Annex (PhD) - List of Modules in Clusters

1. Algorithm and Theory: Algorithms, Theory
   - CS4231 Parallel and Distributed Algorithms
   - CS4232 Theory of Computation
   - CS5206 Foundation in Algorithms
   - CS5215 Constraint Programming
   - CS5230 Computational Complexity
   - CS5234 Combinatorial and Graph Algorithms
   - CS5235 Approximation Algorithms
   - CS5236 Advanced Automata Theory
   - CS5237 Computational Geometry and Applications
   - CS5330 Randomized Algorithms
   - CS6209 Topics in Cryptography
   - CS6234 Advanced Algorithms

   - CS4222 Wireless Computing & Sensor Networks
   - CS4223 Multi-core Architectures
   - CS4231 Parallel and Distributed Algorithms
   - CS4236 Cryptography Theory and Practice
   - CS4238 Computer Security Practice
   - CS4274 Mobile and Multimedia Networking
   - CS5222 Advanced Computer Architecture
   - CS5223 Distributed Systems
   - CS5229 Advanced Computer Networks
   - CS5231 Systems Security
   - CS5233 Simulation and Modelling Techniques
   - CS5248 Systems Support for Continuous Media
   - CS5321 Network Security
   - CS5331 Web Security
   - CS6204 Advanced Topics in Networking
   - CS6205 Advanced Modelling & Simulation
   - CS6209 Topics in Cryptography
   - CS6213 Topics in Distributed Computing
   - CS6230 Topics in Information Security
   - CS6231 Topics in System Security
   - CS6270 Virtual Machines

3. Knowledge Systems: Artificial Intelligence, Computational Biology, Database
   - CS4220 Knowledge Discovery Methods in Bioinformatics
   - CS4221 Database Design
   - CS4224 Distributed Databases
   - CS4225 Massive Data Processing Techniques in Data Science
   - CS4244 Knowledge-Based Systems
   - CS4246 AI Planning and Decision Making
   - CS4248 Natural Language Processing
   - CS5215 Constraint Programming
• CS5226 Database Tuning
• CS5228 Knowledge Discovery and Data Mining
• CS5233 Simulation and Modelling Techniques
• CS5238 Advanced Combinatorial Methods in Bioinformatics
• CS5246 Text Processing on the Web
• CS5340 Uncertainty Modelling in AI
• CS6203 Advanced Topics in Database Systems
• CS6207 Advanced Natural Language Processing
• CS6208 Advanced Topics in Artificial Intelligence
• CS6220 Advanced Topics in Data Mining
• CS6221 Modeling and Analysis Techniques in Systems Biology
• CS6222 Topics in Computational Biology


• CS4241 Multimedia Information Retrieval
• CS4242 Social Media Computing
• CS4243 Computer Vision and Pattern Recognition
• CS4247 Graphics Rendering Techniques
• CS4248 Natural Language Processing
• CS4249 Phenomena and Theories of Human-Computer Interaction
• CS4347 Sound and Music Computing
• CS5237 Computational Geometry and Applications
• CS5240 Theoretical Foundations in Multimedia
• CS5241 Speech Processing
• CS5246 Text Processing on the Web
• CS5248 Systems Support for Continuous Media
• CS5249 Audio In Multimedia Systems
• CS6243 Computational Photography
• CS5242 Multimedia Computing and Applications
• CS5243 Advanced Computer Animation
• CS6206 Advanced Topics in Human-Computer Interaction
• CS6207 Advanced Natural Language Processing
• CS6212 Topics in Media
• CS6240 Multimedia Analysis
• CS6241 Advanced Topics in Computer Graphics
• CS6242 Digital Libraries

5. Programming Language and Software Engineering

• CS4211 Formal Methods for Software Engineering
• CS4212 Compiler Design
• CS4215 Programming Language Implementation
• CS4218 Software Testing and Debugging
• CS4271 Critical Systems and their Verification
• CS5214 Design of Optimising Compilers
• CS5215 Constraint Programming
• CS5218 Principles of Program Analysis
• CS5219 Automated Software Validation
• CS5232 Formal Specification and Design Techniques
• CS5272 Embedded Software Design

Updated Nov 2014
1. Ph.D. candidates who have completed CS4235 *Computational Geometry* may count CS4235 towards the *Algorithm and Theory* cluster.

2. Ph.D. candidates who have completed CS4217 *Software Development Technologies*, CS5239 *Computer System Performance Analysis*, CS5270 *Verification of Real Time Systems*, CS5271 *Performance Analysis of Embedded Systems*, and CS5322 *Database Security* may count these modules towards the *Computer Systems* cluster.

3. Ph.D. candidates who have completed CS5220 *Databases and The Web*, CS5225 *Parallel & Distributed Database Systems*, CS5235 *Approximation Algorithms*, CS5247 *Motion Planning and Applications*, and CS5322 *Database Security* may count these modules towards the *Knowledge Systems* cluster.

4. Ph.D. candidates who have completed CS4235 *Computational Geometry*, CS4342 *3D Modelling and Animation*, and CS5341 *Computational Photography* may count these modules towards the *Media Technology* Cluster.

5. Ph.D. candidates who have completed modules in this cluster before Semester 2 of AY2014/15 may count these modules towards the *Programming Language and Software Engineering* cluster instead of the *Computer Systems* cluster.