Faculty of Science, Engineering and Technology

Swinburne University of Technology

EEE20004 : Analogue Electronics 1

Tutorial 2 : Diode Circuits.

1. The full-wave rectifier circuit shown in Figure 1 has an input signal whose frequency is 60 Hz. The rms value of v_S = 8.5 V. Assume each diode cut-in voltage is V_γ = 0.7 V.

(a) What is the maximum value of V_O?

(b) If R = 10 Ω, determine the value of C such that the ripple voltage is no larger than 0.25 V.

(c) What must be the PIV rating of each diode?

(Problem 2.7 of text : (a) V_O(peak) = 11.32 V (b) 37.7 mF (c) 23.36 V)

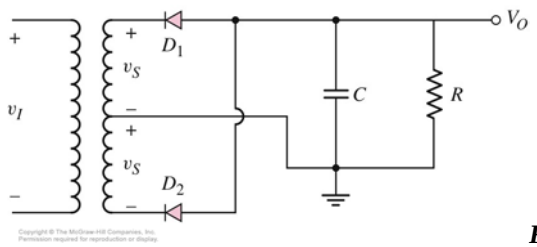

Figure 1 (Fig. P2.7 of text)

2. The circuit of Figure 2 is a complementary output rectifier. If v_s = 26sin[2π(60)t] V, sketch the output waveforms v_o^+ and v_o^- versus time, assuming V_γ = 0.6 V for each diode.

(Problem 2.9 of text)

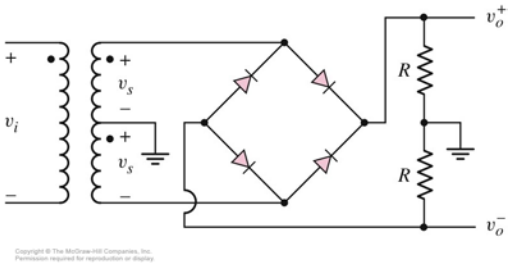

Figure 2 (Fig. P2.9 of text)

3. Sketch v_o versus time for the circuit in Figure 3 with the input shown. Assume $V_\gamma = 0$.

(Problem 2.12 of text)

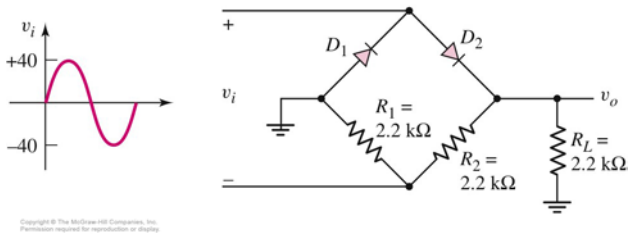

Figure 3 (Fig. P2.12 of text)

4. **(a)** Sketch v_o versus time for the circuit in Figure 4. The input is a sine wave given by $v_i = 10\sin\omega t$ V. Assume $V_\gamma = 0$.

(b) Determine the rms value of the output voltage.

(Problem 2.13 of text : (b) $v_o(\text{rms}) = 3.04$ V)

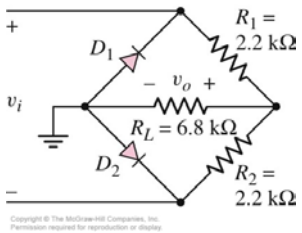

Figure 4 (Fig. P2.13 of text)

5. In the voltage regulator circuit in Figure 5, let $V_I = 6.3$ V, $R_i = 12\ \Omega$, and $V_Z = 4.8$ V. The Zener diode current is to be limited to the range $5 \le I_Z \le 100$ mA.

(a) Determine the range of possible load currents and load resistances.

(b) Determine the power rating required for the Zener diode and the load resistor.

(Problem 2.16 of text : (a) $25 \le I_L \le 120$ mA, $40 \le R_L \le 192\ \Omega$ (b) $P_Z = 480$ mW)

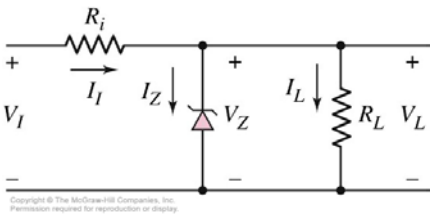

Figure 5 (Fig. P2.16 of text)

6. In the voltage regulator circuit in Figure 5, let $V_I = 20$ V, $R_i = 222\ \Omega$, $V_Z = 10$ V, and $P_Z(\text{max}) = 400$ mW.

(a) Determine I_L, I_Z, and I_I, if $R_L = 380\ \Omega$.

(b) Determine the value of R_L that will establish $P_Z(\text{max})$ in the diode.

(c) Repeat part (b) if $R_i = 175\ \Omega$.

(Problem 2.17 of text : (a) $I_L = 26.3$ mA, $I_Z = 18.7$ mA, $I_I = 45$ mA (b) $R_L = 2$ kΩ (c) $R_L = 585\ \Omega$)

7. Consider the circuit in Figure 6. Let $V_\gamma = 0$. The secondary voltage is given by $v_s = V_s \sin\omega t$, where $V_s = 24$ V. The Zener diode has parameters $V_Z = 16$ V at $I_Z = 40$ mA, and the incremental Zener resistance $r_z = 2\ \Omega$. Determine R_i such that the load current can vary over the range $40 \le I_L \le 400$ mA with $I_Z(\text{min}) = 40$ mA and find C such that the ripple voltage is no larger than 1 V.

(Problem 2.22 of text : $R_i = 18.2\ \Omega$, C =9901 μF)

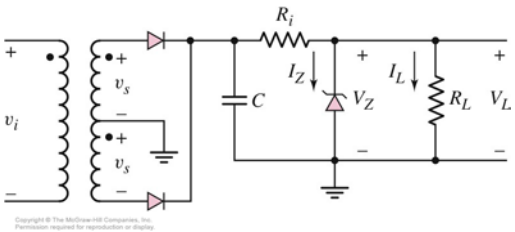

Figure 6 (Fig. P2.22 of text)

8. For the circuit shown in Figure 7,

(a) Plot v_O versus v_I for $0 \le v_I \le 15$ V. Assume $V_\gamma = 0.7$ V. Indicate all breakpoints.

(b) Plot i_D over the same range of input voltage.

(Problem 2.25 of text)

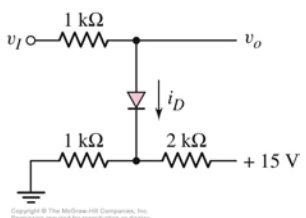

Figure 7 (Fig. P2.25 of text)

9. For the circuit shown in Figure 8, let $V_\gamma = 0.7$ V and assume the input voltage varies over the range $-10 \le v_I \le 10$ V.

(a) Plot v_O versus v_I. Indicate all breakpoints.

(b) Plot i_D over the same range of input voltage.

(Problem 2.26 of text)

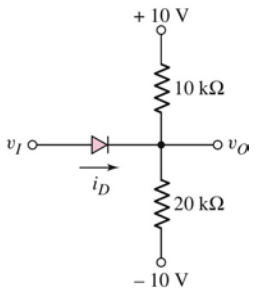

Figure 8 (Fig. P2.26 of text)

10. Sketch the steady state output voltage v_O versus time for each circuit with the input voltage shown in Figure 9. Assume $V_\gamma = 0$ and assume the RC time constant is large.

(Problem 2.32 of text)

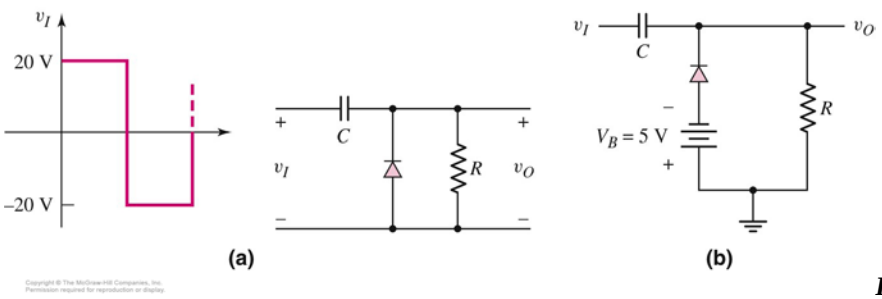

Figure 9 (Fig. P2.32 of text)

11. Let $V_\gamma = 0.7$ V for each diode in the circuit in Figure 10.

(a) Find I_{D1} and V_O for $R_1 = 5$ kΩ and $R_2 = 10$ kΩ.

(b) Repeat part (a) for $R_1 = 10$ kΩ and $R_2 = 5$ kΩ.

(Problem 2.43 of text : (a) $I_{D1} = 0.86$ mA, $V_O = 0$ (b) $I_{D1} = 0$, $V_O = -3.57$ V)

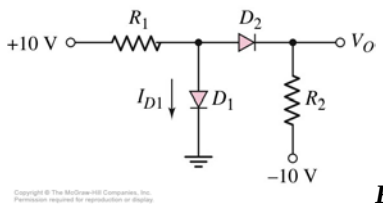

Figure 10 (Fig. P2.43 of text)

12. Each diode in the circuit in Figure 11 has piecewise linear parameters of $V_\gamma = 0$ and $r_f = 0$. Plot v_O versus v_I for $0 \le v_I \le 30$ V. Indicate the breakpoints and give the state of each diode in the various regions of the plot.

(Problem 2.48 of text)

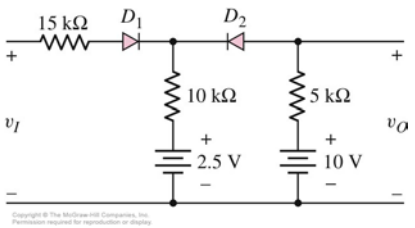

Figure 11 (Fig. P2.48 of text)

13. In the circuit of Figure 12, **derive** and sketch a clearly labelled transfer curve (i.e. plot of V_{out} versus V_{in}) for the circuit. Use a constant voltage drop model for the diodes, with $V_F = 0.7$ V.

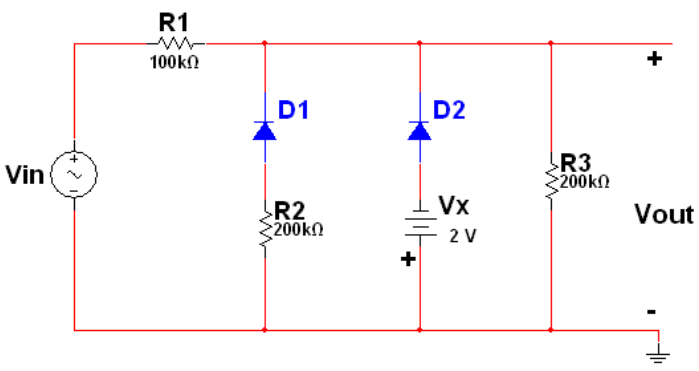

Figure 12