Reg. No. 3

B.E (Full Time) Degree End Semester Examination, NOV/DEC 2011
Electronics Communication Engineering
Second Semester
Regulation - 2004

EC181 –ELECTRONIC DEVICES

Time: 3 Hours Max Marks:100

Answer all the Questions

PART –A (10 * 2 = 20 MARKS)

1. What is the Hall Effect?
2. Distinguish between carrier drift and carrier diffusion.
3. Define the built-in potential and state how it maintains thermal equilibrium.
4. An abrupt silicon pn junction has dopant concentrations of $N_a=2x10^{16}cm^{-3}$ and $N_d=2x10^{15}cm^{-3}$ and T=300 K .Calculate the maximum electric field in the space charge region at $V_R=8V$.
5. In a BJT which junction is thin? Why?
6. Sketch the hybrid pi model of a transistor of your choice.
7. What is Threshold Voltage corresponding to a MOS Structure?
8. Sketch a MOSFET structure.
9. Differentiate between an ordinary BJT and power BJT.
10. Sketch the VI characteristics of a thyristor.

PART –B (5 * 16 = 80 MARKS)

11(i) Calculate the thermal equilibrium electron and hole concentration in silicon at T=300 K for the case when the Fermi energy level is 0.22 eV below the condition band energy E_C (4)

(ii)Discuss the significance of Fermi level. (6)

(iii)Derive the expression for drift current density in a pn junction. (6)

12a(i) A silicon pn junction at T=300K is doped with impurity concentrations of $N_d = 5x10^{16}cm^{-3}$ and $N_a = 2x10^{16}cm^{-3}$.The junction is forward biased at 0.610V. Determine the minority carrier concentrations at the space charge edges. (4)

(ii) Design a pn junction diode with silicon, such that it operates at $T=300K$, $J_n=20A/cm^2$ and $Jp=5A/cm^2$ at $V_a=0.65V$. Assume other parameters of the semiconductor on your own. (6)

(iii) Write notes on Schottky Barrier diodes. (6)

Or

12b(i) A silicon pn junction diode at T=300K has the following parameters: $N_d=8x10^{16}cm^{-3}$, $Na=2x10^{15}cm^{-3}$, $D_n=25cm^2/s$, $D_p=10cm^2/s$, $\tau_{no}=5x10^{-7}s$ and $\tau_{po}=10^{-7}s$. The cross – sectional area is $A=10^{-3}cm^2$. Determine the diffusion resistance if the diode is forward biased at (a)$V_a=0.550$ V and (b) $V_a=0.610$ V (8)

(ii) Discuss about Tunnel diodes. (4)

(iii) What are the turn –on and turn –off transients of a semiconductor diode? (4)

13a(i) Calculate the common emitter current gain of a silicon npn bipolor transistor at T=300 K given the following parameters.

$D_E=10cm^2/s$	$X_B=0.70\ \mu m$
$D_B=25cm^2/s$	$X_E=0.50\ \mu m$
$\tau_{EO}=1x10^{-7}\ s$	$N_E=1x10^{18}cm^{-3}$
$\tau_{BO}=5x10^{-7}s$	$N_B=1x10^{16}cm^{-3}$
$J_{ro}=5x10^{-8}Acm^2$	$V_{BE}=0.65V$

(6)

(ii) Discuss about large signal switching characteristics of a BJT. (10)

Or

13b(i) Discuss in detail about Gummel –Poon Model of a BJT. (8)

(ii) Calculate the emitter to collector transit time and the cutoff frequency of a bipolar transistor, given the transistor parameters as below: $T=300K$, $I_E=1ma$, $C_{je}=1pF$, $x_B=0.5\mu m$, $D_n=25cm^2/s$, $x_{dc}=2.4\ \mu m$, $r_c=20\Omega$, $C\mu=0.1Pf$ and $C_s=0.1\ pF$ (4)

(iii) What are hetero – junction BJTs? State their features [4]

14a(i) Calculate the maximum space charge width given T=300 K for a silicon doped to $N_a=10^{16}cm^{-3}$. The intrinsic carrier concentration is $n_i=1.5x10^{10}cm^{-3}$ (4)

(ii) For a MOSFET structure, obtain the I–V relationships (12)

Or

14b(i) Calculate C_{ox}, C'_{min} *and* C'_{FB} for an MOS capacitor, given a p type silicon substrate is at $T=300\ K$ doped to $N_a=10^{16}\ cm^{-3}$.The oxide is silicon dioxide with a thickness of 550 A^0 and the gate is aluminium. (6)

(ii) Elaborate on the threshold voltage modifications due to short and narrow channel effects. (10)

15a. Write Short notes on

(i) Triac (8)

(ii) Gallium Arsenide devices (8)

Or

15b. Elaborate on power BJTs and power MOSFETs.

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