MS exam, ECE 107

Consider a lossless transmission line of characteristic impedance $Z_0 = 50\Omega$. The frequency of operation is 1GHz.

1) A load with impedance Z_L terminates the transmission line at $z = 0$. The load consists of a resistor R_L, capacitor C_L, and inductor L_L connected in series. Give an expression for the reflection coefficient.

2) The capacitance of the capacitor is given as $C_L = 20\,\text{pF}$.

   a. Find combinations of R_L and L_L that lead to the reflection coefficients $\Gamma = 0$ or $\Gamma = -1$ (one combination for each Γ).

   b. Find combinations of R_L and L_L that lead to the reflection coefficients $\Gamma = -0.5$ or $\Gamma = 0.5$ (one combination for each Γ).

   c. Find a combination of R_L and L_L that leads to the reflection coefficients $\Gamma = e^{j\pi/3}$ (i.e. $|\Gamma| = 1$ and $\arg\{\Gamma\} = \pi/3$).

3) Now, the load impedance Z_L is matched to the characteristic impedance of the transmission line. The phasor voltage at the location $z = 0$ is given by $\tilde{V}(0) = 5e^{j\pi/6}\,V$. Give expressions describing the voltage and current in this transmission line in the form of phasors and in the time domain representation.