

Master of Science Program in Computational Science and Engineering (CSE SM)

The CSE SM program is designed with a common core that serves science and engineering disciplines, and an elective component that focuses on particular applications. Students must complete coursework distributed as described below (F = course offered fall semester; S = course offered spring semester). Please consult the MIT Subject Listing (<http://student.mit.edu/catalog/index.cgi>) for subject descriptions, schedules, and additional details.

Core Subjects (3 courses / 36 units)*

Students are required to take three of four core subjects designed to provide foundation materials needed for the study of more advanced elective topics. The core subjects are chosen from the following:

- **2.096[J] / 6.7300 [J] / 16.910[J]** Introduction to Numerical Simulation (F; formerly 6.336)
- **2.097[J] / 6.7330[J] / 16.920[J]** Numerical Methods for Partial Differential Equations (F; formerly 6.339)
- **6.7200[J] / 15.093[J]** Optimization Methods (F; formerly 6.255)
- **6.7310 [J] / 18.335[J]** Introduction to Numerical Methods (S; formerly 6.337)

Restricted Electives (2 courses / 24 units)*†

Students choose two graduate level restricted electives (REs) from the following list of specialized subjects that have computational themes and related components, and that are aligned with the program's educational mission:

- **1.125** Architecting & Engineering Software Systems (F)
- **1.545** Atomistic Modeling & Simulations of Materials & Structures (F)
- **1.583** Topology Optimization of Structures (F)
- **1.723** Computational Methods for Flow in Porous Media (F)
- **2.096[J] / 6.7300 [J] / 16.910[J]** Introduction to Numerical Simulation (F; formerly 6.336)
- **2.097[J] / 6.7330[J] / 16.920[J]** Numerical Methods for Partial Differential Equations (F; formerly 6.339)
- **2.098** Introduction to Finite Element Methods for Partial Differential Equations (S)
- **2.111[J] / 6.6410[J] / 8.370[J] / 18.435[J]** Quantum Computation (F)
- **2.168** Learning Machines (S)
- **2.29** Numerical Fluid Mechanics (S)
- **3.320** Atomistic Computer Modeling of Materials (F)
- **4.450[J] / 1.575[J]** Computational Structural Design and Optimization (F)
- **4.453** Creative Machine Learning for Design (S)
- **6.3732[J] / IDS.131[J]** Statistics, Computation and Applications (S; formerly 6.439)
- **6.7200[J] / 15.093[J]** Optimization Methods (F; formerly 6.255)
- **6.7210[J] / 15.081[J]** Introduction to Mathematical Programming (F; formerly 6.251[J])
- **6.7220[J] / 15.084[J]** Nonlinear Optimization (S; formerly 6.252[J])
- **6.7230** Algebraic Techniques and Semidefinite Optimization (S; formerly 6.256)
- **6.7250** Optimization for Machine Learning (S; taught under 6.881 in Spring '21)
- **6.7310 [J] / 18.335[J]** Introduction to Numerical Methods (S; formerly 6.337)
- **6.7720 / 15.070[J]** Discrete Probability and Stochastic Processes (S; formerly 6.265[J])
- **6.7810** Algorithms for Inference (F; formerly 6.438)
- **6.7830** Bayesian Modeling and Inference (S; formerly 6.435)
- **6.7900** Machine Learning (F; formerly 6.867)
- **6.7910[J] / 9.520[J]** Statistical Learning Theory and Applications (F; formerly 6.860)
- **6.7940** Dynamic Programming and Reinforcement Learning (S; formerly 6.231)
- **6.8300** Advances in Computer Vision (S; formerly 6.869)
- **6.8410** Shape Analysis (S; formerly 6.838)
- **9.660** Computational Cognitive Science (F)
- **10.551** Systems Engineering (S)

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Restricted Electives Cont. (2 courses / 24 units)*†

- 10.552 Modern Control Design (F)
- 10.554 [J] / 2.884 [J] Process Data Analytics (F)
- 10.557 Mixed-integer and Nonconvex Optimization (S)
- 10.637[J] / 5.698[J] Computational Chemistry (F; formerly Quantum Chemical Simulation)
- 12.515 Data and Models (S)
- 12.521 Computational Geophysical Modeling (F)
- 12.620[J] / 6.5160[J] / 8.351[J] Classical Mechanics: A Computational Approach (F)
- 12.714 Computational Data Analysis (S)
- 12.805 Data Analysis in Physical Oceanography (F)
- 12.850 Computational Ocean Modeling (S)
- 15.077[J] / IDS.147[J] Statistical Machine Learning and Data Science (S; *Cannot be used if taken Fall 2015 or later & credit also received for 6.867/6.7900*)
- 15.083 Integer Programming and Combinatorial Optimization (S)
- 15.764[J] / 1.271[J] / IDS.250[J] Theory of Operations Management (S)
- 16.110 Flight Vehicle Aerodynamics (F)
- 16.225[J] / 2.099[J] Computational Mechanics of Materials (S)
- 16.413[J] / 6.4132[J] Principles of Autonomy and Decision Making (F)
- 16.888[J] / IDS.338[J] / EM.428[J] Multidisciplinary Design Optimization (S)
- 16.930 Advanced Topics in Numerical Methods for Partial Differential Equations (S)
- 16.940 Numerical Methods for Stochastic Modeling & Inference (F)
- 18.336[J] / 6.7340[J] Fast Methods for Partial Differential and Integral Equations (F; formerly 6.335[J])
- 18.337[J] / 6.7320[J] Parallel Computing & Scientific Machine Learning (S; formerly 6.338[J])
- 18.338 Eigenvalues of Random Matrices (F)
- 18.369 Mathematical Methods in Nanophotonics (S)
- 22.15 Essential Numerical Methods (S; first ½ of term)
- 22.212 Nuclear Reactor Analysis II (S)
- 22.213 Nuclear Reactor Physics III (F)
- 22.315 Applied Computational Fluid Dynamics and Heat Transfer (S)

Unrestricted Elective (1 course / 12 units)*

Students may choose any **graduate-level 12-unit subject** to satisfy the unrestricted elective (UE) component.

**Courses that can be repeated for credit cannot be used to satisfy multiple CSE SM requirements.*

Thesis (36 units)

Concurrent with coursework, students conduct thesis research leading to the writing of a master's thesis under the supervision of a faculty advisor. Students must register for thesis research credit (CSE.THG or CDO.THG) each term they are conducting thesis research as well as the term immediately prior to graduating, e.g. IAP for February degree list and summer term for September degree list. Thesis research progress will be assessed on a continuing basis with students receiving either a 'J' / 'satisfactory' or 'U' / 'unsatisfactory' at the end of each term. Upon completion of the final thesis students will receive a traditional letter grade; this letter grade will appear by itself in the term the thesis was completed and next to the J or U in prior terms (e.g. J/A).

English Language Proficiency

All incoming CSE SM students are required to take the MIT Graduate Writing Exam (GWE). **Students who do not receive a score of 75 or higher are required to take 21W.794 Graduate Technical Writing Workshop.** Students may choose to take the workshop with P/D/F grading (rather than an A-F letter grade), however they must receive a P grade.

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Academic Performance

CSE SM students are expected to maintain a cumulative grade point average (GPA) of at least 4.5 out of 5.0. If a student's term GPA is at or below 4.0 for two sequential terms, if an unsatisfactory grade ('U') is given for thesis research, or if a grade of C or lower is given in any subject, a warning from the CCSE directors will be issued to the student. All situations are handled on a case-by-case basis, and additional action(s), including a Vice Chancellor's warning up to denial of further registration, may be taken if necessary.

†Previously Approved REs No Longer Included

- 1.204 Computer Modeling: From Human Mobility to Transportation Networks (no longer offered)
- 1.124[J] / 2.091[J] Software and Computation for Simulation (no longer offered)
- 2.089[J] / 1.128[J] Computational Geometry (no longer offered)
- 2.092 / 2.093 Finite Element Analysis of Solids and Fluids I (no longer offered)
- 2.094 Finite Element Analysis of Solids and Fluids II (no longer offered)
- 2.37 Fundamentals of Nanoengineering (cannot be used if taken Spring 2020 or later)
- 6.482 Modeling with Machine Learning: from Algorithms to Applications (no longer offered)
- 6.673 Introduction to Numerical Simulation in Electrical Engineering (no longer offered)
- 6.581[J] / 20.482[J] Foundations of Algorithms and Computational Techniques in Systems Biology (no longer offered)
- 6.864 Advanced Natural Language Processing
- 6.XXX* Optimization for Machine Learning (*Spring 2021: 6.881 until permanent # assigned; Instructor: Suvrit Sra)
- 10.34 Numerical Methods in Chemical Engineering (cannot be used if taken Fall 2019 or later)
- 15.062[J] / IDS.145[J] Data Mining: Finding the Data and Models that Create Value (cannot be used if taken Fall 2019 or later)
- 15.074 Predictive Data Analytics and Statistical Modeling (no longer offered)
- 15.082 Network Optimization (no longer offered)
- 18.0851 Computational Science and Engineering I (cannot be used if taken Fall 2018 or later)
- 18.0861 Computational Science and Engineering II (cannot be used if taken Fall 2018 or later)
- 22.107 Computational Nuclear Science and Engineering (no longer offered)