EE5390: Analog Integrated Circuit Design; Assignment 1

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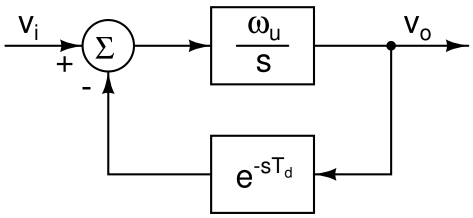

Figure 1: Problem 1

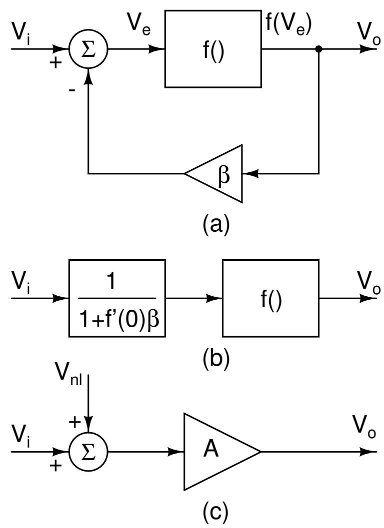

Figure 2: Problem 2

1. (a) Setup the differential equation for the system above.

   (b) V_i is 1 V for a long time and changes to 0 V at $t = 0$. What is the equation for $t > 0$?

   (c) Assume that the solution is of the form $V_p \exp(\sigma t)$. Obtain the equation from which you will determine σ (You are not required to solve it).

   (d) Express the above equation as $f(\sigma) = 0$. Sketch $f(\sigma)$. Determine the extremum of $f(\sigma)$ in terms of T_d. For what value of T_d does the extremum become equal to zero?

   (e) Assume that the solution is of the form $V_p \exp((\sigma + j\omega)t)$. Obtain the equations from which you will determine σ and ω (You are not required to solve them).

   (f) Reduce the above to a single equation in ω.

2. Fig. 2(a) shows a nonlinearity f enclosed in a negative feedback loop with a feedback fraction β. VFig. 2(b) shows a nonlinearity f preceded by an attenuation factor.

   (a) In each case, denote the transfer characteristic of the overall system by g, i.e. $V_o = g(V_i)$ and calculate the first three terms of the Taylor series of g about the operating point of the circuit in terms of f and its derivatives. Assume that $f(0) = 0$.

   (b) Fig. 2(c) shows the linear small signal equivalent circuit from V_i to V_o with an additional input V_{nl}. For the systems in Fig. 2(a) and

   (c) Fig. 2(b), compute the small signal equivalent gain A and the additional input V_{nl}. What do you infer from the results?