19:40

16/1/2006

# EEM411 FINAL ÇÖZÜMLERİ

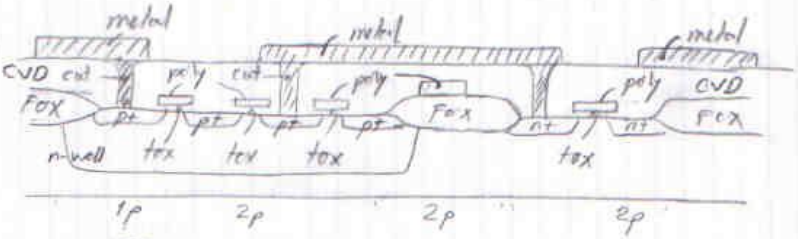
1/3

1) $W_{eff.} = W_{drawn} - \Delta W$

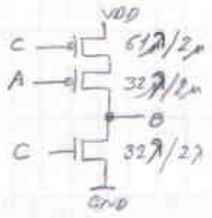
2) $F = A\bar{B} + \bar{A}B$ ; exor işlevi. Varsayım çıkışta "pull-down"

3)

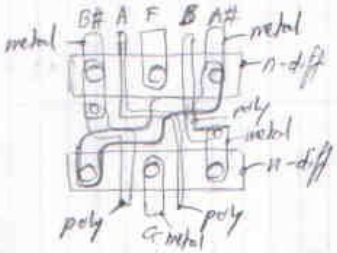

4) a) (7p)



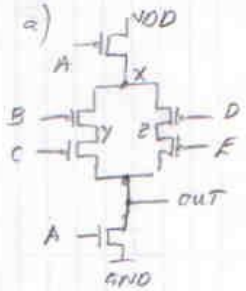

b) (3p)




5)




6) a)




MA: W/L = 12/2
MB: 8/2
MC: 8/2
MD: 12/2
ME: 12/2
$M_{A_N}$: 10/2

b) $C_x = (120+36+64)\lambda^2 \times 30f/\lambda^2 + (10+4+6+6+8+8+2)\lambda \times 15f/\lambda$ (220; 44)

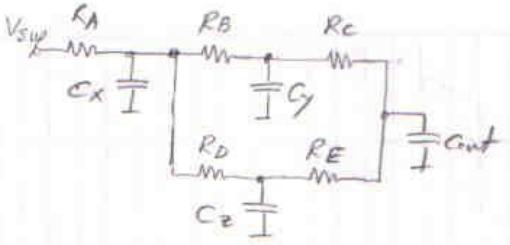
$C_y = (48)\lambda^2 \times 30f/\lambda^2 + (12)\lambda \times 15f/\lambda$

$C_z = (72)\lambda^2 \times 30f/\lambda^2 + (12)\lambda \times 15f/\lambda$

$C_{out} = (96+36+64)\lambda^2 \times 30f/\lambda^2 + (8+12+6+8+8+2+6+2)\lambda \times 15f/\lambda + (280)\lambda^2 \times 20f/\lambda^2 + (28+28+10)\lambda \times 10f/\lambda$

6)

c)




$R_D = R_E + R_A = \frac{10}{12}\ 3K\Omega = 2.5\ K\Omega$

$R_C = R_B = \frac{10}{8}\ 3K\Omega = 3.75\ k\Omega$

worst case is when $R_D \to \infty$ (OFF)

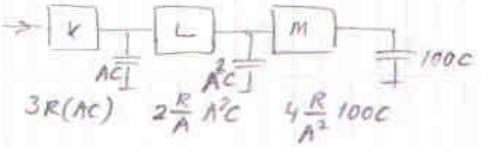
$$\tau = C_x R_A + C_y(R_A + R_B) + C_z(R_A + R_B + R_C) + C_{out}(R_A + R_B + R_C)$$

$$t_{pLH} = 0.69\,\tau$$

7) a)


$t_d = 405\,RC$

b)

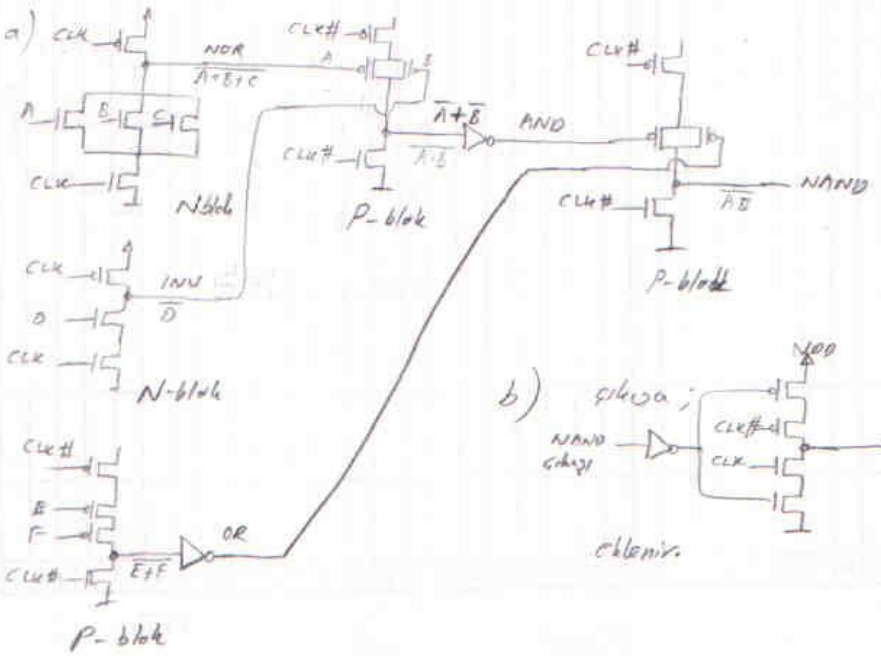



$t_d = (5A)RC + \left(\frac{400}{A^2}\right)RC$

c) $\frac{\partial t_d}{\partial A} = 0 = 5 - 800A^{-3} \Rightarrow 800A^{-3} = 5$

$A^3 = \frac{800}{5} \Rightarrow A = (160)^{1/3}$

8) a)




b) çıkışa;




eklenir.

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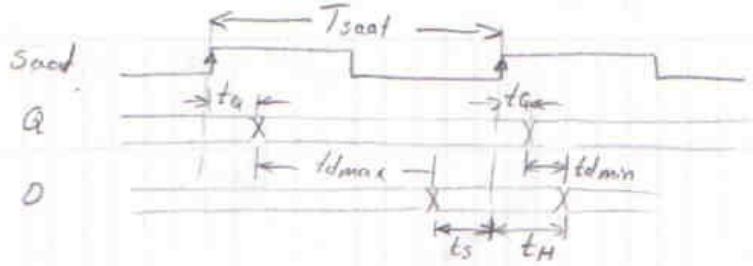
(3/3)

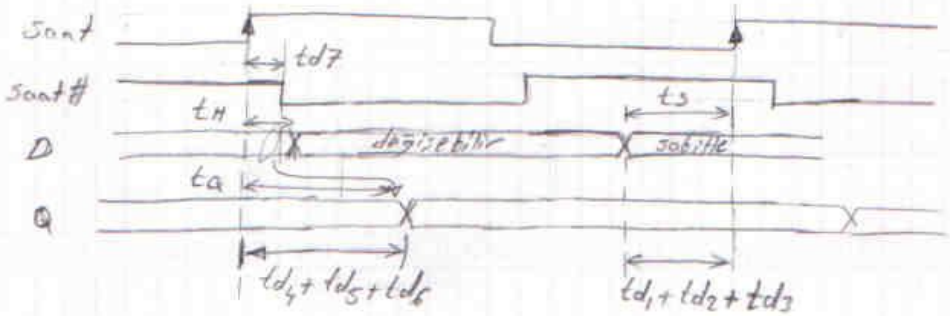
9)




$t_Q + t_{d_{max}} + t_S \leq T_{saat} \Rightarrow t_{d_{max}} \leq T_{saat} - t_Q - t_S$

$t_Q + t_{d_{min}} \geq t_H \Rightarrow t_{d_{min}} \geq t_H - t_Q$

10)

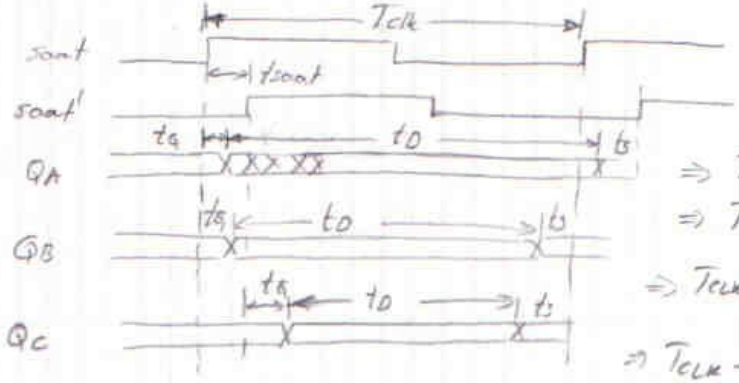



$t_H = t_{d_7}$

$t_S = t_{d_1} + t_{d_2} + t_{d_3}$

$t_Q = t_{d_4} + t_{d_5} + t_{d_6}$

11) a)




$\Rightarrow T_{CLK} + t_{saat} \geq t_Q + t_D + t_S$

$\Rightarrow T_{CLK} \geq t_Q + t_D - t_{saat} + t_S$

$\Rightarrow T_{CLK} \geq t_Q + t_D + t_S$

$\Rightarrow T_{CLK} - t_{saat} \geq t_Q + t_D + t_S$

$T_{CLK} \geq t_Q + t_D + t_S + t_{saat}$

b) Latency = 4

c) Throughput = $\frac{1}{T_{CLK}}$