Problem 1 (50 pts) For a pn junction: \( N_A = 10^{18} \text{ cm}^{-3} \), \( N_D = 10^{16} \text{ cm}^{-3} \), \( A = 10^{-4} \text{ cm}^2 \), and \( n_i = 1.5 \times 10^{10} \text{ cm}^{-3} \), let \( L_p = 5 \text{ µm} \), \( L_n = 10 \text{ µm} \), \( D_p \) (in the n region) = 10 cm\(^2\)/V.s, and \( D_n \) (in the p region) = 20 cm\(^2\)/V.s. Calculate (a) \( I_S \); (b) current of pn junction if it is forward biased at 0.7 V; (c) junction built-in voltage; (d) depletion width at reverse bias 0.3 V; (e) depletion capacitance at thermal equilibrium and diffusion capacitance at forward bias 0.7 V.
Problem 2 (30 pts) For the bridge-rectifier circuit, use the constant-voltage-drop diode model to calculate (a) the average (dc component) of the output voltage; (b) the peak diode current; and (c) the peak inverse voltage (PIV). Known: \( v_S \) is a 10-V (rms) sinusoid, \( V_D \approx 1 \text{ V} \) and \( R = 1 \text{ k}\Omega \).
Problem 3 (20 pts) Precisely determine the current $I_D$ and the diode voltage $V_D$ for the following circuit. $V_{DD}=10 \, \text{V}$ and $R = 2 \, \text{k}\Omega$. Assume that the diode has a current of 1 mA at a voltage of 0.7V.