Ph.D. Diagnostic and Comprehensive Examination
Spring 2022

Last updated on 2/14/2022

Examination Guidelines

- The examination is "closed-book" and no formula sheet is allowed. Some questions include reference formulas. A scientific calculator is allowed.
- This is a four-hour examination.
- M.E. students need to answer five questions, but no more than two from the mathematics group. The ME students' responses are graded at a master's level.
- Ph.D. students need to answer eight questions, but no more than three from the mathematics group. The Ph.D. students' responses are graded at a doctoral level.
- The answers to only five (M.E.) or eight (Ph.D.) questions need to be turned in separate blue books.
- Students need to abide by Old Dominion University's honor pledge. No material shall be shared without prior permission of the proctor(s).
- Copies of sample examinations are available at **https://www.odu.edu/ece/students/graduate**

Examination Topics

Problem	Topic	Suggested Text and Chapters or Topics	Primary Faculty Member(s)
A1	**MATH** Complex Variables and Differential Equations	Complex functions, analyticity & the Cauchy-Riemann equations, contour integration & the residue theorem, linear differential equations with constant coefficients, integrating factors, initial-value problems, method of undetermined coefficients, power series solutions. • "Complex Variables and Applications," 3rd Edition, J. W. Brown and R. V. Churchill, McGraw- Hill, 1995, Chapters 1–7. • "Elementary Differential Equations and Boundary Value Problems" 9th ed., W. E. Boyce and R. C. DiPrima, Wiley, 2008, Chapters 1–6.	Dr. Xiao
A2	**MATH** Vector Calculus	"Advanced Engineering Mathematics," E. Kreyszig,10th ed., Wiley 2011, Chapters 9–10	Dr. Vahala
A3	**MATH** Linear Algebra	• "Linear Algebra with Applications," G. Williams, Jones and Bartlett Publishers 2010. Chapters 1–5. • "Linear Algebra and Its Applications," G. Strang, 4th edition, Brooks/Cole Publishing 2006, Chapters 1–6.	Dr. Popescu
A4	**MATH** Probability	"Probability and Statistics" A. Papoulis, Prentice Hall, 1990, Chapters 1–6, 8, 9.	Dr. Gray

CIRCUITS & ELECTRONICS			
B1	**CIRCUITS** Sinusoidal Steady State Analysis	"Electric Circuits," J. W. Nilsson & Susan A. Riedel,9th ed., Prentice Hall, Chapters 7 – 10.	Dr. Lakdawala
B2	**CIRCUITS** Circuit Analysis with the Laplace Transform	"Electric Circuits," J. W. Nilsson & Susan A. Riedel,9th ed., Prentice Hall, Chapter 13.	Dr. Lakdawala
B3	**ELECTRONICS**	"Microelectronic Circuits," A. S. Sedra and K. C. Smith,5th ed., Oxford Univ. Press, New York, 1998. Chapters: 2-5.	Dr. Namkoong
SYSTEMS, SIGNAL AND IMAGE PROCESSING			
C1	**IMAGE PROCESSING**	"Digital Image Processing," R. C. Gonzalez and R. E. Woods, 3rd ed., Prentice Hall, 2007, Chapters 1 – 4.	Dr. Chen
C2	**DIGITAL SIGNAL PROCESSING** Discrete-Time System Analysis	"Linear Systems and Signals," B. P. Lathi, 2nd ed., Oxford, 2005, Chapters 3, 5.	Dr. Li
C3	**DIGITAL SIGNAL PROCESSING** Sampling and Fourier Analysis of Discrete-Time Signals and Systems	"Linear Systems and Signals," B. P. Lathi, 2nd ed., Oxford, 2005, Chapters 8, 9.	Dr. Li
C4	**CONTROL SYSTEMS**	"Control Systems Engineering," N. S. Nise, 6th ed., Wiley, 2011, Chapters 2 – 11, Secs. 12.1 – 12.2.	Dr. González
C5	**COMMUNICATION SYSTEMS**	"Fundamentals of Communication Systems," J. G. Proakis and M. Salehi, Pearson/Prentice-Hall, 2005. Chapters 1 – 7.	Dr. Popescu
C6	**COMMUNICATION NETWORKS**	▪ Data Link Layer error detection and correction methods ▪ Sliding window protocols ▪ Multiple access protocols (Aloha variants, CSMA with CD/CA) ▪ Routing algorithms (Link State, Distance Vector, RIP, OSPF) ▪ TCP congestion control • "Computer Networks," A. S. Tanenbaum, Prentice Hall, 5th Ed., 2011, Sections 3.1 – 3.4, 4.1 – 4.2, 5.1 – 5.6, 6.2, 6.4, 6.5. • "Computer Networking: A Top-Down Approach," J. F. Kurose and K. W. Ross, 5th ed., 2010 Chapters 1, 3–5.	Dr. Xin

PHYSICAL ELECTRONICS I			
D1	**ELECTROMAGNETICS** Maxwell Equations, Propagation, Reflection and Transmission of Plane waves	"Applied Electromagnetism," L. C. Shen and J. A. Kong, 3rd ed., Cengage Learning, Chapters 2 – 4.	Dr. Jiang
D2	**ELECTROMAGNETICS** Electrostatics	"Applied Electromagnetism," L. C. Shen and J. A. Kong, 3rd ed., PWS Foundation Engineering Series, Chapters 9 – 10.	Dr. Namkoong
D3	**OPTICAL FIBER COMMUNICATIONS**	• "Optoelectronics," Wilson & Hawks, Prentice Hall, 3rd ed., 1998, Chapters 4, 7, and 8. • "Optical Fiber Communication," McGraw Hill, 4th ed., 2011, Chapters 1 – 4, 6 & 7, 11.	Dr. Laroussi
PHYSICAL ELECTRONICS II			
E1	**SOLID STATE ELECTRONICS**	"Semiconductor Devices," S. M. Sze, Wiley, 2nd edition 2001, Chapters 4 – 9.	Dr. Baumgart
E2	**PHYSICAL ELECTRONICS**	"Semiconductor Devices," S. M. Sze, Wiley, 2nd edition 2001, Chapters 1 – 4.	Dr. Marsillac
E3	**PLASMA SCIENCE AND DISCHARGES**	Maxwell-Boltzmann distribution, plasma frequency, Debye-shielding, drift, diffusion, plasma conductivity, waves in plasmas with no B field, reaction rates, particledynamics. • "Introduction to Plasma Physics," F. F. Chen, Plenum Press, 1974. • "Principles of Plasma Discharges and Materials Processing," M. A. Lieberman and A. J. Lichtenberg, 2nd ed., Chapters 2 – 6, 14.	Dr. Elsayed-Ali

COMPUTER SYSTEMS			
F1	**MICROPROCESSORS**	• Ch. 1. Microprocessor systems, microcontrollers and integrated peripherals. • Ch. 2. Programming microprocessors, assembly language programming, programmer's model, instruction set architecture, addressing modes, structured programming and pseudocode. • Ch. 3. Assembly language parameter passing, using the stack and local variables, subroutines. • Ch. 4. Microprocessor interfacing, dealing with timing problems, assembly coding for speed, pulse- width modulation. • Ch. 5. Memories in microprocessor systems, program and data memory, efficient assembly coding for small memories. • Ch. 6. Interrupts, exception handling, real-time processing. • "Microprocessor Systems Design: 68000 Hardware, Software, and Interfacing," A. Clements, PWS Publishing Company, 1997.	Dr. Belfore
F2	**DIGITAL SYSTEM DESIGN**	• "The designer's guide to VHDL," P. Ashenden, Morgan-Kaufman, 3rd ed., 2008. (VHDL reference) • "VHDL & Computer Design Fundamentals," M. Mand & C. Kime, 4th ed., Prentice Hall, 2008, Chapters 1–9. • "Digital Design Using VHDL," C. H. Roth and L.K. John, 2nd ed., Cengage Learning, 2007, Chapters 1–5, 8, 9.	Dr. Belfore
F3	**COMPUTER ARCHITECTURE**	• Ch. 2: Architecture Classification, Instruction Set Architecture • Ch. 3: Number systems and arithmetic, IEEE (standard 754) floating point arithmetic. • Ch. 4: Datapath and controller design, Pipelining - design, hazards, dependency resolution schemes • Ch. 5: Memory system design, MMUs, caches and hierarchies, replacement policies.	Dr. Chen
F4	**ALGORITHMS**	"Introduction to Algorithms," T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, 3rd ed., MIT Press, 2009, Chapters 2 – 4, 7, 9.	Dr. Belfore
F5	**DATA STRUCTURES** Stacks, queues, and linked lists. Binary trees.	• Comparison of elementary data structures such as stacks, queues, and linked lists "Data Structures with C++ Using STL," W. Ford and W. Topp, 2nd ed., Prentice Hall, 2002, Chapters 5 – 13.	Dr. Chen
F6	**LOGIC/DIGITAL CIRCUITS**	Digital Design and Computer Architecture, Second Edition, 2012, by David Harris and Sarah Harris	Dr. Al-Assadi

CYBERSECURITY			
G1	**COMPUTER NETWORKS AND SECURITY**	"Computer Networking: A Top-Down Approach," J. F. Kurose and K. W. Ross, 8th ed., 2021, Chapters 7 and 8	Dr. Alsharif
G2	**CYBER DEFENSE FUNDAMENTALS**	"Introduction to Cryptography with Coding Theory", Wade Trappe and Lawrence C. Washington, Chapter 1-9	Dr. Wu
G3	**CYBER PHYSICAL SYSTEM SECURITY**	"Security in Computing", 5th edition, by Charles Pfleeger, Shari Lawrence Pfleeger, and Jonathan Margulies, Chapter 3-9	Dr. Wu
G4	**FOUNDATIONS OF CYBERSECURITY**	Set-UID Programs, Buffer Overflow Attack and Format String Vulnerability. "Computer Security- A Hands-on Approach", Wenliang Du, 1st Edition, Chapters 1, 4 and 6	Dr. Shetty
G5	**SECURITY AND PRIVACY OF EMBEDDED SYSTEMS**	E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Second Edition, by, MIT Press, 2017. Link to download pdf: https://ptolemy.berkeley.edu/books/leeseshia/ Chapter 17: Security and Privacy	Dr. Al-Assadi