

# Ph.D. Qualifying Exam Syllabus

## *Area 6: Databases*

### 1. Overview of Subject Area

Databases and database systems have become an essential and ubiquitous component of everyday life in modern society. Database management has evolved from a specialized computer application to a central component of a modern computer environment. As a result, knowledge about database systems has become an essential part of an education in computer science and information science. Wherever applications arising from a broad spectrum of diverse disciplines produce large volumes of data, database technology can help to structure, store, retrieve, analyze, query, and manipulate them in databases.

Therefore, the coverage of the PhD Qualifying Exam with respect to databases extends to the fundamental concepts of database management. These concepts incorporate aspects of database design, database languages, and database-system implementation.

### 2. List of Topics

For the PhD Qualifying Exam, the PhD student should be familiar with the following topics:

- Conceptual design using the Entity-Relationship Model
- Relational data model
- Relational algebra
- Relational query languages (SQL)
- Logical database design including functional dependencies and normalization
- Disk management and buffering
- Record storage and primary file organizations
- Index structures
- Implementation of relational operators
- Query processing
- Algebraic query optimization
- Cost-based query optimization
- Concurrency control
- Recovery
- Transaction processing
- Database system architecture
- Object-relational databases

### 3. Relevant CISE Graduate Courses

The relevant graduate database courses, which include the topics listed above, are

- COP 5725 “Database Management Systems”
- COP 6726 “Database System Implementation”

### 4. Reading List

The textbooks listed below are recommended for study. They are possible references to find information about the topics of the list above.

- Paolo Atzeni, Stefano Ceri, Stefano Paraboschi and Riccardo Torlone. *Database Systems: Concepts, Languages and Architectures*. McGraw Hill, 1999.
- Ramez Elmasri, Shamkant B. Navathe. *Fundamentals of Database Systems*. Addison-Wesley, 4<sup>th</sup> edition, 2004.
- Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom. *Database Systems: The Complete Book*. Prentice Hall, 1<sup>st</sup> edition, 2002.
- Raghu Ramakrishnan, Johannes Gehrke. *Database Management Systems*. McGraw-Hill, 3<sup>rd</sup> edition, 2003.
- Abraham Silberschatz, Henry F. Korth, S. Sudarshan. *Database System Concepts*. McGraw-Hill, 4<sup>th</sup> edition, 2002.