Special Problem 5.1-1

The impedance of the load in the circuit below is dependent on frequency $f$:

$$Z_L(f) = 3f^2 + j\frac{5-f}{2} \Omega$$

where $f$ is frequency in GHz.

The characteristic impedance $Z_0$ of the lossless transmission line is unknown.

What is known is that at one specific frequency $f$, a perfect match occurs (i.e., $\Gamma_L = 0$).

Determine the frequency at which this perfect match occurs, and the value of characteristic impedance $Z_0$. 

![Diagram of the circuit](image-url)