ECE 529: Homework #1

Due Session 8 (February 1)

1. Do the following for each of the 4 circuits below:

   A. Plot $v_o(t)$ versus time
   B. Plot the current indicated in the figure versus time
   C. Comment how the behavior and topology of each circuit relates to the fundamental rules of power electronics
   D. Simulate with your transients program

   **Case 1:**
   
   ![Case 1 Circuit Diagram]
   
   Where $v_o(0) = 0V$

   **Case 2:**
   
   ![Case 2 Circuit Diagram]

   **Case 3:**
   
   ![Case 3 Circuit Diagram]

   Where $v_o(0) = 0V$

   **Case 4:**
   
   ![Case 4 Circuit Diagram]
2. Calculate and plot the switching power loss as a function of frequency in a range of 500Hz -20kHz assuming $V_d=3000V$ and $I_o=500A$ in the circuit in figure 2.1 below. The data sheets for a switching device list the following switching times corresponding to the linearized characteristics shown in figure 2.2 below, assuming clamped inductive switching.

Define units: $\text{nsec} := 10^{-9} \cdot \text{sec}$

- $t_{\text{rise}_i} := 100\text{nsec}$
- $t_{\text{fall}_i} := 200\text{nsec}$
- $t_{\text{d}_\text{on}} := 0\text{nsec}$
- $t_{\text{rise}_v} := 100\text{nsec}$
- $t_{\text{fall}_v} := 50\text{nsec}$
- $t_{\text{d}_\text{off}} := 0\text{nsec}$

If the onstate voltage is 1.5V also calculate the conduction losses (just calculate them for one frequency).