Diode Content and Equations

Diode Symbol, Terminal Names, Voltage and Current Orientations

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Ideal Diode:	**Model**	**Eq. Var**	**Cond**	**Ineq. Var**	**Cond**
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 ($v_D << -nV_T$): $i_D = -I_S$

0.7V CVD Model:	**Ideal Diode in series with 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:	**Ideal Diode in series with 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

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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

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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

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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)

Exam I Organization

Around 4-5 Problem Sections

Diode analysis at DC:	Given a circuit, assume a bias, find the answer, & verify bias.
Diode Transfer Function:	Given a circuit, assume a bias, find the transfer function, and find the range of the independent variable.
Diode Small Signal Analysis:	Large Signal Circuit, Small Signal Resistance, Small Signal Relationship.
Short Answer Section:	True or False, Calculations (maybe using exponential model), General Application Questions (line regulation, Peak Inverse Voltage, Ripple Voltage, …), AC/DC Supplies, Quick Analysis, Concept Understanding.
Applications:	Given a circuit … what is its purpose.