

# COMPUTER SYSTEMS ENGINEERING

Computer Systems Engineering is an interdisciplinary program between the Computer Science Department and the Electrical Engineering Department. It is a School of Engineering major that leads to a Bachelor of Science in Engineering degree. The program is targeted for undergraduates with an interest in implementation and application of computers and computer-based systems. Through course work and laboratory experiences, students obtain a strong foundation in the basics of both Computer Science and Electrical Engineering. From there, students specialize in either Digital Systems, Networking, or Robotics and Mechatronics. A senior project caps the program and provides a special hands-on experience.

## UNDERGRADUATE RESEARCH OPPORTUNITIES

### **CURIS (Undergraduate Research in Computer Science)**

Each summer undergraduates work with CS faculty through the summer research college. Interested students apply for positions during the winter quarter; CURIS decisions are made and offers sent out before spring quarter begins. These positions are fully-funded and provide invaluable experience in cutting-edge research. All CS and CSE students are notified via email of CURIS opportunities and the application process.

### **Research Opportunities for Computer Science/Computer Systems Engineering Undergraduates**

At the beginning of each academic year CS faculty are asked to provide a list of ongoing research projects that are appropriate for undergraduate involvement. Descriptions of the projects are listed at <http://curis.stanford.edu/research.html> (don't let the 'curis' fool you; this is not the web site for the summer CURIS program).

### **Research Tour/Lunch Series**

Each year the CS department offers research lab tours and luncheons specifically geared toward undergraduates. These tours allow students to experience first-hand what goes on in a lab, and the luncheons provide an opportunity for students to discuss interests with research faculty. Past tours included the AI Robotics Lab, the IRoom and the Graphics Lab.

## Research Seminars and Talks

At various times throughout the year, the CS department hosts talks and presentations on various research and technology topics. In addition to these one-time events, there are regularly scheduled seminars which are open to undergraduates. Many of these seminars are available as 1 unit, 500-level courses, but enrollment is not required for attendance.

## Pursuing a Research-Oriented Undergraduate Program:

### *Freshman and Sophomore Year*

Students interested in pursuing research should plan to finish the CS core (CS 103, 106, 107, 109, 110 and 161) by the end of the sophomore year. If you already have an idea of the area in CS you'd like to pursue, you may find these course suggestions useful:

<b>If you're considering...</b>	<b>...make sure to take these freshman/sophomore year</b>
Possible AI courses	CS 109
Possible graphics courses	Math 51 and/or Math 104
Possible theory courses	CS 109, CS 154 or 161

Students are encouraged to apply for CURIS summer research positions but should be aware they may not yet have the necessary background to explore a research area in depth.

### *Junior Year*

During the junior year students considering research can take one of the following sequences:

<b>Field of Interest</b>	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>
Artificial Intelligence	221	Any 22x	Coursework suggested by CURIS advisor
Databases	145	245	
Graphics	248*	448	
Human-Computer Interaction	147	247	
Systems	144	140	
Theory	157 and 161	256 or 259	

\* Students should take Math 51 before taking CS 248.

Students doing summer research through CURIS should expect to take a course or two spring quarter to prepare them for their research project.

## Senior Year

Students may choose to take CS 294 if they do not have a specific project in mind but wish to contribute to active research.

*Note:* The above are meant to be taken only as suggestions. If you have questions, contact the CS course advisor at [advisor@cs.stanford.edu](mailto:advisor@cs.stanford.edu).

## REQUIREMENTS

Course	Title	Units	Quarter	Year
<b>Mathematics (25 units minimum)</b>				
MATH 41	Calculus	5	A	Fr
MATH 42	Calculus	5	AW	Fr
MATH 51	Linear Alg and Differential Calculus of Several Variables	5	AWS	Fr
MATH 52 or 53	Integral Calc of Several Variables/ Linear Algebra	5	AWS	So
CS 109	Introduction to Probability for Computer Scientists <sup>1</sup>	5	S	So
<b>Science (12 units minimum)</b>				
PHYSICS 41	Mechanics	4	W	Fr
PHYSICS 43	Electricity and Magnetism	4	S	Fr
PHYSICS 45	Light and Heat	4	A	Fr/So
<b>Engineering Fundamentals (13 units minimum)</b>				
ENGR 40	Introductory Electronics	5	AS	So
CS 106B <i>or</i>	Programming Abstractions	5	WS	Fr/So
CS 106X	Programming Abstractions (Accelerated)		AS	Fr/So
Fund. Elective	See list of approved courses earlier in Handbook; may not be 106A, B or X			
<b>Technology in Society (One course, 3-5 units)</b>				
<i>See Figure 3-3 for list of SoE approved courses.</i>				
<b>Writing in the Major (One course)</b>				
<i>CS 181, CS191W, CS194, CS201 and CS294W fulfill the "Writing in the Major" requirement.</i>				
<b>Core (32 units minimum)</b>				
CS 103	Mathematical Foundations of Computing <sup>2</sup>	5	W	Fr/So
CS 107	Computer Organization and Systems <sup>3</sup>	5	AS	So
CS 108 <i>or</i>	Object-Oriented Systems Design	4	AW	So
CS 110	Principles of Computer Systems	5	S	So
EE 108A	Digital Systems I	4	AW	So/Jr
EE 108B	Digital Systems II	3-4	AW	So/Jr
Senior Project	CS 191, 191W, 194, 294 or 294W (see note 4)	3		Sr
Plus two of the following (see note5):				
EE 101A	Circuits I	4	W	So/Jr
EE 101B	Circuits II	4	AS	So/Jr
EE 102A	Signals and Systems I	4	W	So/Jr
EE 102B	Signals and Systems II	4	S	So/Jr

**CHOOSE ONE OF THE FOLLOWING THREE SPECIALIZATIONS:**

<b>Digital Systems Specialization (20 units minimum)</b>				
CS 140 <i>or</i> CS 143	Operating Systems Compilers	4	AW A	Jr/Sr Jr/Sr
EE 109	Digital Systems Design Lab	4	S	So/Jr
EE 271	VLSI Systems	3	A	Jr/Sr
Plus three to four of the following (see note 6)				
CS 140 <i>or</i> 143	(if not counted above)	4	AW/A	Jr/Sr
CS 144	Introduction to Computer Networking	4	A	Jr/Sr
CS 240E	Embedded Wireless Systems	3	Not given 2007-08	Jr/Sr
CS 244	Advanced Topics in Networking	4	W	Jr/Sr
CS 244E	Low-Power Wireless Networking	3	Not given 2008-09	Jr/Sr
EE 273	Digital Systems Engineering	3	W	Jr/Sr
EE 282	Computer Architecture	3	A	Jr/Sr

<b>Networking Specialization (20 units minimum)</b>				
CS 140	Operating Systems	4	AW	Jr/Sr
CS 144	Introduction to Computer Networking	4	A	Jr/Sr
Plus four to five of the following (see note 6)				
CS 240	Advanced Topics in Operating Systems	3	AS	Jr/Sr
CS 240E	Embedded Wireless Systems	3	Not given 2008-09	Jr/Sr
CS 240X	Advanced Operating Systems II	3	Not given 2008-09	Jr/Sr
CS 244	Advanced Topics in Networking	4	W	Jr/Sr
CS 244B	Distributed Systems	3	W	Jr/Sr
CS 244E	Low-Power Wireless Networking	3	Not given 2008-09	Jr/Sr
CS 249A	OOP from a Modeling and Simulation Perspective	3	A	Jr/Sr
CS 249B	Advanced Object-Oriented Programming	3	W	Jr/Sr
EE 179	Introduction to Communication	3	S	Jr/Sr
EE 276	Introduction to Wireless Personal Communications	3	S	Jr/Sr

<b>Robotics and Mechatronics Specialization (19 units minimum)</b>				
CS 205A	Mathematical Methods for Robotics, Vision and Graphics	3	A	So/Jr
CS 223A	Introduction to Robotics	3	W	Jr/Sr
ME 210 or EE 118	Introduction to Mechatronics	4	W	So/Jr
ENGR 105	Feedback Control Design	3	W	So/Jr
Plus two to three of the following (see note 6)				
CS 223B	Introduction to Computer Vision	3	W	Jr/Sr
CS 225A	Experimental Robotics	3	Not given 2008-09	Jr/Sr
CS 225B	Robot Programming Laboratory	4	A	Jr/Sr
CS 277	Experimental Haptics	3	S	Jr/Sr
ENGR 205	Introduction to Control Design Techniques	3	A	Jr/Sr
ENGR 206	Control System Design	4	Not given 2008-09	Jr/Sr
ENGR 207A	Modern Control Design I	3	W	Jr/Sr
ENGR 207B	Modern Control Design II	3	S	Jr/Sr

**Notes:**

1. Students who complete STATS 116, MS&E 120, or CME 106 in *Winter 2008-09 or earlier* may count that course as satisfying the CS109 requirement. These same courses taken in *Spring 2008-09 or later* cannot be used to satisfy the CS109 requirement.
2. Students who have taken either CS 103X or CS 103A, B are considered to have satisfied the CS103 requirement. Students taking CS103A, B may complete the lower number of elective courses in a given specialization (see note 6).
3. The name of CS 107 has changed. The previous CS107 course titled *Programming Paradigms* also fulfills this requirement.
4. CS191 and 191W independent study projects require faculty sponsorship and must be approved, in advance, by the advisor, faculty sponsor, and the CSE senior project advisor (Robert Plummer or Patrick Young). A form bearing these signatures, along with a brief description of the project, should be filed with the department representative in Gates 182 the quarter before work on the project is begun.
5. Students pursuing the **Robotics and Mechatronics** or **Networking** specializations must take EE 102A and 102B.
6. Students who take CS 103A,B may complete the lower number of elective courses in a given specialization (i.e., one less elective than students taking CS 103X or CS 103).

**Note: The online version of the UGHB is considered the definitive and final version of SoE requirements for each major.** Since corrections or updates may have been made after this Handbook went to press in August 2008, download an online CSE program sheet from [ughb.stanford.edu](http://ughb.stanford.edu) to ensure you are using an accurate major plan.

# INSTRUCTIONS FOR DECLARING MAJOR IN ENGINEERING: COMPUTER SYSTEMS ENGINEERING

## 1. Find an Advisor

For details see [http://csmajor /ChoosingAdvisor.shtml](http://csmajor/ChoosingAdvisor.shtml)

Find a CS professor or lecturer who verbally agrees to be your advisor. See <http://csmajor/FacultyList.php> for a list of faculty members. You should meet with him or her in person, either in office hours or by appointment. Write your advisor's name here.

I have spoken to  and he/she has agreed to be my advisor.

## 2. Go to Axess

Print out a copy of your unofficial transcript from Axess (Academics → View Unofficial Transcript). *Please don't staple it.*

**I have an unofficial transcript from this quarter.**

While you're on Axess, be sure to declare there. (Academics → Declare a Major/Minor). CSE majors select "Engineering", as your major and CSE as your field of study (subplan).

**I have declared on Axess.**

## 3. Basic Information

Full Name	First	Middle	Last		
Name you go by:		Birth date:	Month:	Day:	Year:
SUID #		E-mail @stanford.edu			
Major	<input type="radio"/> CS <input type="radio"/> CSE	Expected graduation	<input type="radio"/> 2011 <input type="radio"/> 2010 <input type="radio"/> 2009 <input type="radio"/> 2008 <input type="radio"/> Other:		
Date you came to see the Course Advisor:					

## 4. See the Course Advisor in Gates 160

Bring this form to the Course Advisor's office hours in **Gates 160**. The current quarter's office hours are posted at <http://csmajor/WhoToSee.shtml>.

*NOTE: There are no office hours during finals week, break, or summer quarter. It may take up to a week for a declaration to go through, so please plan accordingly! Juniors should do this before winter quarter.*

**Stanford University ♦ School of Engineering**  
**Computer Systems Engineering – Digital Systems Specialization**  
**2008–2009 Program Sheet**

*Final version of completed and signed program sheet due to the department no later than one month prior to the final quarter of senior year.*

**\*Follow all requirements as stated for the year of the program sheet used.\***

Name: \_\_\_\_\_ SU ID: \_\_\_\_\_  
 Email: \_\_\_\_\_ Local Phone: \_\_\_\_\_  
 Date: \_\_\_\_\_ Date B.S. expected: \_\_\_\_\_

**Mathematics and Science Requirements**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<i>Mathematics (25 units minimum)</i>							
MATH	41	Calculus				5	
MATH	42	Calculus				5	
MATH	51	Calculus				5	
MATH	52 or 53	Calculus				5	
CS	109	Introduction to Probability for Computer Scientists <sup>1</sup>				5	
<i>Mathematics Unit Total (25 units minimum)</i>							

*Science (12 units minimum)*

PHYSICS	41	Mechanics				4	
PHYSICS	43	Electricity and Magnetism				4	
PHYSICS	45	Light and Heat				4	
<i>Science Unit Total (12 units minimum)</i>							
<i>Mathematics and Science Unit Total (37 units minimum)</i>							

**Technology in Society Requirement (1 course required; see UGHB Fig. 3-3 for approved list)**

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**Engineering Fundamentals (13 units minimum)**

CS	106	Programming Abstractions (B or X)				5	
ENGR	40	Introductory Electronics				5	
		Elective ( <i>see UGHB Fig.3-4; 1 course required; may not be CS 106A, B or X</i> )					
<i>Engineering Fundamentals Total (13 units minimum)</i>							

**NOTES**

- \* This form is available as an Excel file at <http://ughb.stanford.edu/>. The printed form must be signed by the departmental
  - \* Read all emails from the Office of Student Affairs; this is the SoE's only method of conveying key information to Eng majors.
  - \* All courses listed on this form must be taken for a letter grade if offered by the instructor.
  - \* Minimum Grade Point Average (GPA) for all courses in Engineering Fundamentals and Computer Systems Engineering Core and Depth (combined) is 2.0.
  - \* Transfer and AP credits in Math, Science, Fundamentals, & TIS must be approved by the SoE Dean's office. Transfer credits in CSE Core and Depth must be approved by the Computer Science undergraduate program representative. Transfer credit information and petitions are available at <http://ughb.stanford.edu/transfer.html>.
  - \* All courses listed on this form must only be included under one category. Delete courses not taken.
- (1) Students who complete STATS 116, MS&E 120, or CME 106 in Winter 2008-09 or earlier may count that course as satisfying the CS 109 requirement. These same courses taken in Spring 2008-09 or later cannot be used to satisfy the CS 109 requirement.

**Computer Systems Engineering (55 units minimum)**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<b>Core (32 units minimum)</b>							
CS	103	Mathematical Foundations of Computing <sup>2</sup>				5	
CS	107	Computer Organization and Systems <sup>3</sup>				5	
CS	108 or 110	Object-Oriented Systems Design, <i>or</i> Principles of Comp Sys				4 or 5	
EE	108A	Digital Systems I				4	
EE	108B	Digital Systems II				3 or 4	
Senior Project		CS191, 191W, 194, 294 or 294W (see notes 4,5)				3	
<b>Plus two of the following (delete courses not taken)</b>							
EE	101A	Circuits I				4	
EE	101B	Circuits II				4	
EE	102A	Signals and Systems I				4	
EE	102B	Signals and Systems II				4	
<i>Computer Systems Engineering Core Total (32 units minimum)</i>							

**Depth (20 units minimum)**

CS	140 or 143	Operating Systems or Compilers				4	
EE	109	Digital Systems Design Lab				4	
EE	271	VLSI Systems				3	
<b>Plus three to four of the following (see note 6; delete courses not taken)</b>							
CS	140 or 143	<i>if not counted above</i>				4	
CS	144	Introduction to Computer Networking				4	
CS	240E	Embedded Wireless Systems				3	
CS	244	Advanced Topics in Networking				4	
CS	244E	Low-Power Wireless Networking				3	
EE	273	Digital Systems Engineering				3	
EE	282	Computer Architecture				3	
<i>Computer Systems Engineering Depth Total (20 units minimum)</i>							

**Computer Systems Engineering Core + Depth Total (53 units minimum)**

**Program Approvals**

**Departmental**

Printed Name: \_\_\_\_\_  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**School of Engineering (signature not required prior to graduation)**

Printed Name: \_\_\_\_\_  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**NOTES (continued from page 1)**

- (2) Students who have taken either CS 103X or CS 103A, B are considered to have satisfied the CS 103 req't. Students taking CS103A/B may complete the lower number of elective courses in a given specialization (see footnote 6).
- (3) The name of CS107 has changed. The previous CS 107 course titled *Programming Paradigms* also fulfills this req't.
- (4) The WIM req't may be met by taking CS 181 for TIS or through the Senior Project course (191W, 194, or 294W only).
- (5) Independent study projects (CS 191 or 191W) require faculty sponsorship and must be approved, in advance, by the advisor, faculty sponsor, and the CSE senior project advisor (Robert Plummer or Patrick Young). A signed approval form, along with a brief description of the proposed project, should be filed with the department representative in Gates 182 the quarter before work on the project is begun.
- (6) Students who take CS 103A, B may complete the lower number of elective courses in a given specialization (i.e., one less elective than students taking CS 103X or CS 103).

**Stanford University ♦ School of Engineering**  
**Computer Systems Engineering – Networking Specialization**  
**2008–2009 Program Sheet**

*Final version of completed and signed program sheet due to the department no later than one month prior to the*

**\*Follow all requirements as stated for the year of the program sheet used.\***

Name: _____	SU ID: _____
Email: _____	Local Phone: _____
Date: _____	Date B.S. expected: _____

**Mathematics and Science Requirements**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<i>Mathematics (25 units minimum)</i>							
MATH	41	Calculus				5	
MATH	42	Calculus				5	
MATH	51	Calculus				5	
MATH	52 or 53	Calculus				5	
CS	109	Introduction to Probability for Computer Scientists <sup>1</sup>				5	
<i>Mathematics Unit Total (25 units minimum)</i>							

*Science (12 units minimum)*

PHYSICS	41	Mechanics				4	
PHYSICS	43	Electricity and Magnetism				4	
PHYSICS	45	Light and Heat				4	
<i>Science Unit Total (12 units minimum)</i>							
<i>Mathematics and Science Unit Total (37 units minimum)</i>							

**Technology in Society Requirement (1 course required; see UGHB Fig. 3-3 for approved list)**

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**Engineering Fundamentals (13 units minimum)**

CS	106	Programming Abstractions (B or X)				5	
ENGR	40	Introductory Electronics				5	
		Elective (see UGHB Fig.3-4; 1 course required; may not be CS 106A, B or X)					
<i>Engineering Fundamentals Total (13 units minimum)</i>							

**NOTES**

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  - \* Read all emails from the Office of Student Affairs; this is the SoE's only method of conveying key information to Eng majors.
  - \* All courses listed on this form must be taken for a letter grade if offered by the instructor.
  - \* Minimum Grade Point Average (GPA) for all courses in Engineering Fundamentals and Computer Systems Engineering Core
  - \* Transfer and AP credits in Math, Science, Fundamentals, & TIS must be approved by the SoE Dean's office. Transfer credits in Computer Systems Engineering Core and Depth must be approved by the Computer Science undergraduate program representative. Transfer credit information and petitions are available at <http://ughb.stanford.edu/transfer.html>.
  - \* All courses listed on this form must only be included under one category. Delete courses not taken.
- (1) Students who complete STATS 116, MS&E 120, or CME 106 in Winter 2008-09 or earlier may count that course as satisfying the CS 109 requirement. These same courses taken in Spring 2008-09 or later cannot be used to satisfy the CS 109 requirement.

program sheet continued on page 2

**Computer Systems Engineering (54 units minimum)**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<i>Core (32 units minimum)</i>							
CS	103	Mathematical Foundations of Computing <sup>2</sup>				5	
CS	107	Computer Organization and Systems <sup>3</sup>				5	
CS	108 or 110	Object-Oriented Systems Design, <i>or</i> Principles of Comp Sys				4 or 5	
EE	102A	Signals and Systems I				4	
EE	102B	Signals and Systems II				4	
EE	108A	Digital Systems I				4	
EE	108B	Digital Systems II				3 or 4	
Senior Project	CS191, 191W, 194, 294 or 294W (see notes 4, 5)					3	
<i>Computer Systems Engineering Core Total (32 units minimum)</i>							

*Depth (20 units minimum)*

CS	140	Operating Systems				4	
CS	144	Introduction to Computer Networking				4	

*Plus four to five of the following (see note 6; delete courses not taken)*

CS	240	Introduction to Computer Vision				3	
CS	240E	Embedded Wireless Systems				3	
CS	240X	Advanced Operating SystemsII				3	
CS	244	Advanced Topics in Networking				4	
CS	244B	Distributed Systems				3	
CS	244E	Low-Power Wireless Networking				3	
CS	249A	OOP from a Modeling and Simulation Perspective				3	
CS	249B	Advanced Object-Oriented Programming				3	
EE	179	Introduction to Communication				3	
EE	276	Introduction to Wireless Personal Communications				3	

*Computer Systems Engineering Depth Total (20 units minimum)*

*Computer Systems Engineering Core + Depth Total (53 units minimum)*

**Program Approvals**

*Departmental*

Printed Name: \_\_\_\_\_  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

*School of Engineering (signature not required prior to graduation)*

Printed Name: \_\_\_\_\_  
Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**NOTES (continued from page 1)**

- (2) Students who have taken either CS 103X or CS 103A, B are considered to have satisfied the CS 103 requirement. Students taking CS103A, B may complete the lower number of elective courses in a given specialization (see footnote 6).
- (3) The name of CS107 has changed. The previous CS 107 course titled *Programming Paradigms* also fulfills this requirement.
- (4) The WIM requirement may be met by taking CS 201 as a Technology in Society course or through the Senior Project course
- (5) Independent study projects (CS 191 or 191W) require faculty sponsorship and must be approved, in advance, by the advisor, faculty sponsor, and the CSE senior project advisor (Robert Plummer or Patrick Young). A signed approval form, along with a brief description of the proposed project, should be filed with the department representative in Gates 182 the quarter before work on the project is begun.
- (6) Students who take CS 103A, B may complete the lower number of elective courses in a given specialization (i.e., one less elective than students taking CS 103X or CS 103).

**Stanford University ♦ School of Engineering**  
**Computer Systems Engineering**  
 Robotics and Mechatronics Specialization  
**2008–2009 Program Sheet**

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**\*Follow all requirements as stated for the year of the program sheet used.\***

Name: \_\_\_\_\_ SU ID: \_\_\_\_\_  
 Email: \_\_\_\_\_ Local Phone: \_\_\_\_\_  
 Date: \_\_\_\_\_ Date B.S. expected: \_\_\_\_\_

**Mathematics and Science Requirements**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<i>Mathematics (25 units minimum)</i>							
MATH	41	Calculus				5	
MATH	42	Calculus				5	
MATH	51	Calculus				5	
MATH	52 or 53	Calculus				5	
CS	109	Introduction to Probability for Computer Scientists <sup>1</sup>				5	
<i>Mathematics Unit Total (25 units minimum)</i>							

*Science (12 units minimum)*

PHYSICS	41	Mechanics				4	
PHYSICS	43	Electricity and Magnetism				4	
PHYSICS	45	Light and Heat				4	
<i>Science Unit Total (12 units minimum)</i>							
<i>Mathematics and Science Unit Total (37 units minimum)</i>							

**Technology in Society Requirement (1 course required; see UGHB Fig. 3-3 for approved list)**

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**Engineering Fundamentals (13 units minimum)**

CS	106	Programming Abstractions (B or X)				5	
ENGR	40	Introductory Electronics				5	
		Elective (see UGHB Fig.3-4; 1 course required; may not be CS 106A, B or X)					
<i>Engineering Fundamentals Total (13 units minimum)</i>							

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- (1) Students who complete STATS 116, MS&E 120, or CME 106 in Winter 2008-09 or earlier may count that course as satisfying the CS 109 requirement. These same courses taken in Spring 2008-09 or later cannot be used to satisfy the CS 109 requirement.

**Computer Systems Engineering (53 units minimum)**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<b>Core (32 units minimum)</b>							
CS	103	Mathematical Foundations of Computing <sup>2</sup>				5	
CS	107	Computer Organization and Systems <sup>3</sup>				5	
CS	108 or 110	Object-Oriented Systems Design, <i>or</i> Principles of Comp Sys				4 or 5	
EE	102A	Signals and Systems I				4	
EE	102B	Signals and Systems II				4	
EE	108A	Digital Systems I				4	
EE	108B	Digital Systems II				3 or 4	
Senior Project		CS191, 191W, 194, 294 or 294W (see notes 4, 5)				3	
<i>Computer Systems Engineering Core Total (32 units minimum)</i>							

**Depth (19 units minimum)**

CS	205A	Mathematical Methods for Robotics, Vision and Graphics				3	
CS	223A	Introduction to Robotics				3	
ME	210	Introduction to Mechatronics (or EE 118)				4	
ENGR	105	Feedback Control Design				3	

**Plus two to three of the following (see note 6; delete courses not taken from form)**

AA	278	Optimal Control and Hybrid Systems				3	
CS	223B	Introduction to Computer Vision				3	
CS	225A	Experimental Robotics				3	
CS	225B	Robot Programming Laboratory				4	
CS	277	Experimental Haptics				3	
ENGR	205	Introduction to Control Design Techniques				3	
ENGR	206	Control System Design				4	
ENGR	207A	Modern Control Design I				3	
ENGR	207B	Modern Control Design II				3	

*Computer Systems Engineering Depth Total (19 units minimum)*

**Computer Systems Engineering Core + Depth Total (52 units minimum)**

**Program Approvals**

*Departmental*

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_

**School of Engineering (signature not required prior to graduation)**

Printed Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Signature: \_\_\_\_\_

**NOTES (continued from page 1)**

- (2) Students who have taken either CS 103X or CS 103A, B are considered to have satisfied the CS 103 requirement. Students taking CS103A, B may complete the lower number of elective courses in a given specialization (see footnote 6).
- (3) The name of CS107 has changed. The previous CS 107 course titled *Programming Paradigms* also fulfills this requirement.
- (4) The WIM requirement may be met by taking CS 181 as a Technology in Society course or through the Senior Project course
- (5) Independent study projects (CS 191 or 191W) require faculty sponsorship and must be approved, in advance, by the advisor, faculty sponsor, and the CSE senior project advisor (Robert Plummer or Patrick Young). A signed approval form, along with a brief description of the proposed project, should be filed with the department representative in Gates 182 the quarter before work on the project is begun.
- (6) Students who take CS 103A, B may complete the lower number of elective courses in a given specialization (i.e., one less elective than students taking CS 103X or CS 103).