

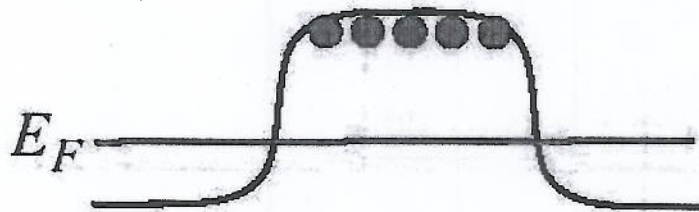
NAME:

ECE344 Semiconductor Devices
Fall 2008

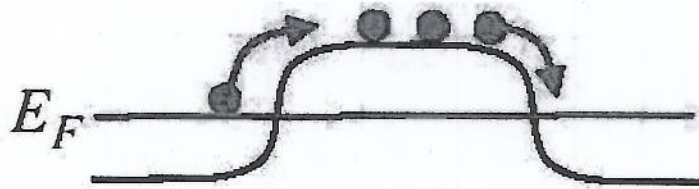
QUIZ-5

Question 1: [5points]

Let us consider a nMOSFET, INDICATE next of each of the following graphs, what is the correct combination XYZ (for example 123), where the choices for X, Y, Z are define below.



213



422



731

Choices for X: (main regime of operation of the MOS channel)

- 1- Flat-band regime ; 2- Accumulation of h^+ ; 3- Accumulation of e^- ;
4-Depletion of h^+ ; 5- Depletion of e^- ; 6- Inversion of h^+ ; 7- Inversion of e^-

Choices for Y: (situation for the gate potential)

- 1- $V_g < 0$ 2- $0 < V_g < V_T$ (below threshold); 3- $V_g > V_T$ (above threshold)

Choices for Z: (situation for the I_d current)

- 1- $I_d \gg 0$; 2- $I_d > 0$; 3- $I_d = 0$

Question 2: [5points]

-0.5

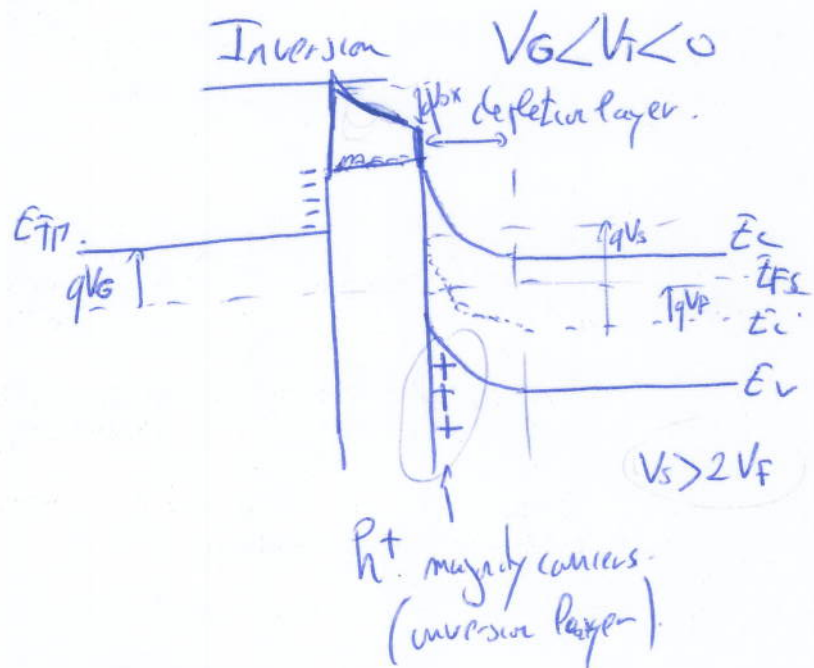
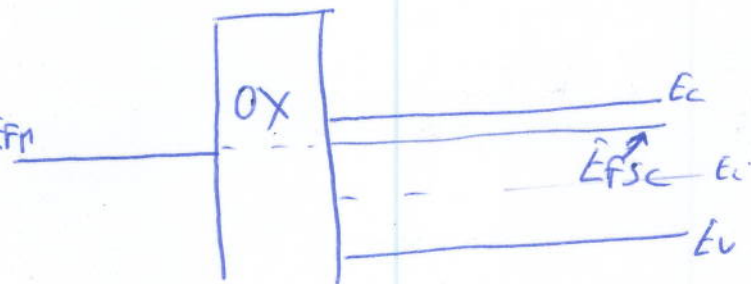
Answer Yes in the cases below if applicable (1 point by wrong answer)

	Linear Model	Quadratic Model	Bulk Charge Model
Consider the variation of charge in the channel		yes	yes
Consider the variation of charge in the bulk			yes
Valid below Threshold			
Valid Below Saturation $V_{d,sat}$		yes	yes
Valid Above $V_{d,sat}$			

Question 3:[4points]

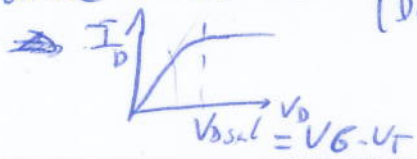
Plot the energy band diagram of a pMOS capacitor (N-type semiconductor) at the inversion regime. Indicate the maximum of information possible in this diagram such as the location of the majority carriers at the surface.

Flat - Band



Question 4: [6points]

For a nMOSFET device, complete the following 'step-by-step' table going from top to bottom. You will start with the conditions $V_G=0$ and $V_{DS}=0$ at the step 0 (i.e. top of the table). For example, in step 1 you change the value of V_G which stays the same in step 2 but it changes again in step 3.

step 0. ($V_G = 0, V_{DS} = 0$)	What happens for I_{DS} ?	Comments
step 1. $0 < V_G < V_T$	$I_{DS} = 0$	Below threshold but no source-drain voltage.
step 2. $0 < V_{DS} < V_G - V_T$	$I_{DS} > 0$ but small.	Subthreshold current (Diffusion)
step 3. $V_G > V_T$	$I_{DS} > 0$	above threshold. (Drift) 
step 4. $V_{DS} > V_G - V_T$	$I_{DS} = I_{DSsat}$	post-pinch off I-V. saturation of channel since $V_{DSsat} = V_G - V_T$.