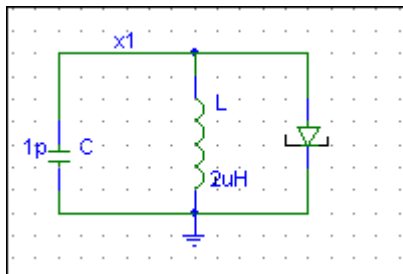


1. A single-valued continuous piecewise linear circuit can be described by

$$y(x) = b_0 + b_\infty \cdot x + \sum_{i=1}^N b_i \cdot \text{abs}(x - x_i) \quad (3.1)$$

where there are N break points x_i . Approximate the tunnel diode curve, similar to [text, p. 11] but for the ZJ56A [1963 CAS Trans., p. 526], when $I_{\text{peak}} = 1\text{ma}$ at $V_{\text{peak}} = 0.09\text{v}$, $I_{\text{valley}} = 0.1\text{ma}$ at $V_{\text{valley}} = 0.35\text{v}$ and $I(0.5\text{v}) = I_{\text{peak}}$.

2. For the following tunnel diode circuit use capacitor voltage and inductor current as the state to set up the state equations. Assuming the tunnel diode is described by your piecewise linear equation form 1. above, sketch the phase plane response; from this show that there is a stable limit cycle. Obtain computer aided solutions, say Spice and Matlab, and determine from it the frequency of oscillation. Investigate the tunnel diode model of Tarney [Proc. IRE, 02/1962, pp. 202-203], $i(v) = a(V_{\text{valley}} - v)^2 \tanh(v/(2VT)) + cv$; $c = I_{\text{valley}}/V_{\text{valley}}$, $VT = \text{thermal voltage}$, $a = (I_{\text{peak}} - cV_{\text{peak}})/((V_{\text{valley}} - V_{\text{peak}})^2 \tanh(V_{\text{peak}}/(2VT)))$. A Pspice model on the web for the tunnel diode is in an Orcad technical note at : <http://www.orcad.com/technical/library/schematic/contentpage/tn/tn101.htm>.



3. For the following OTA hysteresis circuit, find a means of specifying OTA parameters so that desired hysteresis widths and heights are obtained. For the nonlinear OTA try $i(v) = I_o \cdot \tanh(1000000 \cdot [v - v_{\text{break}}])$ and for the linear $i(v) = g_m \cdot v$; to run in Spice you will probably need to do a transient response with a triangular input voltage that runs up and down through the hysteresis jump points.

