1. Series And Parallel Capacitors

Derive $C_{eq}$ for the following circuits.

(a)  

(b)  

2. Current Sources And Capacitors

(a) For the circuits given below, give an expression for $v_{out}(t)$ in terms of $I_s$, $C_1$, $C_2$, $C_3$ and $t$. Assume that all capacitors are initially uncharged, i.e. the initial voltage across each capacitor is 0V.

i. 

ii.
(b) For the circuit in subpart (i) of part (a), assume that the direction of the current is flipped at some time \( t = T \). Give an expression for \( v_{out}(t) \) for \( t > T \) in terms of \( I_s, C_1 \) and \( C_2 \). For what value of \( t \) will \( v_{out}(t) = 0 \)?

3. Voltage Booster

We have made extensive use of resistive voltage dividers to reduce voltage. What about a circuit that boosts voltage to a value greater than the supply \( V_S = 5V \)? We can do this with capacitors!

![Diagram of voltage booster circuit]

(a) In the circuit above switches \( \phi_1 \) are initially closed and switch \( \phi_2 \) is initially open. Calculate the value of the output voltage, \( V_{out} \) with respect to ground, and the amount of charge stored on capacitor, \( C \), at that state (phase 1).

(b) Now, after the capacitors are charged, switches \( \phi_1 \) are opened and switch \( \phi_2 \) is closed. Calculate the new voltage output voltage, \( V_{out} \), at steady state.