Updated 10/18/2007

PhD PRELIMINARY WRITTEN EXAMINATION READING LIST

COMMUNICATIONS

Textbook example: R. Ziemer and W. Tranter, "Principles of Communications", Wiley

► Typically covered in a course such as EE4501.Communications Systems.

Systems for transmission and reception of digital and analog information. Characteristics and design of wired and wireless communication systems. Baseband, digital, and carrier-based techniques. Modulation. Coding. Electronic noise and its effects on design and performance of communication systems.

SIGNAL PROCESSING

Textbook example: A. Oppenheim and R. Schafer, "Digital Signal Processing,"

► Typically covered in a course such as EE4541 Digital Signal Processing.

Review of linear discrete time systems and sampled and digital signals; Fourier analysis, discrete and fast Fourier transforms; interpolation and decimation; design of analog, infinite-impulse response and finite impulse response filters; quantization effects.

CONTROLS

Textbook example: C.F. Franklin, J.D. Powell, and A. Emami-Naeini, "Feedback Control of Dynamic Systems", Addison-Wesley

► Typically covered in a course such as EE4231 Linear Control Systems: Designed by Input/Output Methods.

Modeling, characteristics, and performance of feedback control systems. Stability, root locus, and frequency response methods. Digital implementation, hardware considerations.

ANALOG AND DIGITAL ELECTRONICS

Textbook example: Sedra and Smith, Microelectronic Circuits", Oxford Univ. Press

► Typically covered in a course such as EE 3115 Analog and Digital Electronics.

Feedback amplifiers. Stability and compensation. Oscillators. Internal structure of operational amplifiers. Switching active devices. BJT and FET logic gates. Sequential circuits. Designing complex digital circuits.

SEMICONDUCTOR MATERIALS

Textbook example: Neaman, "Semiconductor Physics and Devices"

► Typically covered in a course such as EE 5163 Semiconductor Properties and Devices I.

Principles and properties of semiconductor devices. Selected topics in semiconductor materials, statistics, and transport. Aspects of transport in p-n junctions, heterojunctions.

SEMICONDUCTOR DEVICES

Textbook example: Pierret, "Semiconductor Device Fundamentals", Addison-Wesley

► Typically covered in a course such as EE3161 Semiconductor Devices.

Elementary semiconductor physics; physical description of pn junction diodes, bipolar junction transistors, field-effect transistors.

OPTICS

Textbook example: Amnon Yariv, "Photonics: Optical electronics in modern communications", 6th Edition, Oxford. (Chapters 1-6 and 9 inclusive)

► Typically covered in a course such as EE5624: Optical Electronics. Fundamentals of lasers, including propagation of Gaussian beams, optical resonators, ABCD matrix methods, basic interactions between light and atomic systems, and theory of laser oscillation. Polarization optics, Jones calculus, optics of crystals, electro-optic modulation, acousto-optic modulation.

FIELDS AND TRANSMISSION LINES

Textbook example: Fundamentals of Applied Electromagnetics, by Fawaz Ullaby, Pearson, Prentice Hall.

► Typically covered in a course such as EE3601 Transmission Lines and Fields. Transmission lines, sinusoidal and time domain excitation. Electrostatic and magnetostatic fields, interaction with dielectric and magnetic materials. Time-varying electromagnetic fields. Propagation and reflection of electromagnetic waves. Metallic and optical wave guides, and antennas.

POWER SYSTEMS AND POWER ELECTRONICS

Textbook examples: "Power System Analysis & Design", Glover and Sarma, PWS Publishing Co., 1994

AND

Mohan, Undeland, Robbins, "Power Electronics: Converters, Applications, and Design", Wiley, 1995

► Typically covered in a course such as EE4721 and EE 4741 (question will cover material from both courses).

EE 4721. Introduction to Power System Analysis.
AC power systems; analysis of large power system networks; mathematics and techniques of power flow analysis, short circuit analysis, and transient stability analysis; use of a power system simulation program for design. Integral lab.

EE 4741. Power Electronics.
Switch-mode power electronics; switch-mode DC power supplies; switch-mode converters for DC and AC motor drives, wind/photovoltaic inverters, interfacing power electronics equipment with utility system; power semiconductor devices, magnetic design, electro-magnetic interference (EMI). Integral lab.
Software

SOFTWARE

The software exam tests facility and skill in computer programming in high-level languages such as C, C++, and Matlab, including the basics of compilation and program building. It also tests knowledge of basic data structures (eg., trees, linked lists, hash tables, etc.) and fundamental algorithms (such as sorting, graph traversal, etc.).

Textbook examples:

1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms", MIT Press, Cambridge, MA, 1990.
2. B.W. Kernighan and D.M. Ritchie, "The C programming language", Prentice Hall, Inc., 1988.
3. B. Stroustrup, "The C++ Programming Language", Addison-Wesley, ISBN 0-201-88954-4 and 0-201-70073-5.
4. C. Moler, "Numerical Computing with MATLAB", SIAM Press, ISBN-13: 978-0-898715-60-6 / ISBN-10: 0-89871-560-1.
5. B.W Kernighan and R. Pike, "The Unix Programming Environment", Prentice Hall, Inc., 1984. ISBN 0-13-937681-X (paperback), 0-13-937699-2 (hardback).

Relevant courses:

1. EE 4940: Practical Programming and Scripting for Engineers/Scientists
   - https://laoo.dtc.umn.edu/classWiki/tiki-index.php?page=EE4940-4970-Fall-2007

2. CSci 4041: Algorithms and Data Structures
   - http://www-users.itlabs.umn.edu/classes/Spring-2007/csci4041/

COMPUTER AIDED DESIGN

Syllabus:

Basic graph/numerical algorithms. Algorithms and data structures for logic-level and high-level synthesis, optimization and verification. Physical-design algorithms. Basic electrical elements/devices and their equations. Modified Nodal Analysis nonlinear differential equation formulations. Newton-Raphson algorithm. DC and AC analyses.

Textbook examples:

1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", 1998, John Wiley & Sons, ISBN: 0-471-98489-2?

AND

2. L.O. Chua and P.-M. Lin, "Computer-aided analysis of electronic circuits: algorithms and computational techniques", Prentice Hall, 1975. ISBN: 978-0131654150.

Relevant courses:

The CAD WPE exam tests the application of concepts learned in UG courses such as Linear Systems and Circuits (EE2011), Signals and Systems (EE3015) and Semiconductor Devices (EE3161). The syllabus for the CAD WPE is also covered in the introductory graduate-level CAD course sequence EE5301 and EE5302. (For EE5302, only material taught in the first 8 weeks of class are relevant to the CAD WPE).

Web page:

- Further details relevant to the syllabus for the CAD WPE are at: https://potol.ece.umn.edu/CAD-WPE/

COMPUTER ARCHITECTURE

Textbook examples: "Computer Systems Design and Architecture," V. P. Heuring and H. F. Jordan, Addison-Wesley, 1997.

AND

"Computer Organization and Design: The Hardware/Software Interface," D. A. Patterson and J. L. Hennessy, Morgan Kaufmann, 1998.

►Typically covered in a course such as EE5361 Computer Organization and Design

EE 5361. Computer Architecture and Machine Organization.
Introduction to computer architecture. Aspects of computer systems, such as pipelining, memory hierarchy, and input/output systems. Performance metrics. Examination of each component of a complicated computer system.
Digital Design
Textbook examples: "Fundamentals for Digital Logic Design", Brown Vranesic, McGraw-Hill

AND
"Digital Systems Design using VHDL", Charles H. Roth, Jr., PWS Publishing Co. [The questions will be related to design concepts but not to the specifics of any hardware description language.]

►Typically covered in courses such as: EE 2301 & EE4301

EE 4301. Digital Design with Programmable Logic.
Introduction to system design and simulation. Design using VHDL code and synthesis. Emulation using VHDL code.

Textbook examples: "Advanced Digital Desgin: Using Verilog, State Machines, and Synthesis for FPGAs," Sunggu Lee, Thomson, 2006.

MAGNETICS

Textbook examples: "Modern Magnetic Materials" by R. C. O'Handley.

Typically covered in a courses such as: EE 5653

EE 5653. Physical Principles of Magnetic Materials.
Physics of diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism; ferromagnetic phenomena; static and dynamic theory of micromagnetics, magneto-optics, and magnetization dynamics; magnetic material applications..