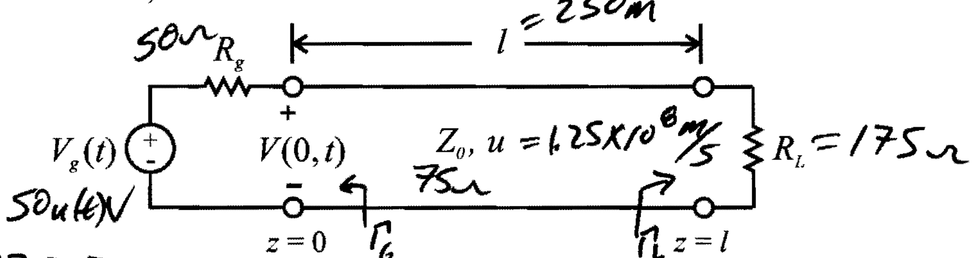
EE 382 Applied EM Quiz #5 (Spring 2018)

Name Key A

Instructions: Closed book. Place answers in indicated spaces and **show all work for credit.**

Equations: $\Gamma_x = \dfrac{Z_x - Z_0}{Z_x + Z_0}$, $SWR = \dfrac{1+|\Gamma|}{1-|\Gamma|}$, $Z_{in}(z) = Z_0 \dfrac{1+\Gamma(z)}{1-\Gamma(z)}$, distance = velocity × time, $V = IR$

For the transmission line circuit shown, calculate the load reflection coefficient Γ_L and generator reflection coefficient Γ_g, one-way transit time T, and initial & steady-state current & voltage at $z = 0$. Then, draw a voltage bounce diagram for $0 \le t \le 3T$, and sketch $V(0, t)$ for $0 \le t \le 3T$. Given: $V_g(t) = 50\ u(t)$ V, $R_g = 50\ \Omega$, $Z_0 = 75\ \Omega$, $R_L = 175\ \Omega$, $u = 1.25 \times 10^8$ m/s, and $l = 250$ m.



$\Gamma_L = \dfrac{Z_L - Z_0}{Z_L + Z_0} = \dfrac{175-75}{175+75} = \underline{0.4}$; $\Gamma_g = \dfrac{Z_g - Z_0}{Z_g + Z_0} = \dfrac{50-75}{50+75} = \underline{-0.2}$

$T = l/u = \dfrac{250}{1.25\times10^8} = 2\times10^{-6} = \underline{2\,\mu s}$

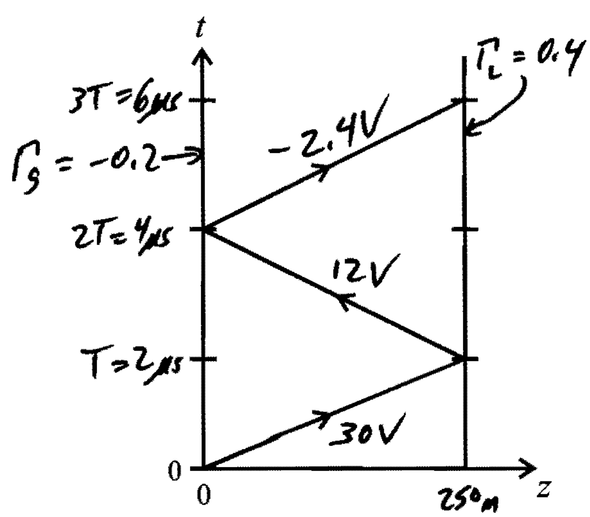
$I_{initial} = \dfrac{V_g}{R_g + Z_0} = \dfrac{50}{50+75} = \underline{0.4A}$ $V_{initial} = V_g \dfrac{Z_0}{Z_0 + R_g} = \dfrac{50(75)}{50+75} = \underline{30V}$

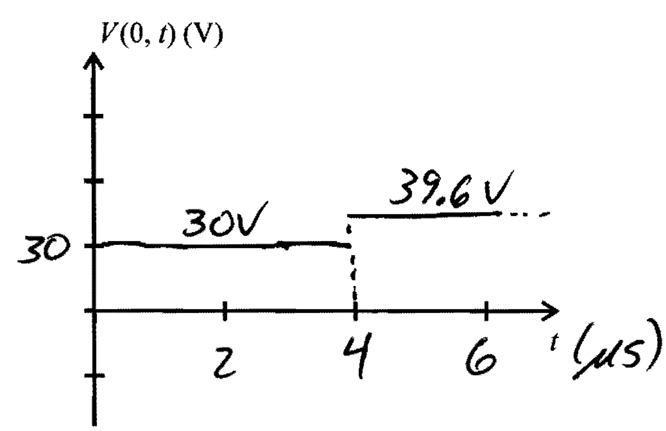
$I_{SS} = \dfrac{V_g}{R_g + R_L} = \dfrac{50}{50+175} = \underline{0.\overline{22}A}$ $V_{SS} = V_g \dfrac{R_L}{Z_0 + R_L} = \dfrac{50(175)}{50+175} = \underline{38.\overline{8}\,V}$

$0 \le t < 4\mu s$ $V(0,t) = V_{initial} = \underline{30V}$ $4\mu s \le t < 8\mu s$ $V(0,t) = 30 + 12 - 2.4 = \underline{39.6V}$

Γ_L = 0.4 Γ_g = −0.2 T = 2 μs   Initial current = 0.4 A

Initial voltage = 30V   S.S. current = $0.\overline{22}$ A   S.S. voltage = $38.\overline{8}$ V





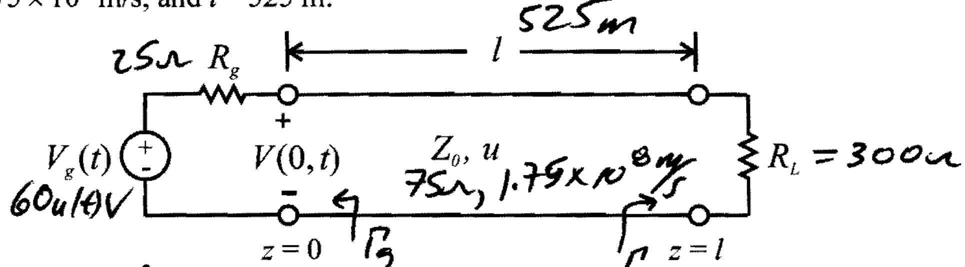
EE 382 Applied EM Quiz #5 (Spring 2018)

Name Key B

Instructions: Closed book. Place answers in indicated spaces and **show all work for credit.**

Equations: $\Gamma_x = \frac{Z_x - Z_0}{Z_x + Z_0}$, $SWR = \frac{1+|\Gamma|}{1-|\Gamma|}$, $Z_{in}(z) = Z_0 \frac{1+\Gamma(z)}{1-\Gamma(z)}$, distance = velocity × time, $V = IR$

For the transmission line circuit shown, calculate the load reflection coefficient Γ_L and generator reflection coefficient Γ_g, one-way transit time T, and initial & steady-state current & voltage at $z = 0$. Then, draw a voltage bounce diagram for $0 \le t \le 3T$, and sketch $V(0, t)$ for $0 \le t \le 3T$. Given: $V_g(t) = 60\ u(t)$ V, $R_g = 25\ \Omega$, $Z_0 = 75\ \Omega$, $R_L = 300\ \Omega$, $u = 1.75 \times 10^8$ m/s, and $l = 525$ m.



$\Gamma_L = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{300-75}{300+75} = 0.6$; $\Gamma_g = \frac{Z_g - Z_0}{Z_g + Z_0} = \frac{25-75}{25+75} = -0.5$

$T = l/u = \frac{525}{1.75\times10^8} = 3\times10^{-6} = 3\,\mu s$

$I_{initial} = \frac{V_g}{R_g + Z_0} = \frac{60}{25+75} = 0.6A$; $V_{initial} = V_g \frac{Z_0}{Z_0 + R_g} = \frac{60(75)}{25+75} = 45V$

$I_{SS} = \frac{V_g}{R_g + R_L} = \frac{60}{25+300} = 0.184615A$; $V_{SS} = V_g \frac{R_L}{R_g + R_L} = \frac{60(300)}{25+300} = 55.3846V$

$0 < t < 6\mu s$ = $V(0,t) = V_{initial} = 45V$ $6 \le t < 12\mu s$ $V(0,t) = 45 + 27 - 13.5 = 58.5V$

Γ_L = 0.6 Γ_g = −0.5 T = 3μs   Initial current = 0.6A

Initial voltage = 45V   S.S. current = 0.1846A   S.S. voltage = 55.385V