2015 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


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


AC-3 Optimization


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:


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:


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:


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:

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:

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:

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:


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:

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*

CE-2 Compilers


• *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](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, 6.3.1, 6.5.2, 6.6.1, 6.6.2, 6.7.

CE-3 Artificial Intelligence – Not offered in August 2015


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. 5th Edition, Morgan Kaufmann Publishers, 2011 Chapters 1-2, 3 (except 3.4) 4-6, 8, 9


CE-6 Operating Systems

FIELD & 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**


**MN-2 Junction Devices**  
(pn junction diodes, optoelectronic diodes, Bipolar Junction Transistors, Heterojunction Bipolar Transistors, Schottky diodes, and related basic fabrication issues)


**MN-3 Field Effect Devices**  
(MOS-Capacitor, MOSFET, and basic fabrication issues)


**POWER & ENERGY DEVICES & SYSTEMS**

**PE-1 Energy Conversion and Reference Frame Theory**


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

PE-3  Power Electronics and Electric Drives


VLSI & CIRCUIT DESIGN

VC-1  Transistor Level Design


VC-2  Combinational and Sequential Logic


- Synthesis and Optimization of Digital Circuits, Giovanni De Micheli, McGraw-Hill College, 1994, ISBN No. 0070163332 (Chapters 1, 2, 7, 8, 9, 10).


VC-3  Analog Integrated Circuits

