(1) **Short Answer Section**

(a) matched

(b) latency

(c) false

(d) short (1) open (2)

(e) open (1) short (2)

(f) decrease (1) increase (2) decrease (3)

(g) true

(h) iteration

(2) **Descriptive Answer Section**

(a) Transmission Line Equations:

- term circled: \( V^- g \left( t + \frac{z}{v_p} \right) \)

- term boxed: \( \frac{v^+}{z_0} \)

- \( v(0, t) = V^+ f(t) + V^- g(t) \)

- \( i(z, 0) = \frac{V^+}{z_0} f \left( \frac{D - z}{v_p} \right) - \frac{V^-}{z_0} g \left( \frac{D + z}{v_p} \right) \)

(b) Continuum of Reactance:

We should recognize this situation as our model for a transmission line with impedance:

\[
Z_0 = \sqrt{\frac{L}{C}} = 100 \Omega
\]

A pulse enters this network and, assuming ideal, lossless components, simply bounces back and forth on the line with an amplitude of 100 V and a current of 1 A.

(c) Mystery Matching Circuit:

The inductor acts as an open circuit initially, so that the load resistance appears to be \( Z_0 - R_L \) in series with \( R_L \) for a total of \( Z_0 \) resistance – a perfect match to the line! In time the inductor becomes a short circuit, removing the effects of the matching resistor; only the true load remains. This scheme only works for \( R_L < Z_0 \)
– otherwise, the matching resistor would have to be negative.

**Work-out Problem Section**

(3) **Discharge of a Long Capacitor:**
When charged to 200 V, we can equivalently model this capacitor as two 100 V DC waveforms traveling forwards and backwards, each reflecting on the ends of the open-circuited line with $\Gamma = 1$. When the finger touches one end of the capacitor (say at $z = D$ on the "load" side), the reflection coefficient at that end becomes 0 due to the perfect impedance match. The voltage discharges into the finger while being fed for the first $T$ by the existing forward 100V waveform, then by the reflected 100V backwards-propagating wave for the next $T$. For this configuration, $v_p = \frac{1}{\sqrt{LC}} = 10 \text{ m/s}$, so the total discharge time is $2T = \frac{2D}{v_p} = 0.1 \text{ s}$. Snapshots of the line voltage are shown below:

\[t = 0\]
\[z: 0 \rightarrow D/2 \rightarrow D\]
\[200 \text{ V} \quad 100 \text{ V} \quad 100 \text{ V} \]

\[t = T/2\]
\[z: 0 \rightarrow D/2 \rightarrow D\]
\[200 \text{ V} \quad 100 \text{ V} \quad 100 \text{ V} \]

\[t = T\]
\[z: 0 \rightarrow D/2 \rightarrow D\]
\[100 \text{ V} \quad 100 \text{ V} \quad 100 \text{ V} \]

\[t = 3T/2\]
\[z: 0 \rightarrow D/2 \rightarrow D\]
\[100 \text{ V} \quad 100 \text{ V} \quad 100 \text{ V} \]

\[t = 2T\]
\[z: 0 \rightarrow D/2 \rightarrow D\]
\[0 \text{ V} \quad 100 \text{ V} \quad 100 \text{ V} \]

(4) **Striplines on PCB:**

a. $w_1 = w_2 = \frac{w_0 - 2h}{2}$

b. Make $w_1$ and $w_2$ different widths such that $Z_1||Z_2$ is still matched to $Z_0$, while the propagation velocity on segment 2 is twice as high as segment 1.