Chapter 2 Diode circuits

[2-1] The zero-bias capacitance of a silicon PN junction diode is C_{j0}=0.02pF and the built-in potential is V_{bi}=0.80V. The diode is reverse biased through a 47kΩ resistor and a voltage source. For t<0, the applied voltage is 5V and, at t=0, the applied voltage drops to zero volts. Estimate the time it takes for the diode voltage to change from 5V to 1.5V. (As an approximation, use the average diode capacitance between the two voltage levels)

[2-2] The cut-in voltage of the diode shown in the circuit in Fig.E2-2 is V_r=0.7V. The diode is to remain biased "on" for a power supply voltage in the range 5V≤V_{ps}≤10V. The minimum diode current is to be $I_{D(min)}$=2mA. The maximum power dissipated in the diode is to be no more than 10mW. Determine appropriate values of R_1 and R_2.

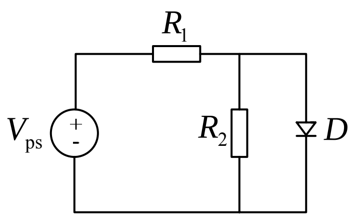

Fig.E2-2

[2-3] Assume each diode in the circuit shown in Fig.E2-3 has a cut-in voltage of V_r=0.65V. (a) The input voltage is V_I=5V. Determine the value of R_1 required such that I_{D1} is one-half the value of I_{D2}. What are the values of I_{D1} and I_{D2}? (b) If V_I=8V and R_1= 2kΩ, determine I_{D1} and I_{D2}.

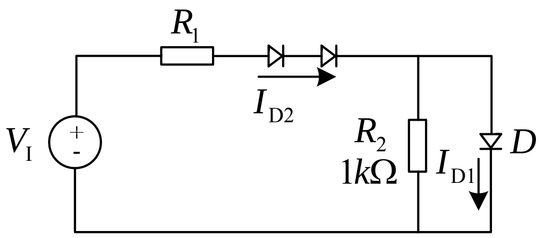

Fig.E2-3

[2-4] The diode in the circuit shown in Fig.E2-4 is biased with a constant current source *I*. A sinusoidal signal V_s is coupled through R_s and *C*. Assume that *C* is large so that it acts as a short circuit to the signal. (a) Find the expression of sinusoidal component of the diode voltage. (b) If R_s =260Ω, find v_o/V_s, for *I*=1mA, *I*=0.1mA, and *I*=0.01mA.

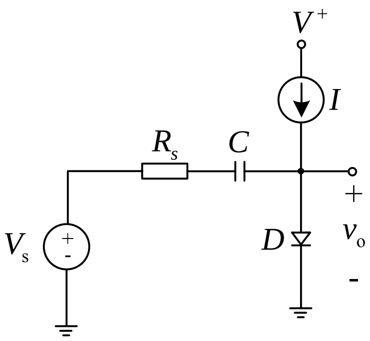

Fig.E2-4

[2-5] The full-wave rectifier circuit shown in Fig.E2-5 has an input signal whose frequency is 60Hz. The rms value of v_s is 8.5V. Assume each diode cut-in voltage is V_r=0.7V. (a) What is the maximum value of v_o? (b) If R=10Ω, determine the value of C such that the ripple voltage is no larger than 0.25V. (C) What must be the PIV rating of each diode?

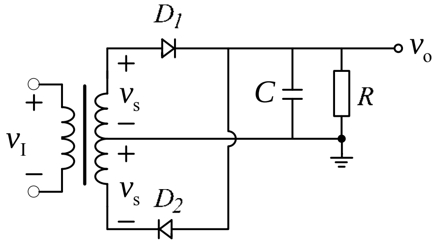

Fig.E2-5

[2-6] The circuit in Fig.E2-6 is a complementary output rectifier. Please analysis its working process (in the positive half period and negative half period of v_s). If v_s=26sin[2π (50)t]V, sketch the output waveforms v_o^+ and v_o^- versus time, assuming V_r=0.6V for each diode.

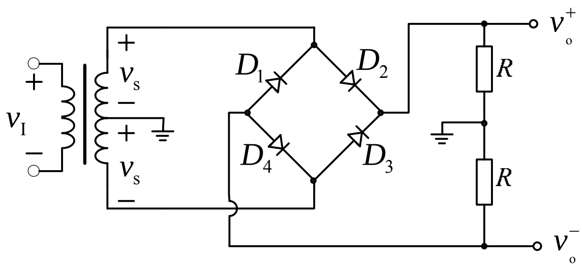

Fig.E2-6

[2-7] Consider the Zener diode circuit shown in Fig.E2-7. Assume V_Z=12V and r_Z=0. (a) Calculate the Zener diode current and the power dissipated in the zener diode for $R_L = \infty$. (b) What is the value of R_L such that the current in the Zener diode is one-tenth of the current supplied by the 40V source? (c) Determine the power dissipated in the Zener diode for the conditions of part(b).

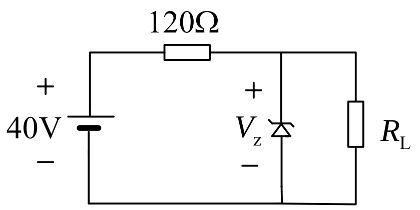

Fig. E2-7

[2-8] In the voltage regulator circuit in Fig.E2-8, let V_I=6.3V. R_i=12Ω and V_Z=4.8V. The zener diode circuit is to be limited to the range 5⩽I_Z⩽100mA. (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.

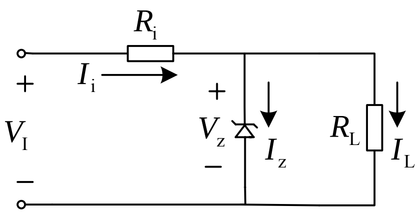

Fig.E2-8

[2-9] In the voltage regulator circuit in Fig.E2-8, V_I=20V, V_z=10V, R_i=222Ω, and $P_{z(max)}$=400mW. (a)Determine I_L, I_z, and I_i, if R_L=380Ω. (b) Determine the value of R_L that will establish $P_{z(max)}$ in the diode.

[2-10] Consider the circuit in Fig.E2-10. Let V_r=0V. (a) Plot v_o versus v_I over the range -10V≤v_I≤+10V. (b) Plot i_1 over the same input voltage range as part(a).

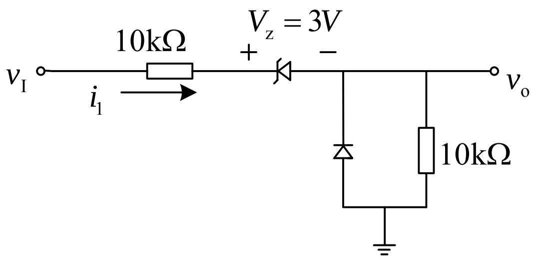

Fig.E2-10

[2-11] For the circuit in Fig.E2-11, (a) Plot v_o versus v_I for $0V \leqslant v_I \leqslant 15V$. Assume V_r=0.7V. Indicate all breakpoints. (b) Plot i_D over the same range of input voltage.

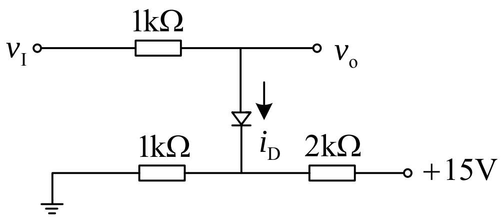

Fig.E2-11

[2-12] For the circuit in Fig.E2-12, u_i=20sinωt (mV)，f=1kHz，determine the voltage u_D and current i_D, assume the capacitance C is large.

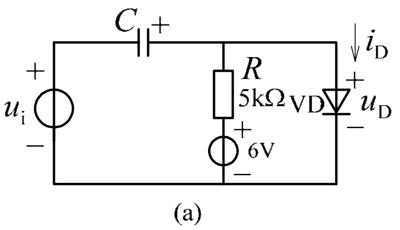

Fig. E2-12

[2-13] For the circuit in Fig.E2-13，constant current source I=2mA。Assume the diode voltage drop U_D=660mV at 20℃， determine U_D at 50℃。

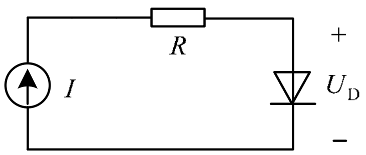

Fig. E2-13

[2-14] For the circuit in Fig.E2-14，Assume V_r=0V. Calculate U_Y、IDA、IDB、IR under the following conditions.（a）U_A=10V，U_B=0V；（b）U_A=6V，U_B=5V；（c）U_A=U_B=5V.

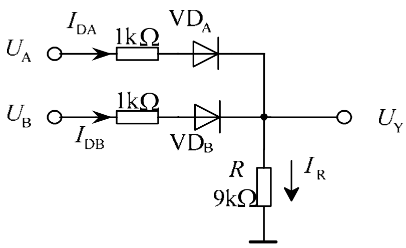

Fig.E2-14

[2-15] There are two Zener diodes, VD_{Z1} and VD_{Z2}，Zener voltage are 5.5V and 8.5V，respectively, and their forward voltage drop are all 0.5V。Design a circuit which can output stable 3V voltage.