Sem III
Electronics

ED work 01"

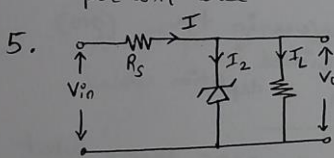
14/09/2017

1. For a n-channel MOS Transistor, substrate doping is $10^{16}/cm^3$, gate oxide thickness is 500 Å, no of fixed oxide charge is $2\times10^{10}/cm^2$.
   a) Find threshold voltage for zero substrate bias. $V_{TO}=0.44V$ (10M)
   b) If there are ± 10% variations in above parameters. Find the range of V_{TO}. (0.342 to 0.559V) (10M)

2. Draw EBD of MOSCAP under (6m)
   a) Accumulation b) Depletion c) Inversion

3. Explain why band-bending is present when a MOS junction is formed. (5m)

4. (similar numerical) in (Assg I)
   A Si pn junction has $V_{bi}=0.7$ and $N_a = 100 N_d$. Find width of depl^n region and value of depletion capacitance per unit area when a R.B of 10V is applied across it. (10m)

5. 

   1. V_{in} is greater than vtg at which the zener breakdowns (3m)
   2. I_L is less than betn I and I_2, the zener breakdown current at which the zener breakdown.
   3. R_s is less than zener nominal resistance.

   of these statements
   (a) 1, 2 & 3 are correct
   b) 1 & 2 are correct
   (c) 2 & 3 are correct
   d) 1 & 3 are correct.

6. The static characteristics of an forward-biased pn J^n is a straight line, if the plot is of (2m)
   a) log(I) vs log(V)
   b) log(I) vs V
   c) I vs log(V)
   c) I vs V

   $I_D = I_S\left[\exp\frac{V_D}{nV_T}-1\right]$
   $V_D = nV_T \ln\left[1+\frac{I_D}{I_S}\right]$

7. A diode has $I_S = 10^{-18}$A. and $n = 1.05$. If diode has current of 70 µA, then diode voltage is 0.87 V (4m)

8. A Si pn junction diode has doping profile $N_a = N_d = 5\times10^{19}/cm^3$. (3m)
   The space-charge width at a F/W bias vtg of $V_a = 0.4V$ is ______ Å
   $W = \sqrt{\frac{2\epsilon_s(V_{bi}-V_a)}{q}\left(\frac{N_a+N_d}{N_aN_d}\right)}$

9. A jFET can be used as a voltage variable resistor (2m)
   (a) at pinch-off cond^n
   b) beyond pinch-off vtg
   (c) well below pinch-off
   d) for any value of V_{DS}

10. which one of the following is not LED material (2m)
   (a) GaAs
   b) GaP
   (c) SiC
   d) SiO_2

11. Draw Low-freq C-V curve for a MOSCAP and explain different cases. (3m)

12. Explain why at high-freq^n C-V curve C becomes C_{ox} beyond inversion. (3m)

13. For a ptype semiconductor, Fermi-level is closer to VB (1m)

14. Si diode is less suited for low-vtg rectifier operat^n, becoz (2m)

a) it can withstand high temperature

b) its reverse-saturat^n current is low

c) its cut-in voltage is high

d) its break-down vtg is high

15. i) For a ptype substrate, $N_A = 10^{16}/cm^3$, Find ϕ_{FP} = −0.35V (3m) $\phi_{FP} = V_T \ln\left(\frac{n_i}{N_A}\right)$

ii) For a $t_{ox} = 100 °A$, Find C_{ox}. → $\frac{\epsilon_{ox}}{t_{ox}}$ = 351.5 nF/cm²

16. An MOSCAP is biased so that majority carriers in the semiconductor pile up at the oxide-semiconductor interface is biased in which region (2m)

a) accumulation b) Flat-band c) inversion d) depletion

17. An MOSCAP is biased so that minority carriers in the semiconductor pile-up at Si-SiO_2 interface is biased in (2m)

a) accumulation b) Flat-band c) inversion d) depletion

18. The quantity ϕ_F is a critical parameter in MOS theory. What happens when the surface potential equals $2\phi_F$? (3m)

a) the Maj CC at the surface equals the maj CC in the bulk.

b) the maj CC at the surface equals the intrinsic CC 'n_i'.

c) the min. CC at the surface equals the maj CC in the bulk

d) None of the above.

19. In which operation region(s) does the Eber's-Moll describe a BJT (2m)

a) forward active b) Inverted active c) Saturat^n d) Cut-off

e) all of the above

20. The bandgap of Si at 300K is 1.12eV eV (1m)

21. The action of a JFET in its equivalent ckt can be best represented as a (2m)

a) Current-controlled current source

b) voltage-controlled voltage source

c) current-controlled voltage source

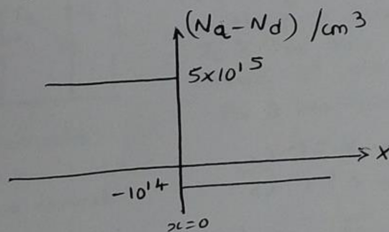
d) voltage-controlled current source.

The intrinsic carrier concentration of Si sample at 300K is $1.5\times10^{16}/cm^3$. If after doping, no. of maj carriers are $5\times10^{20}/cm^3$ the minority carrier density is $n_{min} = \frac{n_i^2}{maj\,cc}$ $/cm^3 = 4.5\times10^{11}/cm^3$ (3m)

23. The primary reason for widespread use of Si in semiconductor device technology is (2m)
    a) abundance of Si on surface of earth.
    b) the large bandgap of Si compared to Ge.
    c) the favorable properties of SiO_2.
    d) Lower melting point.

24. Which of the following is NOT associated with a pn J^n. (2m)
    a) Junction capacitance b) Charge storage capacitances
    c) Depletion capacitance d) Channel length modulation.

25. A Si pn J^n at T=300K has doping profile shown below. (10m)



$N_a = 5\times10^{15}/cm^3$
$N_d = 10^{14}/cm^3$

Estimate
i) Build-in potential → $V_{bi} = 0.559$ V
ii) x_n and x_p at zero bias → $x_n = 261.72\times10^{-6}$ cm, $x_p = 523\times10^{-6}$ cm
iii) Sketch E-field Vs x for given situation.