CSE PhD MAJOR/MINOR REQUIREMENTS

General Requirements
1. 10 letter graded credits are required for the major - core classes counted towards the qualification process cannot be counted.
2. 6 credits (at least 5 letter graded) are required for each of the 2 minors. Note: Graduate core classes used towards the qualification process cannot be counted.

Additional Notes
1. Students can take major and minors outside of the list below. They should contact a faculty member in that area prior to taking any of the classes.
2. Input from High-End Computing and Networking areas was not received in time for this update. However, students can still continue to major and minor in these areas - please see above.
3. Students could meet the requirements for the major/minors listed below using an alternative set of classes, including possibly graduate classes taken at another institution. They should contact their major/minor advisor to discuss this in ADVANCE.

TOPIC AREAS

Software Engineering and Programming Languages

Major course requirements (10 credit hours)

Required:
- a. 6341 - Foundations of Programming Languages
  (1) Can be counted only if 6321 was used for qualification process

Electives: Choose from the following
- a. 5234 - Distributed Enterprise Computing
- b. 5235 - Applied Enterprise Architectures and Services
- c. 5236 - Mobile Software Development
- d. 5239/5349 - taught by SE&PL faculty subject to the following constraints:
  (1) At least 3 credit-hours from courses other than 5239/5349
  (2) At least 2 credit-hours from 5239/5349
- e. 5343 - Compiler Design and Implementation
- f. 6321 - Computability and Complexity
  (1) Can be counted only if 6341 was used for qualification process
- g. 6333 - Distributed Algorithms

Minor course requirements (6 credit hours)

Required:
- a. 6341 - Foundations of Programming Languages
  (1) Can be counted only if 6321 was used for qualification process

Electives: Choose from the following
- a. 5234 - Distributed Enterprise Computing
- b. 5235 - Applied Enterprise Architectures and Services
- c. 5236 - Mobile Software Development
- d. 5239/5349 - Intermediate Studies in taught by SE&PL faculty
- e. 5343 - Compiler Design and Implementation
- f. 6321 - Computability and Complexity
  (1) Can be counted only if 6341 was used for qualification process
g. 6333 - Distributed Algorithms

Graphics

**Major course requirements** (10 credit hours)

*Required:*
- a. 5542 - Real-time Rendering
- b. 5543 - Geometric Modeling
- c. 5545 - Advanced Computer Graphics

*Electives:* Choose from the following
- a. 5544 - Introduction to Data Visualization
- b. 5559 - Intermediate Studies in Computer Graphics
- c. 5912 - Game Design Capstone
- d. 5913 - Computer Animation Capstone

**Minor course requirements** (6 credit hours)

*Required:*
- a. 5542 - Real-time Rendering

*Electives:* Choose from the following
- a. 5541 - Computer Game and Animation Techniques
- b. 5543 - Geometric Modeling
- c. 5544 - Introduction to Data Visualization
- d. 5559 - Intermediate Studies in Computer Graphics
- e. 5912 - Game Design Capstone
- f. 5913 - Computer Animation Capstone

Theory and Algorithms

**Group 1:**
- CSE 6321 - Computability and Complexity (if not used for qualification process)
- CSE 6332 - Advanced Algorithms
- CSE 6333 - Intro to Distributed Computing
- CSE 5543 - Geometric Modelling
- CSE 5539 - Computational Geometry/Randomized algorithms and other courses offered by theory faculty
- CSE 5351 - Introduction to Cryptography

**Group 2:**
- Math 4547, 4548 (547, 548, 549) Analysis
- Math 4575 (575) Combinatorial Mathematics and Graph Theory
- Math 4578 (578) Discrete Mathematical Models
- Math 5051 (648, 649) Mathematical Logic
- Math 5801 (655, 656, 657) Topology
- Math (674) Survey of Combinatorial Mathematics
- Math 6501, 6502 (775, 776, 777) Combinatorics and Graph Theory
- Math 6251, 6252 (722, 723, 724) Probability
- ISE (702) Mathematical Programming: Linear
- ISE 5200 (720) Linear Optimization
- Stat 6201 (520, 521) Mathematical Statistics

**Major course requirements** (10 credit hours)
At least 2 courses from group 1, one of which must not be numbered 5xy9.
**Minor course requirements** (6 credit hours)
At least one course from group 1, not numbered 5xy9.

**Software Systems**

**Major course requirements** (10 credit hours)

*Required:*
- a. One of:
  - (1) 5242 – Advanced Database Management System
  - (2) 5243 - Introduction to Data Mining
- b. One of:
  - (1) 6333 – Distributed Algorithms
  - (2) 6431 – Advanced Operating Systems (if not used for the qualifying process)

*Electives*: Choose from the following
- a. 5241 - Introduction to Database Systems
- b. 5243 - Introduction to Data Mining
- c. 5245 - Introduction to Network Science
- d. 5249 - Intermediate Studies in Databases
- e. 5343 - Compiler Design and Implementation
- f. 5433 - Operating Systems Laboratory
- g. 5439 - Intermediate Studies in Operating Systems
- h. 5449 - Intermediate Studies in Parallel Computing
- i. 5915 - Capstone Design: Information Systems
- j. 6431 – Advanced Operating Systems (if not used for qualification process)

**Minor course requirements** (6 credit hours)

**DATABASE Track** ➔

*Required*: One or both of:
- a. 5242 - Advanced Database Management System
- b. 5243 - Introduction to Data Mining

*Electives*: Choose from the following
- a. 5241 - Introduction to Database Systems
- b. 5245 - Introduction to Network Science
- c. 5249 - Intermediate Studies in Databases
- d. 5915 - Capstone Design: Information Systems
- e. 6249 - Advanced Studies in Databases

**DISTRIBUTED COMPUTING Track** ➔

*Required*: None

*Electives*: Choose from the following
- a. 6333 - Distributed Algorithms
- b. 6431 - Advanced Operating Systems (if not used for qualification process)
- c. 5433 - Operating Systems Laboratory
- d. 5439 - Intermediate Studies in Operating Systems
- e. 5449 - Intermediate Studies in Parallel Computing
- f. 6439 - Advanced Studies in Operating Systems
Artificial Intelligence:

**Major course requirements** (10 credit hours)

*Required:*
- a. 5522 - Survey of Artificial Intelligence II: Advanced Techniques
- b. One of:
  - (1) 5523 - Machine Learning and Statistical Pattern Recognition
  - (2) 5526 - Introduction to Neural Networks

*Electives: *Choose from the following
- a. 5524 - Computer Vision for Human-Computer Interaction
- b. 5525 - Foundations of Speech and Language Processing
- c. Including up to one 5539 - Intermediate Studies in Artificial Intelligence

**Minor course requirements** (6 credit hours)

*Required:*
- a. One of:
  - (1) 5521 - Survey of Artificial Intelligence I: Basic Techniques
  - (2) 5522 - Survey of Artificial Intelligence II: Advanced Techniques

*Electives:* Choose from any other graded AI courses including up to one 5539