جامعة القاهرة

Dept. of Electronics and Electrical Communications
Faculty of Engineering – Cairo University
Giza – Cairo - Egypt

قسم هندسة الإلكترونيات و الاتصالات الكهربية
كلية الهندسة - جامعة القاهرة
الجيزة- القاهرة – جمهورية مصر العربية

Reading List for the PhD Comprehensive Exam
Electronics Specialization
(Academic Year 2011 – 2012)

Part I: VLSI Engineeinrg

Responsible Faculty: Dr. Hani FIKRY (Professor of Electronics at Ain Shmas University)

Book Titles:
Integrated Circuits, Rabaey et al., Prentice Hall, 2003
Design of Analog CMOS Integrated Circuits, Razavi, MG, 1999

The required topics are:
- Basic fabrication Techniques for CMOS and BiCMOS
- Implementation techniques for VLSI ASICs
- Digital IC design for delay or power optimization
- Timing issues
- Analog IC layout issues
- CMOS opamp design including frequency response and noise
- Nonlinearity and mismatch issues

Part II: Digital Signal Processing

Responsible Faculty: Dr. Afaf ABDEL-FATTAH (Professor of Electronics at Cairo University)

1) Discrete Time Signals and Systems
- Representation of arbitrary sequences, important sequences, properties of sequences.
- Linear Shift Invariant Systems, definition, properties, linearity, shift Invariance, causality and stability. -Convolution.
- Linear Constant Coefficients Difference Equations, IIR & FIR systems.

2) The Z-Transform
- Definition.
- Two-sided and one-sided Z-Transform.
- Region of convergence and relation to poles of the function.
- Z-Transform of some important sequences.
- Inverse Z-Transform.

- Tables.
- Z-Transform theories and properties.
- Z-Transform of linear constant coefficients difference equations.

3)The Discrete Fourier Transform (DFT)
- Definition
- Discrete Fourier Series Transform Pair (DFS) and relation to the Z-Transform.
- Properties of DFS (linearity, shift of sequences & periodic convolution).
- Relation of DFT to DFS.
- Properties of DFT (linearity, circular shift & circular convolution).

4)Signal Flow-Graph and Matrix Representation
- Representation of Signal flow-graph.
- Matrix representation of digital filters.
- Representation of basic network structures by signal flow-graph:
  IIR (direct form, direct canonic form, cascade form & parallel form).
  FIR (direct form & and cascade form).

5) Network Structures (Realizations)
- Basic building blocks. -Block diagram representation. -Implementation of discrete time systems:
  Recursive realizations(IIR) (direct, direct canonic, cascade & parallel structures)
  Non recursive realizations(FIR) (direct & cascade structures)
  Lattice Structures of FIR systems
  Multi-stage Lattice filter structure -Forward and backward prediction. -Conversion of Lattice coefficients to direct coefficients and vice versa.

6) Digital Filter Design Techniques
- Design of IIR digital filters
  Impulse Invariance Technique
  Bilinear Transformation Technique (for LP & BP filters)
  Frequency transformation of low pass filters (using tables) -Computer-aided design of IIR digital filters
  Minimization of mean square error
  Least squares inverse design -Design of FIR digital filters
  Design of FIR filters using windows
  Design of linear phase FIR filters -Computer-aided design of FIR digital filters
  Design of FIR filters using DFT frequency samples

7) Computation of the Fast Fourier Transform (FFT)
- Decimation in time algorithm. -Decimation in frequency algorithm

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Part III: Semiconductor Devices

Responsible Faculty: Dr. Serag HABIB (Professor of Electronics at Cairo University)

Book Titles: (Any of the following references)

1 - Ben Streetman and Sanjay Banerjee, "Solid State Electronic Devices", 6th Edition, Prentice Hall, 2005. Chapters one to six.
2 - Donald A. Neamen, "Semiconductor Device Fundamentals", McGraw-Hill Education, 2005. Chapters (one to eight) and chapters 11- 12.
3 - R. F. Pierret and G. W. Neudeck (eds.), " Modular Series on Solid State Devices" Addison and Wesley:

Vol. I: "Semiconductor Fundamentals", R. F. Pierret.
Vol. II: "The PN junction Diode", G. W. Neudeck.
Vol. IV: "Field Effect Devices", R. F. Pierret.
Vol. VII: "Advanced MOS Devices", D. K. Schroder.

The required topics are:

1. Semiconductors Basics : Crystal structures, Energy bands, properties of charge carriers in semiconductors at equilibrium and at non-equilibrium, Current continuity equations.

2. Device building Blocks:
2.1 PN junction : Equilibrium conditions, Current flow under forward and reverse bias, Breakdown phenomena, Transient conditions, Second order effects.
2.2 Heterojunction : Surface discontinuity and lattice matching conditions, Energy band diagrams, pseudo-morphic Heterojunctions, graded bandgap junctions, Quantum wells and superlattices.
2.3 Metal – Insulator – Semiconductor (MIS) Capacitor : Ideal MIS capacitor, Accumulation, depletion, and inversion conditions, CV characteristics, Channel conductance, Actual MIS capacitor, Transient behavior and deep depletion behavior.

3.MOSFET:
3.1 Long Channel MOSFET : Output characteristics, Transfer characteristics, Substrate bias, bulk charge, mobility models, Intrinsic and extrinsic capacitances, Large signal and small signal models.
3.2 Short Channel MOSFET : Velocity saturation, Subthreshold current, Drain-induced barrier lowering, Gate Leakage current, Advanced MOSFET structures.
3.3 Scaling laws:

Part IV: Electronic Circuits

Responsible Faculty: Dr. Abdel Halim SHOUSHA (Professor of Electronics at Cairo University)

Book Titles:
I – B. Razavi, “Design of Analog CMOS Integrated Circuits” , McGraw –Hill
II - B. Razavi , “RF Microelectronics” Prentice -Hall

The required topics are: The required topics are:

Operational Amplifiers (Reference I – Chapter 9)
Stability and Frequency Compensation (Reference I – Chapter 10)
Short Channel Effects and Device Models (Reference I – Chapter 16)
Modulation and detections (Reference II – Chapter 3)
Frequency synthesizers (Reference II – Chapter 8)
Power Amplifiers (Reference II – Chapter 9)

Part V: Subject Selected by Adviser
Responsible Faculty: The head of the advising committee of the student.