Fall-2021 UM-SJTU JI Ve311 Homework #2

Instructor: Dr. Chang-Ching Tu

Due: 10:40 am, October 13, 2021 (Wednesday), online submission

Note:

(1) Please use A4 size papers.

(2) Please use the SPICE model below for simulation.

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.model Dbreak D Is=1e-10 Rs=0 N=1 TT=0 Cjo=0pF
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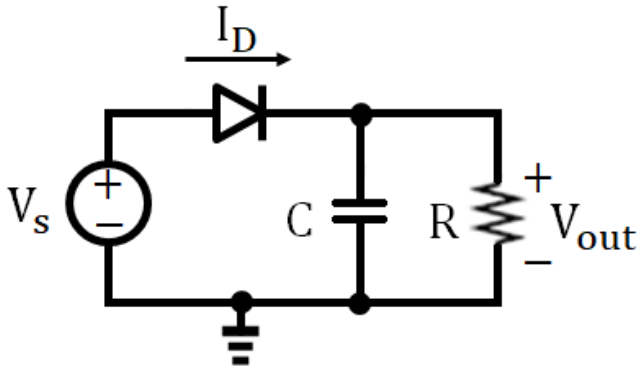
1. [Half-Wave Rectifier] Design a half-wave rectifier circuit, such as below, which can convert a sinusoidal voltage input, $V_s = 5\sin(2\pi 100 \cdot \text{time})$, to an almost constant voltage output.
   (a) [20%] Assuming $V_{on} = 0.9\,V$ and $R = 100\,\Omega$, calculate C which makes the ripple voltage (V_r) is smaller than 0.1 V. Estimate V_{dc}, I_{dc}, θ_c, ΔT, I_{peak}, I_{surge} and PIV of the designed half-wave rectifier.
   (b) [15%] Based on the calculated C, in Pspice plot V_s and V_{out} versus time on the sample graph to find out the values of V_{dc}, I_{dc}, V_r and PIV. Compare the simulation results with the hand-calculated ones.
   (c) [15%] In Pspice, plot I_D versus time to find out the values of I_{peak} and I_{surge}. Compare the simulation results with the hand-calculated ones.



2. [Full-Wave Bridge Rectifier] Design a full-wave bridge rectifier circuit, such as below, which can convert a sinusoidal voltage input, $V_s = 5\sin(2\pi 100 \cdot \text{time})$, to an almost constant voltage output.
   (a) [20%] Assuming $V_{on} = 0.9\,V$ and $R = 100\,\Omega$, calculate C which makes the ripple voltage (V_r) smaller than 0.1 V. Estimate V_{dc}, I_{dc}, θ_c, ΔT, I_{peak}, I_{surge} and PIV of the designed full-wave bridge rectifier.
   (b) [15%] Based on the calculated C, in Pspice plot V_s (using "voltage differential marker" function) and V_{out} versus time on the sample graph to find out the values of V_{dc}, I_{dc}, V_r and PIV. Compare the simulation results with the hand-calculated ones.
   (c) [15%] In Pspice, plot I_{D2} and I_{D3} versus time on the same graph to find out the values of I_{peak} and I_{surge}. Compare the simulation results with the hand-calculated ones.