**Problem 1 (25 Points):**
Plot $V_o(t)$ and $V_in(t)$ for the circuit below. Indicate numerical values for all breakpoints. Let $V_{in}$ be a ±15 volt triangle wave.

![Circuit Diagram](image)

a) Sketch the waveforms using the graph below (17 Points):

![Waveform Graph](image)

b) Sketch the transfer curve, $V_o$ versus $V_{in}$ (8 Points).
Problem 2 (25 Points):
In the circuit below, $V_{\text{in}}(t)$ is a +/- 2 V Triangle wave. Assume a 0.7 V diode drop.

a) Find the range of values of $R_{\text{load}}$ such that $V_o$ will be held constant.

b) Find the peak power dissipated by the 100 $\Omega$ resistor.

c) Find the maximum power dissipated by the load resistor if the load is allowed to vary in the range found in part a.
Problem 3 (25 Points):
A silicon PN junction diode has a donor doping concentration of $N_d=10^{16}/\text{cm}^3$. The concentration of electrons on the p-side is found to be $n_{po}=5\times10^5/\text{cm}^3$. Find the built-in barrier potential for this diode at a temperature of 20 °C.
Problem 4 (25 Points):
An n-type semiconductor has a cross-sectional area of $10^{-3}\text{mm}^2$ and a length of 1 mm. Find the concentration of donor atoms if the resistance of this semiconductor at 30 °C is 1000 Ohms. State any approximations you make in order to solve this problem.