EE Ph.D. Diagnostic Exam Text and Topic Reference Guide
(Last updated in Spring 2015 but remains accurate unless otherwise updated)

Thrust Area: Nanotechnology and MEMS – Materials and Devices

*Nanoelectronics Theory*
Chapter 1. Basic Semiconductor Properties
Chapter 3. Energy Band Theory
Chapter 4. Equilibrium Carrier Statistics

*These topics can be learned by taking EE5381 and/or reading these chapters. The first part of this course covers the above material.*

*Nanoelectronics / MEMS Fabrication*
Chapter 1. An Introduction to Microelectronic Fabrication
Chapter 4. Thermal Oxidation
Chapter 7. Optical Lithography
Chapter 8. Photoresists

Chapter 5 Silicon Micromachining: Bulk
Chapter 6 Silicon Micromachining: Surface

*These topics can be learned by taking EE 5343 and EE5344 and/or learning these chapters. The first part of each course covers the above material.*

Copies of these books are available in the Science and Engineering Library.
For questions regarding this thrust area, please contact Prof. Zeynep Çelik-Butler at zbutler@uta.edu.

Thrust Area: Fundamental Courses

**Topic**: Advanced Electronics

**Text(s):**

**Focus:** All of the topics below are from Text 1
Fabrication - 2.1, 2.2, 2.5, 2.6, 2.9, 2.10, Appendix A.2.1
BJT, JFET, MOS Models - 1.1 - 1.9, Appendix A.1.1
Single and Diff Amps - Chapter 3
Current Sources & Active Loads - Chapter 4, Appendix A.4.1, A.4.2
Output Stages - Chapter 5
Operational Amplifier - 6.1, 6.2, 6.8
Frequency Response - Chapter 7
Feedback - 8.1 - 8.5
Formulas for variety of connections for BJT and MOS devices will be supplied with the exam if needed. A copy of this is shown below.

**Topic:** Random Signals and Noise
**Focus:** Basics concepts of Probability Theory - Conditional Probability, Baye's Theorem
Random Variables - Discrete and Continuous Random Variables
Cumulative distribution function and Probability distribution function
Functions of Random Variables
Pairs of Random Variables
Joint pdf, Joint cdf, conditional pdf and cdf
Functions of a pair of Random variables
Vector Random Variables
Central Limit Theorem
Random Processes
Ergodicity and Stationarity of a Random Process
Power spectral density, auto-correlation and cross-correlation
Response of linear systems to random signals

**Thrust Area: Electromagnetic Fields and Applications**
**Topic:** Electromagnetic Theory
**Focus:** Chapters 1 - 8 of the text

**Thrust Area: Power System Modeling and Analysis**
**Topic:** Power System Modeling and Analysis
**Text(s):** 1. Power Systems Analysis by Arhur R. Bergen and Vijat Vittal.
**Focus:** Chapters 1 - 6, 8-10, and 12 - 14 of the text.

**Thrust Area: Solid-State Devices, Circuits and Systems**
**Topic:** Semiconductor Device Theory
**Focus:** Ch. 1 - Semiconductor Electronics, P1:1,3,4,6,8,18
    Appendix 1A - Electric Fields ...
    Ch. 2 - Silicon Technology, P2:15,18,19,20
    Ch. 3 - Metal-Semiconductor Contacts, P3:2,3,4,5,7,16
    Ch. 4 - pnJunctions, P4:1,2,5,6,9,14
    Ch. 5 Currents in pn Junctions - P5:1,2,3,6,9,11,19,21
    Ch. 6 - Bipolar Transistors I, P6:1,5,8,9,12,13,16,17
    Ch. 7 - Bipolar Transistors II, P7:1,2,7,9,11,23,29
    Ch. 8 - Properties of the MOS System, P8:1,2,4,7,12,15
    Ch. 9 - MOSFETs I, P9:1,3,5,7,14,21,
    Ch. 10 - MOSFETs II, P10:1,2,4,8

**Thrust Area: Digital Signal and Image Processing**
**Topic:** Digital Signal Processing

**Text(s):**

**Thrust Area:** Communications and Information Systems

**Topic:** Digital Communications

**Text(s):**

**Thrust Area:** Optical Devices and Systems

**Topic:** Principles of Photonics

**Text(s):**

**Focus:**
- Chapter 2 “Wave Motion,”
- Chapter 3 “EM Theory, Photons, and Light,”
- Chapter 4 “The Propagation of Light,”
- Chapter 5 “Geometrical Optics,”
- Chapter 8 “Polarization,”
- Chapter 9 “Interference.”

**Thrust Area:** Power Electronics

**Topic:** Power Electronics Engineering

**Text(s):**
2. Power Electronics: Converters, Applications, and Design by Mohan

**Focus:** Coverage of the exam is Chapters 1 to 9 of reference 1 and Chapter 5 of reference 2.

**Thrust Area:** Systems, Controls and Automated Manufacturing

**Topic:** Linear Systems Engineering

**Text(s):**

**Focus:**
- Chapters 1-7 in Text 1 and Chapters 1,2,3,6 and 11 in Text 2.
- State variable description (SVD) of dynamic systems - canonical forms
- State transformations, eigenvalues and eigenvectors
- Transfer functions
- Markov parameters
- Solution of state differential equations
- Controllability and observability - Cayley-Hamilton theorem, decomposition into controllable/uncontrollable and observable/unobservable parts
- State feedback design via pole placement
- Asymptotic observer design
- Combined state feedback with observer, principle of separation, transfer function design approach
- Multivariable systems----minimal realization, Popov-Belevitch-Hautus theorem, eigenvector test