

## CISE Ph.D. Qualifying Exam Syllabus Systems Area

### **Introduction**

The system area covers three sub-areas in computer architecture, programming language, and operating system with the following topics.

### **Computer Architecture**

- Instruction-set architecture
- Execution pipeline
- Memory hierarchy
- I/O subsystem
- Advanced microarchitecture issues: dynamic instruction scheduling, branch prediction, look-up free caches, instruction-level parallelism, multiple instruction fetch/issuing, speculative execution.
- Shared-memory multiprocessor systems with coherent caches

### **Programming Language Principles**

- Programming language syntax: context-free grammars and parsers
- Names, scope, and binding
- Data types and data abstraction
- Control flow and procedural abstraction
- Block structure and activation records
- Programming language paradigms: imperative, object-oriented, functional, logic, concurrent
- Programming language semantics: operational, attribute grammars, denotational, axiomatic

### **Operating System**

- Concurrent processes/threads
- Client/server and object models
- Shared-memory interprocess communication
- Message-passing interprocess communication
- Remote procedure call and remote object invocation
- Distributed synchronization: mutual exclusion and leader election
- Naming and location services
- Memory consistency and data coherency
- Security: cryptography, mutual authentication protocols, distributed access control

### **Relevant Courses**

1. CDA 5155 – Computer Architecture Principles
2. COP 5555 – Programming Language Principles
3. COP 5615 – Operating System Principles

## Reading List

1. Computer Architecture: A Quantitative Approach 3rd Ed. John L. Hennessy, David Patterson, Morgan Kaufmann Publishers.
2. Programming Languages: Principles and Practice, 2nd Ed., K.C. Louden, Thomson Brooks/Cole, 2003.
3. Programming Language Pragmatics, M. L. Scott, Morgan Kaufmann Publishers, 2000.
4. Formal Syntax and Semantics of Programming Languages, K. Slonneger and B. L. Kurtz, Addison Wesley, 1995.
5. Distributed Systems: Principles and Paradigms, Andrew Tanenbaum and Maarten van Steen, Prentice Hall, 2002.
6. Distributed Operating Systems and Algorithms, Randy Chow and Theodore Johnson, Addison-Wesley, 1997.