ESc201A Home Assignment 3 Aug. 19, 2019.

Solutions of the HA#3 will be on Brihaspati on 26/08/19.

Consider all voltage and current sources to be ideal.

1. The frequency of the sinusoidal voltage source in the circuit of fig. 3.1 is adjusted until the amplitude of the sinusoidal output voltage (v_o) is maximum. The maximum amplitude of the voltage source (v_i) is 600V. (a) Find ω_s, (b) Amplitude of V_o at ω_s, (c) The bandwidth of the circuit, (d) The Q of the circuit, and the frequencies at which the amplitude of V_o is $0.707\{V_o\}_{max}$.

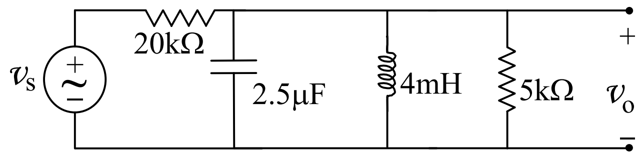

Figure 3.1

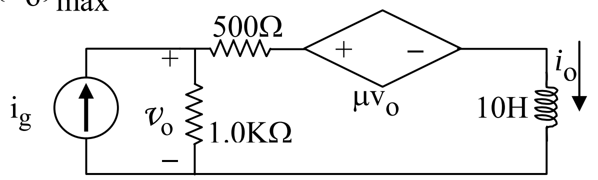

Figure 3.2

2. Find the transfer function i_o/i_g as a function of μ for the circuit shown in fig. 3.2. Hence find i_o at μ=1 and μ=2.5.
3. Find R, L, and C of a series RLC resonant circuit such that it resonates at f_o=500MHz and has a bandwidth of Δf=500kHz. The constraints are that the maximum current through R is 17.32mA and the maximum power dissipation is 62.84mW.
4. The peak amplitude of the sinusoidal voltage source in the circuit shown in fig. 3.3 is $100\sqrt{2}$ V and its period is 200π μs. The load resistor can be varied from 0 to 300Ω, and the load capacitor can be varied from 1 to 4μF. Determine the settings of R_L and C_L that will result in the most average power being transferred to R_L. Calculate the average power dissipated in R_L.

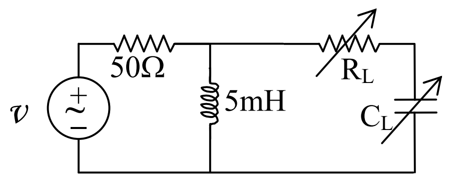

Figure 3.3

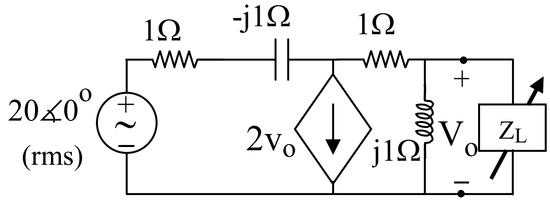

Figure 3.4

5. In fig. 3.4 the load impedance is varied till maximum average power is delivered to Z_L. What is this maximum average power? What percentage of the total power developed in the circuit is delivered to Z_L?
6. A machine is running at a load of 1200kW at a power factor (p.f.) of 0.8 lag. This p.f. needs to be improved to a p.f. of 0.96 lagging by adding an extra load of 300kW to the real power load.
(a) Find the Reactive Power of the added load. (b) What is its p.f.? (c) If the input voltage to the machine is always maintained at 3kV, then what is the rms current drawn by the machine, before and after addition of the 300kW load?
7. Find the numerical expression for the transfer function $H(j\omega) = v_o/v_i$ for the circuit shown in fig. 3.5.
Give the numerical value of each pole and zero of $H(j\omega)$.

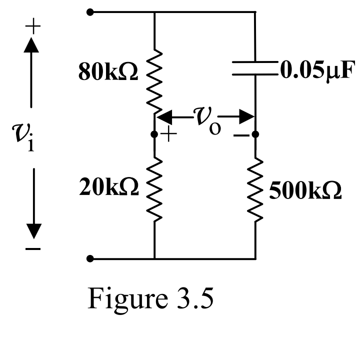

Figure 3.5

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8. The numerical expression for a transfer function is $H(j\omega) = \left\{10^5(j\omega + 5)\right\} \Big/ \left[(j\omega + 100)(j\omega + 500)\right]$.

   On the basis of a straight-line approximation of $H(j\omega)$ versus ω, estimate (a) the maximum $|H(j\omega)|$ in dB and (b) the value of $\omega > 0$ where the $|H(j\omega)|$ equals unity.

9. In the circuit shown in fig. 3.6 find the transfer function $H(j\omega) = v_o/v_i$. Sketch $\measuredangle H(j\omega)$ versus ω.

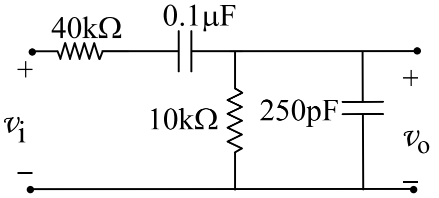

Figure 3.6

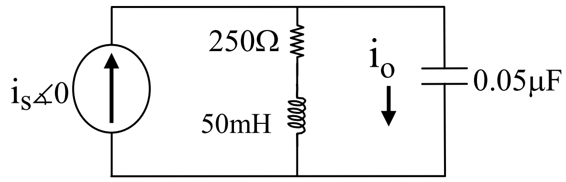

Figure 3.7

10. Derive the transfer function $H(j\omega) = i_o/i_s$ of the circuit shown in fig. 3.7. Sketch the asymptotic $|H(j\omega)|$ as a function of ω and find the bandwidth of the circuit.