

# The Arthur E. Imperatore School of Sciences and Arts

## Interdisciplinary Programs: Program in Computational Science

### Supervisory Committee

Elli Angelopoulou, Computer Science  
Kurt Becker, Physics  
Michael Bruno, Ocean Engineering  
Wayne Carr, Physics  
Quynh Dinh, Computer Science  
Robert Gilman, Mathematics  
Sophia Hassiotis, Civil Engineering  
George Kamberov, Computer Science  
Khaldoun Khashanah, Mathematics  
Yi Li, Mathematics  
Marc Mansfield, Chemistry  
Patrick Miller, Mathematics  
John Oliensis, Computer Science  
Nicolai Panikov, Chemical Biology  
Roger Pinkham, Mathematics  
David Vaccari, Environmental Engineering  
Susanne Wetzel, Computer Science  
Rebecca Wright, Computer Science

### UNDERGRADUATE PROGRAMS

Computational Science is an emerging field in which sophisticated computational techniques are used to build models and solve problems related to science and engineering. It complements existing theoretical and experimental approaches and may be thought of as a new mode of scientific inquiry.

At Stevens, undergraduates may study computational science through an interdisciplinary program leading to a Bachelor of Science in Computational Science with a specialization in an area of science or engineering. The current specializations are:

- Computational Biology
- Computational Chemistry
- Computational Mechanics
- Computational Oceanography
- Computational Physics
- Computer Vision and Computer Graphics
- CyberSecurity
- Environmental Systems

The program consists of the science curriculum core courses and technical electives. The technical electives are divided between foundation courses in mathematics and computer science, and application courses in the student's area of specialization. An important part of the program is a project or research problem to be done in the senior year. Each student must

choose one of the application areas listed above prior to preparing their study plan. Each student's study plan reflects his/her interests and aspirations, and is made up by the student, working with a member of the Supervisory Committee. Potential students are encouraged to consult members of this committee for further information.

The following table includes the core courses and typical foundation courses. Application area courses are discussed below. Courses need not be taken in exactly the order listed.

### Freshman Year

		Term I		
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred.		
Ma 115	Calculus I	3	0	3
Ch 115	General Chemistry I	3	0	3
Ch 117	General Chemistry Lab I	0	3	1
CS 115	Intro. to Computer Science	3	2	4
PEP 111	Mechanics	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education I	0	2	1
<b>TOTAL</b>		<b>15</b>	<b>7</b>	<b>18</b>

		Term II		
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred		
Ma 116	Calculus II	3	0	3
Ch 116	General Chemistry II	3	0	3
Ch 118	General Chemistry Lab II	0	3	1
Ch 281	Biology and Biotechnology	3	0	3
PEP 112	Electricity and Magnetism	3	0	3
Hu	Humanities	3	0	3
PE 200	Physical Education II	0	2	1
<b>TOTAL</b>		<b>15</b>	<b>5</b>	<b>17</b>

### Sophomore Year

		Term III		
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred.		
Ma 221	Differential Equations	4	0	4
Ma 134	Discrete Mathematics	3	0	3
Mgt	Economics	3	0	3
PEP 221	Physics Lab I	0	3	1
Hu	Humanities	3	0	3
PE 200	Physical Education III	0	2	1
<b>TOTAL</b>		<b>13</b>	<b>5</b>	<b>15</b>

		Term IV		
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred		
Ma 227	Multivariable Calculus	3	0	3
	Thermodynamics 1	3	0	3

CS 284	Data Structures & Alg. I	3	0	3
PEP 222	Physics Lab II	0	3	1
Hu	Humanities	3	0	3
PE 200	Physical Education IV	0	2	1
<b>TOTAL</b>		<b>12</b>	<b>5</b>	<b>14</b>

**Junior Year**

<b>Term V</b>				
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred.		
Ma 232	Linear Algebra	3	0	3
Ma 346	Numerical Methods	3	0	3
CS 385	Data Structures & Alg. II	3	0	3
TE	Technical Elective	3	0(3)	3(4)
Hu	Humanities	3	0	3
PE 200	Physical Education V	0	2	1
<b>TOTAL</b>		<b>15</b>	<b>2(5)</b>	<b>16(17)</b>

<b>Term VI</b>				
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred		
Ma 222	Probability & Statistics	3	0	3
Ma 525	Intro. to Computational Sci.	3	0	3
PEP 242	Modern Physics	3	0	3
TE	Technical Elective	3	0(3)	3(4)
Hu	Humanities	3	0	3
PE 200	Physical Education VI	0	2	1
<b>TOTAL</b>		<b>15</b>	<b>2(5)</b>	<b>16(17)</b>

**Senior Year**

<b>Term VII</b>				
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred.		
TE	Technical Elective	3	0(3)	3(4)
TE	Technical Elective	3	0(3)	3(4)
E	Elective	3	0	3
Hu	Humanities	3	0	3
<b>TOTAL</b>		<b>12</b>	<b>0(6)</b>	<b>12(14)</b>

<b>Term VIII</b>				
		Hrs. Per Wk.		
		Class	Lab	Sem.
		Cred		
TE	Technical Elective	3	0(3)	3(4)
TE	Technical Elective	3	0(3)	3(4)
E	Elective	3	0	3
Hu	Humanities	3	0	3
<b>TOTAL</b>		<b>12</b>	<b>0(6)</b>	<b>12(14)</b>

## **Application Areas**

Application areas correspond to the research interests of the faculty associated with the program and are subject to change. Sample selections of application courses are given below. In addition, Ma 441 Introduction to Mathematical Analysis and Ma 442 Real Variables are strongly recommended for students considering graduate school in any field. Note that 600-level courses require special permission. For further information about an application area, consult the faculty advisor for that area.

### **Computational Biology (Professor Panikov)**

Ch 241 Organic Chemistry I  
Ch 242 Organic Chemistry II  
Ch 498 Senior Chemical/Biological Research I  
Ch 580 Biochemistry I

one of the following:

- Ch 499 Senior Chemical/Biological Research II
- Ch 678 Computational Microbiology
- Ch 681 Biochemistry II

### **Computational Chemistry (Professor Mansfield)**

Ch 241 Organic Chemistry I  
Ch 322 Theoretical Chemistry  
Ch 421 Chemical Dynamics  
Ch 498 Chemical Research I  
Ch 499 Chemical Research II

### **Computational Mechanics (Professor Hassiotis)**

E 126 Mechanics of Solids  
CE 345 Modeling and Simulation  
CE 373 Structural Analysis  
Ma 498 Senior Research Project I

one of the following:

- CE 613 Matrix Analysis of Structures
- CE 623 Structural Dynamics
- CE 681 Introduction to Finite Element Methods

### **Computational Oceanography (Professor Bruno)**

E 126 Mechanics of Solids  
CE 342 Fluid Mechanics  
OE 526 Computer-Aided Naval Architecture  
OE 648 Numerical Hydrodynamics  
Ma 498 Mathematical Research I

### **Computational Physics (Professors Becker and Carr)**

PEP 497 SKIL V  
PEP 498 SKIL VI  
PEP 538 Introduction to Mechanics  
PEP 542 Electromagnetism

one of the following:

- PEP 520 Computational Physics
- PEP 575 Fundamentals of Atmospheric Radiation and Climate

**Computer Vision and Computer Graphics (Professors Angelopoulou, Dinh, Kamberov and Oliensis)**

- CS 437 Interactive Computer Graphics
- CS 498 Computer Science Research I
- CS 499 Computer Science Research II
- CS 558 Computer Vision
- CS 638 Interactive Computer Graphics II

**CyberSecurity (Professors Wetzel and Wright)**

- CS 335 Computational Structures
- CS 498 Computer Science Research I
- CS 499 Computer Science Research II
- CS 668 Foundations of Cryptography
- CS 693 Cryptographic Protocols

**Environmental Systems (Professor Vaccari)**

- EN 345 Modeling and Simulation
- EN 375 Environmental Systems
- EN 541 Fate and Transport of Environmental Contaminants
- Ma 498 Mathematical Research I

one of the following:

- Ma 499 Mathematical Research II
- EN 571 Physiochemical Processes for Environmental Control