

Review for Midterm Exam

Topics:

1. p-n Junctions / p-n Heterojunctions
2. Bipolar Transistors / HBTs
3. FETs (JFET, MESFET, HFET/HEMT, MOSFET)
4. Associated topics:
 - Band diagrams
 - 2DEGs / Heterojunctions / Modulation doping
 - Quasi electric fields
 - Advanced processing techniques

p-n Junctions

- I-V Characteristics (Diode equation)
- 1 side heavily doped
- Graded doping
- Band diagram / E-field diagram
- Breakdown (Avalanche, Zener)
- Heterojunction (band diagram, I-V characteristics)
- Fabrication (epitaxial growth, implant/diffusion)

Bipolar Transistors / HBTs

- I-V Characteristics (I_B , I_C , I_E)
- β , γ , α_T
- HBT Design
 - Wide bandgap emitter (abrupt and graded heterojunction)
 - Wide bandgap collector
 - Graded bandgap base (quasi E-field)
- Band diagrams / E-field diagrams
- Breakdown
- Selection of doping levels in the emitter, base, and collector
- Frequency response (g_m , f_T)
- Early effect
- Kirk effect
- Fabrication
 - Wedding cake structure (III-V semiconductors)
 - Silicon IC process
 - Self aligned emitter

MESFET / JFET / HFET

- General device structure
- General fabrication of devices
- For HFET
 - 2DEG
 - Continuous vs delta doping
 - Parasitic channel
 - Band diagram, E-field diagram, channel charge density calculation

MOSFETs

- General device structure
- MOS gate structure
- Band diagrams
- Long channel vs short channel device performance
- Short channel effects
- Constant field scaling, high-K gate dielectric
- Modern device structures
 - SOI
 - FinFET

