## COMPUTATIONAL SCIENCE & ENGINEERING MINOR

*for the Minor in Computational Science & Engineering*

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Core Courses</strong></td>
<td></td>
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<tr>
<td></td>
<td><strong>Programming</strong></td>
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</tr>
<tr>
<td>CS 101</td>
<td>Intro Computing: Engrg &amp; Sci</td>
<td>3</td>
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<tr>
<td>CS 125</td>
<td>Introduction to Computer Science</td>
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</tr>
<tr>
<td>CS 225</td>
<td>Data Structures</td>
<td>4</td>
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<tr>
<td>ECE 220</td>
<td>Computer Systems &amp; Programming</td>
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<tr>
<td>LING 402</td>
<td>Tools &amp; Tech Spch &amp; Lang Proc</td>
<td>3</td>
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<tr>
<td></td>
<td><strong>Applied Math</strong></td>
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</tr>
<tr>
<td>ECE 493</td>
<td>Advanced Engineering Math</td>
<td>3 or 4</td>
</tr>
<tr>
<td>MATH 441</td>
<td>Differential Equations</td>
<td>3 or 4</td>
</tr>
<tr>
<td>or MATH 442</td>
<td>Intro Partial Diff Equations</td>
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</tr>
<tr>
<td>or MATH 489</td>
<td>Dynamics &amp; Differential Eqns</td>
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<tr>
<td>MATH 415</td>
<td>Applied Linear Algebra</td>
<td>3 or 4</td>
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<tr>
<td>MATH 444</td>
<td>Elementary Real Analysis</td>
<td>3 or 4</td>
</tr>
<tr>
<td>or MATH 447</td>
<td>Real Variables</td>
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<tr>
<td>MATH 446</td>
<td>Applied Complex Variables</td>
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<tr>
<td>or MATH 448</td>
<td>Complex Variables</td>
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<tr>
<td>MATH 482</td>
<td>Linear Programming</td>
<td>3 or 4</td>
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<tr>
<td>or MATH 484</td>
<td>Nonlinear Programming</td>
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<tr>
<td>STAT 408</td>
<td>Actuarial Statistics I</td>
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<tr>
<td>or STAT 409</td>
<td>Actuarial Statistics II</td>
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<tr>
<td>or STAT 410</td>
<td>Statistics and Probability II</td>
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</tr>
<tr>
<td>or STAT 420</td>
<td>Methods of Applied Statistics</td>
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<tr>
<td>or STAT 430</td>
<td>Topics in Applied Statistics</td>
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<tr>
<td>or MATH 461</td>
<td>Probability Theory</td>
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<tr>
<td></td>
<td><strong>Computational Methods</strong></td>
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<tr>
<td>CS 411</td>
<td>Database Systems</td>
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<tr>
<td>CS 450</td>
<td>Numerical Analysis</td>
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<tr>
<td>or CSE 401</td>
<td>Numerical Analysis</td>
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<tr>
<td>CS 466</td>
<td>Introduction to Bioinformatics</td>
<td>3 or 4</td>
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<tr>
<td>ECE 448</td>
<td>Artificial Intelligence</td>
<td>3 or 4</td>
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<tr>
<td>GEOG 489</td>
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<tr>
<td>LING 402</td>
<td>Tools &amp; Tech Spch &amp; Lang Proc</td>
<td>3</td>
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<tr>
<td>STAT 440</td>
<td>Statistical Data Management</td>
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<tr>
<td>TAM 470</td>
<td>Computational Mechanics</td>
<td>3 or 4</td>
</tr>
<tr>
<td>or CSE 450</td>
<td>Computational Mechanics</td>
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<tr>
<td></td>
<td><strong>Application Coursework/Computing Elective</strong></td>
<td>9</td>
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<tr>
<td></td>
<td><strong>OPTION 1</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three 400-level CSE courses; see list below:</td>
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<tr>
<td></td>
<td><strong>Core Courses:</strong></td>
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<tr>
<td>CSE 401</td>
<td>Numerical Analysis</td>
<td>3 or 4</td>
</tr>
<tr>
<td>CSE 402</td>
<td>Parallel Progrmg: Sci &amp; Engrg</td>
<td>3 or 4</td>
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<tr>
<td>CSE 408</td>
<td>Applied Parallel Programming</td>
<td>4</td>
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<tr>
<td>CSE 510</td>
<td>Numerical Methods for PDEs</td>
<td>4</td>
</tr>
<tr>
<td>CSE 527</td>
<td>Scientific Visualization</td>
<td>4</td>
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</table>

Computing Electives. Courses below are topically organized and are cross listed with many departments. Double counting from Core courses and application courses is not allowed. Choose Option 1 or Option 2 below.

Information listed in this catalog is current as of 09/2022
## Option 1

### Biological, Chemical and Atmospheric Sciences:
- **CHEM 576**  
  Computational Chemical Biology  
  4
- **CS 466**  
  Introduction to Bioinformatics  
  3 or 4
- **CEE 534**  
  Surface Water Quality Modeling  
  4
- **CEE 557**  
  Groundwater Modeling  
  4
- **CSE 566**  
  Numerical Fluid Dynamics  
  4
- **CHEM 550**  
  Advanced Quantum Dynamics  
  4

### Computer Software, Hardware and Graphics
- **CSE 402**  
  Parallel Progrmg: Sci & Engrg  
  3 or 4
- **CSE 422**  
  Computer System Organization  
  3 or 4
- **CSE 423**  
  Operating Systems Design  
  3 or 4
- **CSE 426**  
  Software Engineering I  
  3 or 4
- **CSE 427**  
  Interactive Computer Graphics  
  3 or 4
- **CSE 429**  
  Software Engineering II  
  3 or 4
- **CSE 521**  
  Computer Architecture  
  4
- **CSE 522**  
  Parallel Computer Architecture  
  4
- **CSE 527**  
  Scientific Visualization  
  4

### Electronics and Electromagnetics:
- **CSE 530**  
  Computational Electromagnetics  
  4
- **CSE 532**  
  Numerical Circuit Analysis  
  4

### Fluid Mechanics
- **CSE 450**  
  Computational Mechanics  
  3 or 4
- **CSE 461**  
  Computational Aerodynamics  
  3 or 4
- **CSE 560**  
  Computational Fluid Mechanics  
  4
- **CSE 561**  
  4
- **CSE 566**  
  Numerical Fluid Dynamics  
  4
- **CSE 412**  
  Numerical Thermo-Fluid Mechs  
  2 to 4

### Numerical Computing:
- **CSE 401**  
  Numerical Analysis  
  3 or 4
- **CSE 414**  
  Algorithms  
  4
- **CSE 441**  
  Introduction to Optimization  
  3 or 4
- **CSE 510**  
  Numerical Methods for PDEs  
  4
- **CSE 511**  
  Iterative & Multigrid Methods  
  4
- **CSE 512**  
  Parallel Numerical Algorithms  
  4
- **CSE 513**  
  Topics in Numerical Analysis  
  4
- **CSE 515**  
  Algorithms  
  4
- **CS 598**  
  Special Topics (Integral Equation and Fast Algorithms)  
  2 to 4
- **CSE 517**  
  Adv Finite Element Methods  
  4
- **CSE 553**  
  Computational Inelasticity  
  4

### Other Related Fields:
- **TAM 598**  
  Advanced Special Topics (Uncertainty Quantification)  
  1 to 4
- **CS 598**  
  Special Topics (Integral Equations and Fast Methods)  
  2 to 4
- **CE 528**  
  Construction Data Modeling  
  4
- **ASTR 510**  
  Computational Astrophysics  
  4

### Physics and Materials Science:
- **CSE 485**  
  Atomic Scale Simulations  
  3 or 4
- **MSE 498**  
  Special Topics (Atomic Scale Simulations)  
  1 to 4
- **AE 598**  
  Special Topics (Mult-scale Modeling of Materials)  
  1 to 4

### Power Systems, Control and Signal and Image Processing:
- **CSE 441**  
  Introduction to Optimization  
  3 or 4
- **CSE 543**  
  Topics in Image Processing  
  4

*Information listed in this catalog is current as of 09/2022*
### ECE 513
Vector Space Signal Processing  
4

### ECE 558
Digital Imaging  
4

**Solid Mechanics:**

### CSE 450
Computational Mechanics  
3 or 4

### CSE 451
Finite Element Analysis  
3 or 4

### CSE 517
Adv Finite Element Methods  
4

### CSE 551
Finite Element Methods  
4

### CSE 552
Nonlinear Finite Elements  
4

### ME 570
Nonlinear Solid Mech Design  
4

### TAM 598
Advanced Special Topics (Computational Nonlinear Dynamics)  
1 to 4

**Statistics and Data Sciences:**

### CSE 428
Statistical Computing  
3 or 4

### CSE 440
Statistical Data Management  
3 or 4

### CSE 448
Advanced Data Analysis  
4

### CSE 525
Computational Statistics  
4

### STAT 530
Bioinformatics  
4

### CSE 542
Statistical Learning  
4

### STAT 430
Topics in Applied Statistics (Big Data Analysis Foundation; Basics of Statistical Learning)  
3 or 4

### STAT 432
Basics of Statistical Learning  
3 or 4

### CS 412
Introduction to Data Mining  
3 or 4

### CS 410
Text Information Systems  
3 or 4

**OPTION 2**

Two 400-level CSE courses listed above AND an independent study on a computational topic. In order for an independent study to fulfill the minor requirement, the student must conduct the undergraduate research with one of the CSE affiliated faculty.

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