2013 QE TOPICS AND REFERENCES

The student is responsible for reading the ECE document "Rules and Procedures for the Ph.D. Qualifying Examination."

AUTOMATIC CONTROL

AC-1 Feedback Control Systems

- *Modern Control Engineering*, by K. Ogata, Fourth Edition, Prentice Hall, Upper Saddle River, 2002, Chapters 1--10

AC-2 Linear Time-Invariant and Time-Varying Systems: A State Space Approach

- *Linear Systems Theory and Design*, by Chi-Tsong Chen, Oxford University Press, (1999). ISBN #0-19-511777-8

AC-3 Optimization

- *An Introduction to Optimization*, by E.K.P. Chong and S.H. Zak, John Wiley and Sons, third edition, (2008).

BIOMEDICAL IMAGING AND SENSING

BE-1 Principles of Imaging

Coverage: Physical principles underlying medical imaging systems and associated mechanisms of image formation, with emphasis on radiographic, nuclear and magnetic resonance techniques. This question is primarily based on the contents of the course ECE 620 Introduction to Biomedical Imaging Systems.

Recommended Reading:

1. Medical Imaging Signals and Systems, by Jerry L. Prince and Jonathan M. Links, Pearson Prentice Hall (2006), Chapters 4-9, 12-13.

2. Principles of Magnetic Resonance Imaging, by Zhi-Pei Liang and Paul C. Lauterbur, IEEE Press (2000), Chapters 2-5.

3. Introduction to Biomedical Imaging, by Andrew Webb, Wiley Interscience (2003), Chapters 1, 2, 4.

BE-2 Biomedical Instrumentation

Coverage: Principles of BioMEMS fabrication methods (Bulk micromachining, surface micromachining, and polymer MEMS), transduction mechanism used in BioMEMS sensors and actuators (electrostatic, piezoresistive, thermal, magnetic, and piezoelectric), microfluidic devices and their biomedical applications.

Recommended Reading:

Foundations of MEMS, Chang Liu, Prentice Hall, 2005. Chapters 2-13 (pages 28-455)

BE-3 Biomedical Signal Processing (not offered in August 2011)

Coverage: Application of signal processing concepts and algorithms to measurement, amplification, filtering and transformations of signals in a biological context; emphasis on linkage between physiology, measurement systems and the obtained measurements.

Recommended Reading:

1. Introduction to Digital Signal Processing, 3rd Edition, J. G. Proakis and D. G. Manolakis, Prentice Hall (1996).

2. From Neuron to Brain, John G. Nicholls *et al*., Sinauer Associates (2001), Chapters 1-2, 5-7, 17-22

3. Bioelectrical Signal Processing in Cardiac and Neurological Applications, Leif Sörnmo and Pablo Laguna, Academic Press (2005), Chapters 3-4, 6-7.

COMMUNICATIONS & SIGNAL PROCESSING

CS-1 Probability and Random Processes

Coverage: Events, independence, random variables, distribution and density functions, expectations, and characteristic functions, dependence, correlation, and regression, multi-variate Gaussian distribution, stochastic processes, stationarity, ergodicity, correlation functions, spectral densities, random inputs to linear systems, Gaussian processes. This question is primarily based on the contents of the course ECE 600 Random Variables and Signals.

Recommended Reading:

1. Probability, Random Variables, and Stochastic Processes, 4th Edition, Papoulis, McGraw-Hill, 2002

CS-2 Signal Processing

Coverage: Discrete signals, systems, and transforms, linear filtering, fast Fourier transform, parametric spectrum estimation, linear prediction, multirate digital signal processing, digital filter design, and adaptive filtering. This question is primarily based on the contents of the course ECE 538 Digital Signal Processing I.

Recommended Reading:

1. Introduction to Digital Signal Processing, 4th Edition, J. G. Proakis and D. G. Manolakis, Prentice Hall, 2007
2. Course lecture notes, laboratories, and previous exams for ECE 538 at https://cobweb.ecn.purdue.edu/~ee538 .

CS-3 Communications

Coverage: Analog and digital communication systems; analog message digitization, signal space representation of digital signals, binary and M-ary signalling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal bandwidth requirements. This question is primarily based on the contents of the course ECE 544 Digital Communications.

Recommended Reading:

1. Principles of Communication, 5th Edition, Ziemer and Tranter, John Wiley & Sons, Inc., 1990

2. Introduction to Digital Communications, Michael B. Pursley, Prentice Hall, 2004

CS-4 Networking

Coverage: Design, analysis and operation of computer communication and telecommunication networks; packet and circuit switching, the OSI standards architecture and protocols, elementary queueing theory for performance evaluation, routing, congestion control, random access techniques, local area networks, reliability and error recovery, and integrated networks. This question is primarily based on the contents of the course ECE 547 Introduction to Computer Communication Networks.

Recommended Reading:

1. Telecommunication Networks: Protocols, Modeling and Analysis, M. Schwartz, Prentice-Hall, 1987

2. Communication Networks Fundamental Concepts and Key Architectures, 2nd Edition, Leon-Garcia, McGraw Hill, 2003

CS-5 Image Processing

Coverage: Digital image processing techniques for enhancement, compression, restoration, reconstruction, and analysis; 2-D signals and systems, image analysis, image segmentation; achromatic vision, color image processing, color imaging systems, image sharpening, interpolation, decimation, linear and nonlinear filtering, printing and display of images; image compression, image restoration, and tomography. This question is primarily based on the contents of the course ECE 637 Digital Image Processing I.

Recommended Reading:

1. Handbook of Image & Video Processing, Al Bovik, Academic Press, San Diego, 2000
2. Course lecture notes, laboratories, and previous exams for ECE 637 at https://engineering.purdue.edu/~bouman/ece637 .

COMPUTER ENGINEERING

CE-1 Theory

- *Introduction to Algorithms, Second Edition*
  by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 1184 pages. Publisher: The MIT Press; 2nd edition (September 1, 2001) ISBN: 0262032937. Chapters 2, 3, 4, 5, Section II except for Chapter 9, 11, 12.1, 12.2, 12.3, Part IV introduction, Chapters 15.1, 15.2, 15.3, 16.1, 16.2, 16.3, 22, 23, 24, 25.1, 25.2 and 34.

CE-2 Compilers

- Crafting a Compiler with C, Charles N. Fischer and Richard J. LeBlanc, Jr. 812 pages. Publisher: Addison Wesley (July 1, 1991) ISBN: 0805321667. Chapters 2.4, 3, 4, 5 (except for 5.7), 6.1, 6.2, 6.6, 7, 8, 9, 10.1, 10.2, 11.1, 11.2, 12.1, 12.2, 12.3, 12.4, 13, 15 (except for 15.8) and 16.

- *Compiler Transformations for High-Performance Computing*, Bacon, Graham and Sharp. ACM Computing Surveys, Volume 4, Issue 6, pages 345 – 420, 1994. http://doi.acm.org/10.1145/197405.197406 Sections 1, 2, 3, 5, 6.2.1, 6.2.4, 6.2.6, 6.2.7, 6.2.8, 6.3.1, 6.5.2, 6.6.1, 6.6.2, 6.7.

CE-3 Artificial Intelligence

- *Artificial Intelligence: A Modern Approach,* by Stuart Russell and Peter Norvig. pp.1-723. first edition, Prentice-Hall, (1995). ISBN 0-13-103805-2.

CE-4 Architecture

- *Computer Architecture: A Quantitative Approach*, by John L. Hennessy and David A. Paterson, Morgan Kaufmann Publishers, fourth edition, (2007). Chapters 1 through 6 and Appendix A, B, and C. **Note that Chapter 4 is new material compared to past offerings.**

CE-5 Computer Network Systems

"*Computer Networks: A Systems Approach*", by Larry Peterson and Bruce Davies. 4th Edition, Morgan Kaufmann Publishers, 2007 Chapters 1-2, 3 (except 3.3) 4-6, 8, 9 (except 9.3)

- J. Saltzer, D. Reed, and D. Clark, "*End-to-end Arguments in System Design*". ACM Transactions on Computer Systems (TOCS), Vol. 2, No. 4, 1984, pp. 195-206.

- S. Deering and D. Cheriton, "*Multicast Routing in Internetworks and Extended LANs*", SIGCOMM', Stanford, CA, Aug 1988, 55-64

- M.Caesar and J. Rexford, *BGP policies in ISP Networks*, IEEE Network Magazine, special issue on interdomain routing, November/December 2005.

CE-6 Operating Systems

- Operating System Concepts, by Avi Silberschatz, Peter Baer Galvin, and Greg Gagne, Eighth edition, John Wiley and Sons (2009). ISBN: 978-0-470-12872-5. Chapters 1-13.

FIELDS & OPTICS

FO-1 Statics 1

Topics may include but are not limited to:

Electrostatics
Magnetostatics
Energy and Force Relations
Boundary Conditions
Quasistatics – L, C, R derivations

- David K. Cheng, Field and Wave Electromagnetics, Chapters 1-6.

FO-2 Dynamics 1 : Propagation, transmission and radiation

Topics may include but are not limited to:

Planewaves
Antennas
Arrays
Waveguides
Interference
T-lines
Boundary Conditions

- David K. Cheng, Field and Wave Electromagnetics, Chapters 7-11

FO-3 Dynamics 2 : Time Varying Fields and Maxwells Equations

Topics may include but are not limited to:

Displacement Current
Faraday's Law
Separation of variables
Boundary conditions
Image theory

- David K. Cheng, Field and Wave Electromagnetics, Chapters 7-11

MICROELECTRONICS & NANOTECHNOLOGY

(formerly Solid State Devices & Materials (SS)

MN-1 Semiconductor Fundamentals

- R. F. Pierret, Advanced Semiconductor Fundamentals, Vol. VI in the Modular Series on Solid State Devices, 2nd edition, Prentice Hall, © 2003.

- R. F. Pierret, Semiconductor Device Fundamentals, Addison-Wesley, © 1996; Chapters 1-3, Appendix A.

- S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices", 3rd Edition, John Wiley and Sons, Hoboken, NJ, 2007; Chapter 1. ISBN-13: 978-0-471-14323-9, ISBN-10: 0-471-14323-5.

MN-2 Junction Devices

(pn junction diodes, optoelectronic diodes, Bipolar Junction Transistors, Heterojunction Bipolar Transistors, Schottky diodes, and related basic fabrication issues)

- R. F. Pierret, *Semiconductor Device Fundamentals,* Addison-Wesley, © 1996; Chapters 4-11, 14.

- S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices", 3rd Edition, John Wiley and Sons, Hoboken, NJ, 2007; Chapters 2,3,5. ISBN-13: 978-0-471-14323-9, ISBN-10: 0-471-14323-5.

MN-3 Field Effect Devices

(MOS-Capacitor, MOSFET, and basic fabrication issues)

- R. F. Pierret, *Semiconductor Device Fundamentals*, Addison-Wesley, © 1996; Chapters 16-19.

- S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices", 3rd Edition, John Wiley and Sons, Hoboken, NJ, 2007; Chapters 4,6. ISBN-13: 978-0-471-14323-9, ISBN-10: 0-471-14323-5.

POWER & ENERGY DEVICES & SYSTEMS

PE-1 Energy Conversion and Reference Frame Theory

- Analysis of Electric Machinery and Drive Systems, by P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, Chapters 1 and 3 IEEE Press, (2002).

PE-2 Electric Machinery (Induction, PM, Wound-Rotor Synchronous)

- *Analysis of Electric Machinery and Drive Systems,* by P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, Chapters 4, 5 and 6, IEEE Press, (2002).

PE-3 Power Electronics and Electric Drives

- *Analysis of Electric Machinery and Drive Systems,* by P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, Chapters 11, 12 and 13, IEEE Press, (2002).

VLSI & CIRCUIT DESIGN

VC-1 Transistors Level Design

- Digital Integrated Circuits: A Design Perspective, 2nd Edition, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Prentice Hall, 2003, ISBN No. 0-13-090996-3. (Chapters 1 to 7, 9, 11, 12)

VC-2 Combinational and Sequential Logic

- Contemporary Logic Design (2nd Edition), Randy H. Katz and Gaetano Boriello, Prentice Hall, 2004, ISBN No. 0201308576 (Chapters 1 to 9).
- Synthesis and Optimization of Digital Circuits, Giovanni De Micheli, McGraw-Hill College, 1994, ISBN No. 0070163332 (Chapters 1, 2, 7, 8, 9, 10).
- Digital Integrated Circuits: A Design Perspective, 2nd Edition, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Prentice Hall, 2003, ISBN No. 0130909963. (Chapter 11)

VC-3 Analog Integrated Circuits

- Analog Integrated Circuit Design, David Johns & Ken Martin, Wiley, ISBN No. 0-471-14448-7.
- Design of Analog CMOS Integrated Circuits, Behzad Razavi, McGraw Hill, ISBN No. 0-07-238032-2.
- Microelectronic Circuits, Adel Sedra & Kenneth Smith, Oxford, ISBN No. 0195142519.