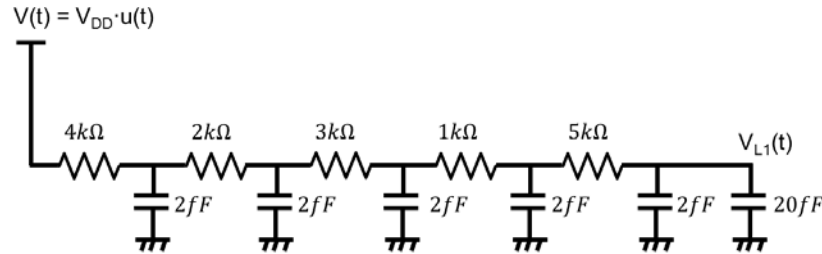


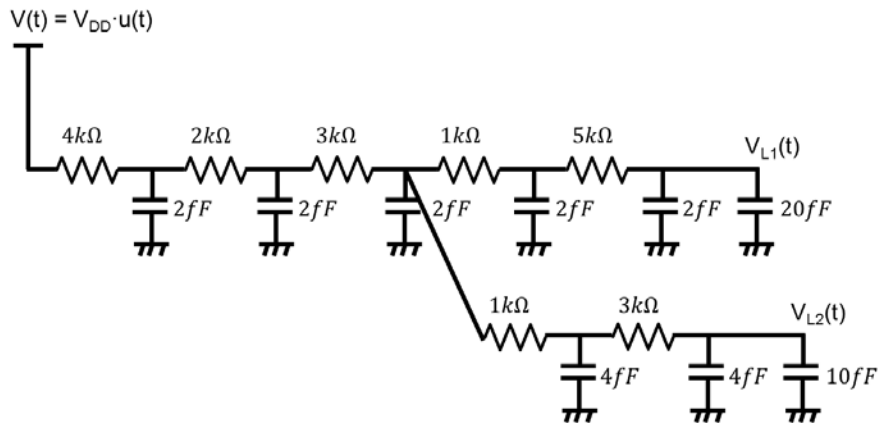
Homework Assignment 7 (Due Mar. 29th at the beginning of the class)

- (1) [Elmore Delay, 10 points] Compute Elmore delay at L1 in the following figure.



$$\text{Delay} = 5k \cdot 22f + 1k \cdot 24f + 3k \cdot 26f + 2k \cdot 28f + 4k \cdot 30f = 110ps + 24ps + 78ps + 56ps + 120ps = 388ps$$

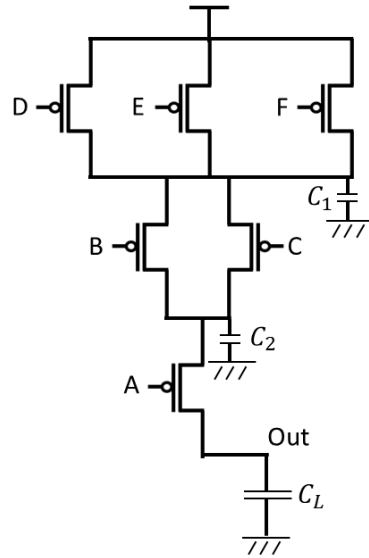
- (2) [Elmore Delay, 10 points] Compute Elmore delays at L1 and L2 in the following figure.



$$\text{Delay at L1} = 5k \cdot 22f + 1k \cdot 24f + 3k \cdot 44f + 2k \cdot 46f + 4k \cdot 48f = 110ps + 24ps + 132ps + 92ps + 192ps = 550ps$$

$$\text{Delay at L2} = 3k \cdot 14f + 1k \cdot 18f + 3k \cdot 44f + 2k \cdot 46f + 4k \cdot 48f = 42ps + 18ps + 132ps + 92ps + 192ps = 476ps$$

- (3) [Switching Characteristics, 10 points] Compute the rise time at the output node in the following figure. C_1 and C_2 are parasitic capacitances at the internal nodes (and they are fully discharged at time 0). The input switches from (A, B, C, D, E, F) = (1, 1, 1, 1, 1, 1) to (0, 0, 1, 1, 0, 1). Use R_X (where X=A, B, C, D, E, F) for the resistance of transistor X.



$$\tau = R_A \cdot C_L + R_B \cdot (C_2 + C_L) + R_E \cdot (C_1 + C_2 + C_L)$$