

Spring 2012

EE Ph.D. Diagnostic Exam Text and Topic Reference Guide

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: 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

Thrust Area: Power System Modeling and Analysis

Topic: Power System Modeling and Analysis

Text(s): 1. Power Systems Analysis by Arthur 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

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: Nanotechnology and MEMS – Materials and Devices

Topic: MEMS Theory

Text(s): 1. Advanced Semiconductor Fundamentals, Modular Series on Solid State Devices Vol. VI 2nd Edition, by R.F. Pierret, Prentice-Hall 2003.

Foucs: Ch. 1 Basic Semiconductor Properties

Ch. 4 Equilibrium Carrier Statistics

Ch. 6 Carrier Transport

Topic: MEMS Fabrication

Text(s): 1. Introduction to Microelectronic Fabrication, Modular Series on Solid State Devices Vol. V 2nd Edition, by Richard C. Jaeger, Prentice-Hall 2002.

Foucs: Ch.1 Overview of Fabrication

Ch. 2 Lithography

Ch. 3 Thermal Oxidation of Silicon

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. Schafer, 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: Renewable Energy and Vehicular Technology

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.