PROBLEM 1: (40 Points)
The circuit below is a power supply. $V_S$ is a 20 volt amplitude sine wave at 60 Hz, $V_S = 20\sin(2\pi 60t)$. Assume that the diodes are ideal.

![Circuit Diagram](image)

a) What are the DC values of $V_{O1}$ and $V_{O2}$ if there is no load hooked up to $V_{O1}$ and $V_{O2}$? (10 Points)

b) We will now hook up a load to the two outputs as shown below:

![Circuit Diagram](image)

Sketch $V_{O1}(t)$ and $V_{O2}(t)$ for $V_{IN}(t)$ shown below. Use the space provided. (10 Points)
**Problem 1 part C)** If $R_{L1} = 100 \ \Omega$ and $R_{L2} = 300 \ \Omega$, find the values of $C_1$ and $C_2$ so the ripple at each output is less than 100 mV. For this answer, specify the smallest capacitor possible that will achieve the desired ripple value. Do not use a standard size capacitor. (20 Points)

**PROBLEM 2: (40 Points)**

\[
\begin{align*}
V_{T1} &= 1 \text{V} \\
K_1 &= 1 \text{ mA/V}^2 \\
V_{T2} &= 2 \text{ V} \\
K_2 &= 250 \mu\text{A/V}^2
\end{align*}
\]

(a) (5 points) Draw the circuit you would use to bias the circuit.

(b) We would like to bias this circuit at $I_D = 1 \text{ mA}$. Find the values of $V_{GS1}$, $V_{GS2}$, and $V_{S2}$. (15 Points)

(c) For this bias, what is the requirement on $V_B$ so that $M2$ is always sat? Do not include any AC swing that might occur at $V_{S1}$. (20 Points)

**PROBLEM 3: (20 Points)**

\[
\begin{align*}
V_T &= 1.5 \text{ V} \\
K &= 50 \mu\text{A/V}^2
\end{align*}
\]

(a) Find a numerical value of $g_m$ for the MOSFET. (10 Points)

(b) Find a numerical value for the gain $V_o/V_{in}$ at mid-band. (10 Points)