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:**
- 5542 - Real-time Rendering
- 5543 - Geometric Modeling
- 5545 - Advanced Computer Graphics

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

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

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

**Electives:** Choose from the following
- 5541 - Computer Game and Animation Techniques
- 5543 - Geometric Modeling
- 5544 - Introduction to Data Visualization
- 5559 - Intermediate Studies in Computer Graphics
- 5912 - Game Design Capstone
- 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. One of:
  1. 5522 - Survey of Artificial Intelligence II: Advanced Techniques
  2. 6521 – Artificial Intelligence
- 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
  3. 6521 – Artificial Intelligence

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