

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

Advanced Semiconductor Fundamentals, Modular Series on Solid State Devices Vol. VI 2nd Edition, by R.F. Pierret, Prentice-Hall 2003.

- 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

Fabrication Engineering at the Micro- and Nanoscale, Stephen A. Campbell, 3rd or 4th Edition, Oxford University Press. 2008 or 2013.

- Chapter 1. An Introduction to Microelectronic Fabrication
- Chapter 4. Thermal Oxidation
- Chapter 7. Optical Lithography
- Chapter 8. Photoresists

Microsensors, MEMS and Smart Devices, J. W. Gardener, V. K. Varadan, and O. O. Awadelkarim, John Wiley and Sons, 2001.

- 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): 1. P. R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 4th. Edition, New York:John Wiley, 2001.

2. Alan Grebene, Bipolar and MOS Analog Integrated Circuit Design, John Wiley, 1984.

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

Text(s): 1. Probability, Statistics, and Random Processes for Electrical Engineering, Third Edition by Alberto Leon-Garcia, Pearson Prentice Hall

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

Text(s): 1.Constantine A Balanis, Advanced Engineering Electromagnetics,Wiley 1st Ed.,1989.

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 Arthur R. Bergen and VijatVittal.

Focus: Chapters 1 - 6, 8 -10,and 12 - 14 of the text.

Thrust Area: Solid-State Devices, Circuits and Systems

Topic: Semiconductor Device Theory

Text(s): 1. Device Electronics for Integrated Circuits, 3rd ed., by Richard S. Muller, Theodore I. Kamins, and Mansun Chan, John Wiley and Sons, New York, 2003. ISBN: 0-471-59398-2. (Books on reserve in the Science and Engineering Library are marked

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 - *pn*Junctions, 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): 1. Digital Signal Processing: A Computer-based Approach 4th edition, by S.K. Mitra, McGraw Hill (Chs. 1-7)
2. Discrete-time Signal Processing, 3rd edition, by A.V. Oppenheim, R.W. Schaffer, Prentice Hall (Chs. 1-5, 8)

Thrust Area: Communications and Information Systems

Topic: Digital Communications

Text(s): 1. John Proakis, Digital Communications, 4th ed, McGraw-Hill Higher Education, ISBN: 0-07-232111-3, 2000. Or 5th edition, ISBN: 0-07-295716-6, 2008.

Thrust Area: Optical Devices and Systems

Topic: Principles of Photonics

Text(s): 1. Optics book by E. Hecht (4th edition, Pearson Education, 2001)

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): 1. Fundamentals of Power Electronics by Robert Ericson and Dragan Maksimovic.
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):

1. Bernhard Friedland, Control System Design, McGraw-Hill Inc., 1986, ISBN 0-07-022441-2
2. Richard C. Dorf, Robert H Bishop, Modern Control Systems (10th Edition), Prentice Hall, 2004, ISBN 0131457330

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