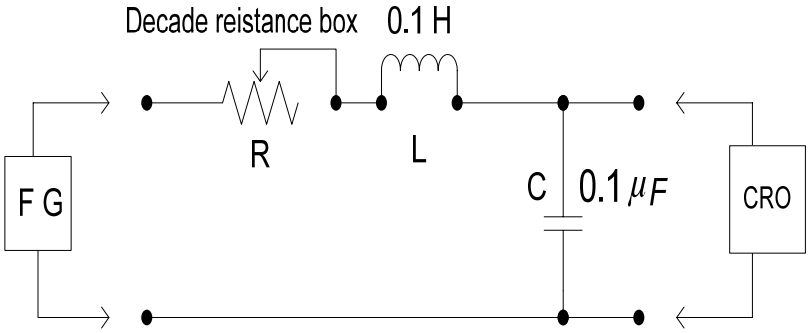
Electrical Engineering Department
Network Lab.

Objective: - Transient and frequency response of R-L-C series Circuit.

(I) *Transient Response;*

Consider the circuit given below;



FG = Function Generator

The above R, L, C series circuit forms a second order system. The response to step (voltage) input should be typical of second order system.

The circuit may be arranged for under damping, critical damping and over damping by varying R; choose different values of R to give normalized damping co-efficient ξ. Instead of a step voltage a square wave voltage is applied to the circuit. The transient response that is the voltage build up in the capacitor is recorded on the C R O. Take a trace. For a typical under damped case find the rise time settling time and the percentage overshoot.

Choose different values of ξ and plot percent overshoot vs. ξ for ξ less than I. (Six values of ξ -- 0.1, 0.2, 0.3, 05, 07 and 0.8 will suffice). Compare with the theoretical values obtained.

(2) ***Frequency Response:***

Use the same RLC series circuit. The natural frequency of oscillation of the system is around 500Hz. Try frequencies from about 50Hz to 5 KHz, space them equally as in a semi-log graph paper (ω / ω_n from 1 to 10)

By using a C.R.O measure voltage $V_R, V_L, V_C ; V_R$. Is also a measure of the current in the circuit. Now plot the gain (magnitude and phase) vs. frequency on a semi log graph sheet. The V_{in} is kept at a constant level. Try values of ξ as in the case of transient response.

The gain and phase response against frequency will be typical of second order system. Find M_m the maximum gain for each ξ and the frequency at which it occurs. Compare M_m with theoretical obtained values.

$$M_m = \frac{1}{2\omega\sqrt{1-\xi^2}}$$

Occurring at $\omega_m = \omega_n \sqrt{1-2\xi^2}$

Find the graph measure also the bandwidth of the system for different ξ