Review and Introduction to Part 6

Session 5h for Electronics and Telecommunications
A Fairfield University E-Course
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Module: Semiconductor Electronics
(in two parts)

- Text: “Electronics,” Harry Kybett, Wiley, 1986, ISBN 0-471-00916-4
- References:
  - Electronics Tutorial (Thanks to Alex Pounds)
  - Electronics Tutorial (Thanks to Mark Sokos)
- 5 - Semiconductors, Diodes and Bipolar Transistors
  - 5 on-line sessions plus one lab
- 6 - FETs, SCRs, Other Devices and Amplifiers
  - 5 on-line sessions plus one lab
- Mastery Test part 3 follows this Module

Section 5: Semiconductors, Diodes and Bipolar Transistors

- 0BJECTIVES: This section reviews semiconductors, doping and junctions. The characteristics and application of Diodes and Bipolar Transistors are then studied.

Section 5 Schedule:

Session 5a	– 09/18	Semiconductors and Doping	Elect 1-7 1.23 – 1.39
MT2 Results	– 09/23	We'll discuss MT2	
Session 5b	– 09/25	Diodes	Kybett Chapter 2
Session 5c	– 09/30	Diode Applications	Kybett Chapter 11
Session 5d	– 10/02	Bipolar Transistors	Kybett pp 51 - 70
(lab - 10/05, Sat.)			
Session 5e	– 10/07	Transistor Amplifiers	Kybett pp 173 – 201
(Quiz 4 due 10/12)			
Session 5f	– 10/16	Review (Discuss Quiz 4)	
(Oct 14 is a holiday)			
Session 5g	- 11/13 11/15	Zener Design Exercise	Email Hand-Out
Session 5h	**01/06**	**Review and Intro to Part 6**	

Diode Review

- Diodes are electronic one-way valves
  - Current can flow from anode to cathode
  - Current is blocked in the reverse direction
- Forward voltage drop

Current flows from A to B but not from B to A.

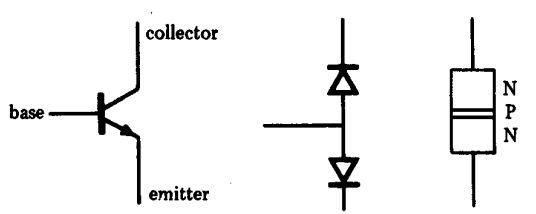
  - Silicon $V_f = 0.7$ volts
  - Germanium $V_f = 0.3$ volts
  - Schottky $V_f = 0.1$ volts
  - GaAs $V_f = 2$ volts
- Peak Inverse Voltage (PIV, PRV, Zener)
- These are non-linear devices (no superposition)

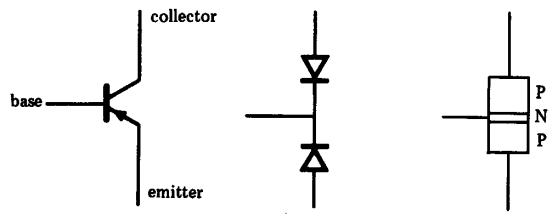
Diode Analysis Review

- First determine if the diode is:
  - Forward biased: conducting with a small voltage drop
  - Reverse biased: an open switch
  - In reverse breakdown (PIV): conducting with a large voltage drop (The Zener voltage)
- Replace the diode with a simple equivalent and then analyze the circuit (Ohm and Kirchoff)
- Check power dissipation in each component to avoid overheating

Transistor Review

- Transistors have three leads: base, emitter and collector
- Testing via ohm meter
  - Two diodes back to back: test each separately for impedance ratio
  - Check collector to emitter for high impedance (leakage)
- Beta (β): Current gain $\beta = I_C/I_B$, as long as no "saturation" ($V_{CE} > 0.2v$)
  - Transistor "action"
  - Carriers injected into "depletion region" (very thin base region)
- NPN and PNP: currents and voltages reversed
- Analyze Base current (I_B) flow as a diode
- Collector current: $I_C = I_B * \beta$
- Collector voltage: $V_C = V_{batt} - I_C * R_C$





Transistor Review (2)

- Amplifier Configurations
  - Common Emitter (voltage gain)
  - Common Collector (buffer, low output impedance)
  - Common Base
    (only used in some high frequency applications)
- Non-Linear Operation
  - Saturation: Transistor is fully on (V_{ce}= 0.2, low β)
  - Cutoff: Transistor is off (V_{be}< 0.5, I_c = 0)

Section 6: FETs, SCRs, Other Devices and Operational Amplifiers

- 0BJECTIVES: This section reviews additional important semiconductor devices and their applications. The Operational Amplifier is also studied.

Section 6 Schedule:

Session 5h	– 01/13	Review and Intro to Section 6		
Session 6a	– 01/15	Field Effect Transistors	Kybett	pp 70 – 77, pp 201-209
Session 6b	– 01/20	Transistors as a switch	Kybett	pp 78 –107
Session 6c	– 01/22	SCR's, Triacs and UJTs		
Session 6d	– 01/27	Class "A", "B", and "C" Amps		
(Lab - 02/01, Sat.)				
Session 6e	– 02/05	Op-Amps	Kybett	pp 209-215
Session 6f	– 02/10	Review for Quiz 6		
(Quiz 6 due 02/23)				
Session 6g	– 02/24	Discuss Quiz 6		
Session 6h	– 02/26	Review for MT3		
MT3	– 03/02	MT3 Exam		
Session 6I	– 03/10	Discuss MT3		