Final Review
Around 8 Problem Sections

One Side of 8.5x11 Letter for Hand Written Notes

Diode Content and Equations – exam 1 + Final

Diode Symbol, Terminal Names, Voltage and Current Orientations

---

Ideal Diode:		**Model**
FB:	$v_D = 0$, for $i_D > 0$	Short
RB:	$i_D = 0$, for $v_D < 0$	Open

Junction Diode: $i_D = I_S(\exp(v_D/nV_T) - 1)$, for both FB and RB

Range of values for I_S ($1x10^{-8}$ to $1x10^{-15}$[Amps]) and n (1 to 2).
V_T is dependent on temperature (Typically 0.025V)

FB approximation ($v_D >> nV_T$): $i_D = I_S\exp(v_D/nV_T)$
RB approximation ($v_D << -nV_T$): $i_D = -I_S$

Solutions of exponential equation is very simple circuits, graphical, or iterative.

0.7V CVD Model:		**RB: Open or FB: 0.7V Battery**
FB:	$v_D = 0.7V$, for $i_D > 0$	Short in series with 0.7V Battery (ideal diode is FB)
RB:	$i_D = 0$, for $v_D < 0.7V$	Open in series with 0.7V Battery (ideal diode is RB, $v_{DI} < 0$)

PWL Model:		**RB: Open or FB: Resistor and Battery**
FB:	$i_D = (v_D-V_{D0})/r_D$, for $v_D > V_{D0}$	Short in series with Resistor and Battery
RB:	$i_D = 0$, for $v_D < V_{D0}$	Open in series with Resistor and Battery

---

Small Signal Diode Model: $r_d = nV_T/I_D$
always assume the diode is FB for small signal analysis problems

Small Signal resistance given i(v) $r = 1/i'_D(v_D)$ evaluated at (V_D,I_D)
Know the table of devices and their Large Signal Model and Small Signal Model

---

Zener Diode (CVD Model):		**Ideal Diode in series with a Battery**
BD:	$v_Z = V_Z$, for $i_Z > 0$	Short in series with a Battery (ideal diode is FB)
RB:	$i_Z = 0$, for $v_Z < V_Z$	Open in series with a Battery (ideal diode is RB, $v_{DI} < 0$)

Zener Diode (PWL Model):		**Ideal Diode in series with Resistor and Battery**
BD:	$i_Z = (v_Z - V_{Z0})/r_z$, for $v_Z > V_{Z0}$	Short in series with Resistor & Battery (ideal diode is FB)
RB:	$i_Z = 0$, for $v_Z < V_{Z0}$	Open in series w/ Res. & Battery (ideal diode is RB, $v_{DI} < 0$)

Zener Symbol and Voltage & Current Orientations
Difference and Similarities between Zener and Junction Diodes

---

Diode Applications (what is the purpose, basic circuit and basic operation)

Current Protection
Simple Digital Logic
Limiter (Circuit Protection) – Transfer Functions
Rectifier Circuits (v_{OUT}/v_{IN}, PIV)
Regulator (line regulation, load regulation)
AC/DC Supply (approximation for ripple voltage)
Voltage Controlled Attenuator
Frequency Mixer

Semiconductors

Silicon lattice (intrinsic, covalent bonds).
Current (two types)
- Drift – charge moving due to electric field.
- Diffusion – charge moving due to heat and concentration gradient.

Doped Silicon
- N-Type: use Phosphorus to add extra electrons.
- P-Type: use Boron to add extra holes.
- Majority carriers
- Minority carriers
- Depleted

PN Junction and Bias States (FB, RB, Breakdown)

Transistors – MOSFETS – Exam 2 + Final

MOSFET Symbol, Terminal Names, Relevant Voltage and Current Orientations, Types, Structure.
- NMOS vs. PMOS
- Substrate, Wells, Silicon Dioxide, Electrodes.
- Multiple Choice, Short Answer.

Basic MOSFET Theory of Operation.
- Channel Shape.
- Multiple Choice, Short Answer.

MOSFET Modes and Equations (equality and inequality).
- Short Answer.
- See slides on MOSFET Equations

DC analysis of MOSFET Circuits.
- 5 Steps. Equivalent NMOS-PMOS Circuits.
- Circuit Analysis.

Small Signal MOSFET Analysis.
- Circuit Analysis.

Digital Logic – Exam 2 + Final

Inverters Static Properties (VOH, VOL, VIH, VIL, NML, NMH, NM)
- Given a curve find these values.

NMOS, PMOS, CMOS Inverters.
- Progression of operating modes as v_{IN} goes from 0 to V_{DD}.

Inverters (other LOGIC) Dynamic Properties (Power and Timing and Area). Transition and Propagation Delays.
- Given a timing curve find transition/propagation times.
- Short Answer. Multiple Choice.

CMOS Logic Design and Sizing.
- Logic Design – Given a function find the circuit. Given a circuit determine the function.
- Find sizes in terms of an inverter (n and p).

Sequential Logic and Memories
- Short Answer. Review the slides.

Transistors – BJTS – Final

BJT Symbol, Terminal Names, Relevant Voltage and Current Orientations.
- NPN vs. PNP
- Multiple Choice, Short Answer.

Basic BJT Theory of Operation.
- Multiple Choice, Short Answer.

BJT Modes and Equations (equality and inequality).
- Short Answer.
- Equations Slides.

DC analysis of BJT Circuits (NPN) – PNP equivalent circuits.
- 5 Steps
- Circuit Analysis.

Small Signal BJT Analysis (NPN) – PNP equivalent circuits.
- Circuit Analysis.