Problem 1

a) Consider the circuit shown in the following figure. The value of $R_1$ is reduced to $R_1 = 10K\Omega$ and the cut-in voltage of the diode is $V = 0.7V$. Determine $I_D$ and $V_D$.

b) Repeat part (a) if $R_1 = 50K\Omega$

![Circuit Diagram](image)

Problem 2

The cut-in voltage of the diode shown in the circuit in the following figure is $V = 0.7V$. The diode is remain biased ‘On’ for a power supply voltage in the range $5\leq V_{ps} \leq 10$ V. The minimum diode current is to be $I_D(\text{min}) = 2$ mA. The maximum power dissipated in the diode is to be no more than $10$ mW. Determine appropriate values of $R_1$ and $R_2$.

![Circuit Diagram](image)

Problem 3

The diode cut-in voltage is $V = 0.7V$ in the four circuits shown in the following figure. Find $I$ and $V_0$ in each of the circuits.
Problem 4

a) In the circuit shown in the figure, find the diode voltage $V_D$ and the supply voltage $V$ such that the current $I_D = 0.4\, \text{mA}$. Assume the diode cut-in voltage is $V_\text{C}=0.7\, \text{V}$.

b) Using the results of part (a), determine the power dissipated in the diode.
**Problem 5**

Assume each diode in the circuit shown in the following figure has a cut-in voltage of $V_\text{r}=0.65\text{V}$.

a) The input voltage is $V_1=5\text{V}$. 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 $V_1=8\text{ V}$ and $R_1=2\text{K}\Omega$, determine $I_{D1}$ and $I_{D2}$.

![Circuit Diagram](image1)

**Problem 6**

The circuit in the following figure is a complementary output rectifier. If $V_s=26\sin[2\pi(60)t]\text{V}$, sketch the output waveforms $v_o^+$ and $v_o^-$ versus time, assuming $V=0.6\text{ V}$ for each diode.

![Circuit Diagram](image2)
**Problem 7**

Sketch $v_0$ versus time for the circuit in the following figure. The input is a sine wave given by $v_i = 10 \sin \omega t$ V. Assume $V = 0$ V.

![Circuit Diagram](image1)

**Problem 8**

Consider the circuit in the following figure. Let $V = 0$ V.

a) Plot $v_O$ versus input voltage $v_I$ over the range $-10V \leq v_I \leq 10V$

b) Plot $i_I$ over the same input voltage range as part (a).

![Circuit Diagram](image2)
**Problem 9**

For the circuit in the following figure,

a) plot $v_0$ versus input voltage $v_I$ for $0 \leq v_I \leq 15$ V. Assume $V_0 = 0.7$ V. Indicate all breakpoints.

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

![Circuit Diagram](image1.png)

**Problem 10**

The diodes in the circuit in the following figure have piecewise linear parameters of $V = 0.6$ V and $\gamma_f = 0$. Determine the output voltage $V_0$ and the diode currents $I_{D1}$ and $I_{D2}$ for the following input conditions.

a) $V_1 = 10$ V, $V_2 = 0$ V.

b) $V_1 = 5$ V, $V_2 = 0$ V.

c) $V_1 = 10$ V, $V_2 = 5$ V.

d) $V_1 = 10$ V, $V_2 = 10$ V.

![Circuit Diagram](image2.png)
Problem 11

Consider the circuit in the following figure. The output of a diode OR logic gate is connected to the input of a second diode OR logic gate. Assume $V_\text{ Dropout} = 0.6 \text{ V}$ for each diode. Determine the outputs $V_{O1}$ and $V_{O2}$ for:

a) $V_1 = V_2 = 0$;
b) $V_1 = 5 \text{ V}, V_2 = 0 \text{ V}$;
c) $V_1 = V_2 = 5 \text{ V}$.

What can be said about the relative values of $V_{O1}$ and $V_{O2}$ in their 'high' state?

Problem 12

Consider the circuit in the following figure. The output of a diode AND logic gate is connected to the input of a second diode AND logic gate. Assume $V_\text{ Dropout} = 0.6 \text{ V}$ for each diode. Determine the outputs $V_{O1}$ and $V_{O2}$ for:

a) $V_1 = V_2 = 5 \text{ V}$.
b) $V_1 = 0 \text{ V}, V_2 = 5 \text{ V}$;
c) $V_1 = V_2 = 0$;

What can be said about the relative values of $V_{O1}$ and $V_{O2}$ in their 'low' state?
**Problem 13**

Sketch the steady-state output voltage $v_0$ versus time for each circuit with the input voltage shown in the following figure. Assume $V_0 = 0$ V and assume the RC time constant is large.

![Circuit Diagrams](image)

**Problem 14**

For the circuit in the figure in Problem 13, let $V_i = 1$ V and $v_I = 10 \sin \omega t$ (steady state). Find analytical expression for steady state $v_0$ versus time and sketch for

a) $V_B = 0$ V 

b) $V_B = +3$ V 

c) $V_B = -3$ V 

**Problem 15**

Design a diode clamper to generate a steady-state output voltage $v_0$ from the input voltage $v_I$ shown in Figure P2.33 if $V = 0.7$ V.
Problem 16

a) Consider a pn junction diode biased at $I_{DQ} = 1\text{mA}$. A sinusoidal voltage is superimposed on $V_{DQ}$ such that the peak-to-peak sinusoidal current is $0.05I_{DQ}$. The diode ideality factor $n=1$. Find the value of the applied peak-to-peak sinusoidal voltage.

b) Repeat part (a) if $I_{DQ} = 0.1\text{ mA}$.

Problem 17

The diode in the circuit shown in the following figure is biased with a constant current source $I$. The diode ideality factor $n=1$. 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) Show that the sinusoidal component of the diode voltage is given by

$$v_0 = v_s\left(\frac{V_r}{V_r + IR_s}\right)$$

b) If $R_s = 260\ \Omega$, find $v_0/v_s$, for $I = 1\text{mA}$, $I = 0.1\text{ mA}$, and $I = 0.01\text{ mA}$.