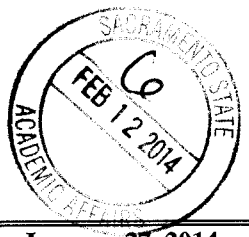
CSCB13-14.002

Faculty Senate Meeting - April 17, 2014
Attachment: FS 13/14-96

SACRAMENTO STATE

Program Proposal
Form B



Academic Group *(College)*: ECS	**Date of Submission to College Dean: January 27, 2014**
Academic Organization *(Department)*: CSC	**Requested Effective: Fall_X__, Spring___, 20_14_.**
Department Chair: Cui Zhang	**Contact if not Department Chair:**
Title of the Program *(Please be specific; indicate minor, undergraduate or graduate degree, etc.)*: B.S. in Computer Science	

Type of Program Proposal:

___X___ Modification in Existing Program:
- **_X_ Substantive Change**
- **___ Non-Substantive Change**
- **_X_ Deletion of Existing Program**

____X___ New Programs
- **___ Initiation (Projection) of New Program on to Master Plan**
- **___ New Degree Programs**
  - **___Regular Process**
  - **___Fast Track Process**
  - **___Pilot Process**
- **___ New Minor, Concentration, Option, Specialization, Emphasis**
- **_X_ New Certificate Program**

PLEASE NOTE:
Form B is to be used only as a Cover Form. Additional information is requested for each of the above as noted in the corresponding procedure in the Policies and Procedures for Initiation, Modification, Review and Approval of Courses and Academic Programs found at:
http://www.csus.edu/acaf/academic_resources/policies_and_procedures/Course_and_Program_Proposals/ApprovalProcess.html

Briefly describe the program proposal (new or change) and provide a justification:

Change 1: The computer science faculty proposes to convert the four existing concentrations to certificates by deleting the concentrations and adding certificates. More specifically, the concentration in Information Assurance and Security (12 units) is deleted and the certificate in Cyber Defense and Operation is added with a change to one of the four required courses to address the need in this specialty area; the concentration in Game Engineering (12 units) is deleted and the certificate in Game Engineering is added with the same requirements; the concentration in Software Engineering (12 units) is deleted and the certificate in Software Engineering is added with the same requirements; and the concentration in Systems Software (12 units) is deleted and the certificate in Systems Software is added with the same requirements. A brief description is provided for each certificate.

As for the existing certificate in Information Assurance and Security (9 units), a brief description is added to be consistent with the four new certificates.

An introduction paragraph is added at the beginning of all five certificates.

Justification: Converting four existing concentrations to certificates with 12 units of required course work ensures the quality of the in-depth studies in these specialty areas, and also helps the BS in Computer Science program comply with the university mandate to reduce the number of units required for an undergraduate degree.

Change 2: The computer science faculty proposes to reduce the number of units for CSC 137 from 4 units to 3 units. (Note: A Form A is also submitted for the CSC 137 revision.)

Justification: This change is guided by (1) the Computer Science Curricula 2013 developed by the ACM/IEEE Computer Society Joint Task Force on Computing Curricula and (2) the common practice in the CSU campuses that the courses equivalent to CSC 137 are offered as either a 3 semester unit course or a 4 quarter unit course. This change also helps the BS in Computer Science program comply with the university mandate to reduce the number of units required for an undergraduate degree.

Change 3: The computer science faculty proposes to delete the certificate in Web Development.

Justification: Due to the very limited resources in the past several years, the department has been unable to offer most of the courses required by this certificate especially the required CSC 12X courses. In reality, no certificates have been granted for several years because of low demand.

Approvals:

Department Chair: Un Zhang **Date:** 2/7/2014

College Dean: [signature] **Date:** 2/7/2014

University Committee: Kael Chalmers **Date:** 3/21/14

Assoc Dean for Undergraduate Studies or Dean for Graduate Studies: [signature] **Date:** 3/24/14

ANALYSIS OF PROGRAM CHANGE PROPOSAL
FOR THE B.S. IN COMPUTER SCIENCE
January 27, 2014

1. **Form B:** Attached.

2. **Programmatic or Fiscal Impact on Other Academic Units' Programs.**

   N/A

3. **Fiscal Analysis of Proposed Changes.**

   a. **How will the proposed changes be accommodated within department/college existing fiscal resources?**

      No additional resources are needed.

   b. **If the proposed changes will require additional resources, describe the level and nature of additional funding the college will seek.**

      N/A.

   c. **What additional space, equipment, operating expenses, library, computer, or media resources, clerical/technical support, or other resources will be needed? Estimate the cost and indicate how these resource needs will be accommodated.**

      N/A.

4. **New/Old Program Requirements**

   See the next page.

Proposed Changes:

The proposed change of converting four existing concentrations to certificates with 12 units of required course work ensures the quality of the in-depth studies in these specialty areas, and helps the BS in Computer Science program comply with the university mandate to reduce the number of units required for an undergraduate degree. The conversion is done by deleting the existing concentrations and adding new certificates.

The proposed change of reducing the number of units for CSC 137 from 4 units to 3 units is guided by (1) the Computer Science Curricula 2013 developed by the ACM/IEEE Computer Society Joint Task Force on Computing Curricula, and (2) the common practice in the CSU campuses that the courses equivalent to CSC 137 are offered as either a 3 semester unit course or a 4 quarter unit course.

This change also helps the BS in Computer Science program comply with the university mandate to reduce the number of units required for an undergraduate degree.(Note: A Form A is also submitted for the CSC 137 revision.)

The proposed change of deleting the existing certificate in Web Development is based on the fact that, due to the very limited resources in the past several years, the department has been unable to offer most of the courses required by this web certificate especially the required CSC 12X courses. In reality, this certificate has not been offered for several years already.

This Form B is to make changes to the program specified by Form B CSCB13-14.001REV approved by the University Curriculum Sub-committee in Fall 2013.

If the proposed changes are approved, the units required for the major will be 81 and the minimum total units required for BS in computer science program will be 123. When the GE Area D unit reduction (3 units) becomes effective in Fall 2014, the minimum total units required for the BS will be 120.

NEW PROGRAM REQUIREMENTS

Units required for Major: 81
Minimum total units required for BS: 123
Grade of "C-" or better required in all courses applied to the Computer Science major.
Note: Students graduating with a Bachelor of Science Computer Science ++++++++++++++++++++ will not be subject to the University's Foreign Language Graduation Requirement. Students who change major may be subject to the University's Foreign Language Graduation Requirement.

Courses in parentheses are prerequisites.

A. Required Lower Division Courses (15 units)

(3)	CSC 15	Programming Concepts and Methodology I (CSC 10 or programming experience in a high-level programming language)
(3)	CSC 20	Programming Concepts and Methodology II (CSC 15)
(3)	CSC 28	Discrete Structures for Computer Science (MATH 26A or MATH 29, and CSC 20; CSC 20 may be taken concurrently)
(3)	CSC 35	Introduction to Computer Architecture (CSC 15)

OLD PROGRAM REQUIREMENTS

Units required for Major: 82-85
Minimum total units required for BS: 124
Grade of "C-" or better required in all courses applied to the Computer Science major.
Note: Students graduating with a Bachelor of Science Computer Science (including all concentrations) will not be subject to the University's Foreign Language Graduation Requirement. Students who change major may be subject to the University's Foreign Language Graduation Requirement.

Courses in parentheses are prerequisites.

A. Required Lower Division Courses (15 units)

(3)	CSC 15	Programming Concepts and Methodology I (CSC 10 or programming experience in a high-level programming language)
(3)	CSC 20	Programming Concepts and Methodology II (CSC 15)
(3)	CSC 28	Discrete Structures for Computer Science (MATH 26A or MATH 29, and CSC 20; CSC 20 may be taken concurrently)
(3)	CSC 35	Introduction to Computer Architecture (CSC 15)

(3)	CSC 60	Introduction to Systems Programming in UNIX (CSC 20, CSC 35)	(3)	CSC 60	Introduction to Systems Programming in UNIX (CSC 20, CSC 35)
B. Required Mathematics and Science Courses (24 units)			**B. Required Mathematics and Science Courses (24 units)**		
(3)	MATH 26A	Calculus I for the Social and Life Sciences (MATH 11)	(3)	MATH 26A	Calculus I for the Social and Life Sciences (MATH 11)
		OR			**OR**
(4)	MATH 30	Calculus I (MATH 29 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test)	(4)	MATH 30	Calculus I (MATH 29 or four years of high school mathematics which includes two years of algebra, one year of geometry, and one year of mathematical analysis; completion of ELM requirement and Pre-Calculus Diagnostic Test)
(3)	MATH 26B	Calculus II for the Social and Life Sciences (MATH 26A)	(3)	MATH 26B	Calculus II for the Social and Life Sciences (MATH 26A)
		OR			**OR**
(4)	MATH 31	Calculus II (MATH 30 or appropriate high school based AP credit)	(4)	MATH 31	Calculus II (MATH 30 or appropriate high school based AP credit)
(4)	STAT 50	Introduction to Probability and Statistics (MATH 26A, MATH 30, or appropriate high school based AP credit)	(4)	STAT 50	Introduction to Probability and Statistics (MATH 26A, MATH 30, or appropriate high school based AP credit)
		OR			**OR**
(2)	ENGR 115	Statistics For Engineers (MATH 31)	(2)	ENGR 115	Statistics For Engineers (MATH 31)
(4)	PHYS 5A	Mechanics, Heat, Sound (MATH 9)	(4)	PHYS 5A	Mechanics, Heat, Sound (MATH 9)
		OR			**OR**
(4)	PHYS 11A	Mechanics General Physics: Mechanics (MATH 30, MATH 31 or equivalent certificated high school courses; MATH 31 may be taken concurrently)	(4)	PHYS 11A	Mechanics General Physics: Mechanics (MATH 30, MATH 31 or equivalent certificated high school courses; MATH 31 may be taken concurrently)
In addition to the above math and science courses (minimum of 14 units), students must choose elective courses to bring the total number of math and science units to a minimum of 24. Eligible courses are:			In addition to the above math and science courses (minimum of 14 units), students must choose elective courses to bring the total number of math and science units to a minimum of 24. Eligible courses are:		
(3-4)	Any MATH or STAT course with calculus as a prerequisite		(3-4)	Any MATH or STAT course with calculus as a prerequisite	
(5)	CHEM 1A	General Chemistry I (High school chemistry and college algebra; sufficient performance on the college algebra diagnostic test, or equivalent, or minimum grade of "C" in CHEM 4)	(5)	CHEM 1A	General Chemistry I (High school chemistry and college algebra; sufficient performance on the college algebra diagnostic test, or equivalent, or minimum grade of "C" in CHEM 4)
(4)	CHEM 1E	General Chemistry for Engineering	(4)	CHEM 1E	General Chemistry for Engineering

		(High school chemistry; Math 30 or eligibility to take MATH 30 as evidenced by the calculus readiness diagnostic exam; passing score on a standardized Chemistry diagnostic exam given prior to each semester, or minimum grade of "C" in CHEM 4)			(High school chemistry; Math 30 or eligibility to take MATH 30 as evidenced by the calculus readiness diagnostic exam; passing score on a standardized Chemistry diagnostic exam given prior to each semester, or minimum grade of "C" in CHEM 4)
(3)	CSC 148	Modeling and Experimental Design (MATH 31, STAT 50, proficiency in a programming language)	(3)	CSC 148	Modeling and Experimental Design (MATH 31, STAT 50, proficiency in a programming language)
(3)	PHIL 160	Symbolic Logic II (MATH 31, PHIL 60, or instructor permission)	(3)	PHIL 160	Symbolic Logic II (MATH 31, PHIL 60, or instructor permission)
(4)	PHYS 5B	Light, Electricity and Magnetism, Modern Physics (PHYS 5A or instructor permission)	(4)	PHYS 5B	Light, Electricity and Magnetism, Modern Physics (PHYS 5A or instructor permission)
(4)	PHYS 11B	General Physics: Heat, Light, Sound (MATH 31, PHYS 11A)	(4)	PHYS 11B	General Physics: Heat, Light, Sound (MATH 31, PHYS 11A)
(4)	PHYS 11C	General Physics: Electricity and Magnetism, Modern Physics (MATH 31, PHYS 11A)	(4)	PHYS 11C	General Physics: Electricity and Magnetism, Modern Physics (MATH 31, PHYS 11A)
(3)	PHYS 106	Introduction to Modern Physics Computing (MATH 31; PHYS 11A, PHYS 11B, PHYS 11C or PHYS 5A, PHYS 5B)	(3)	PHYS 106	Introduction to Modern Physics Computing (MATH 31; PHYS 11A, PHYS 11B, PHYS 11C or PHYS 5A, PHYS 5B)
(3)	PHYS 162	Scientific Computing: Basic Methods (MATH 26A or MATH 30 and PHYS 5A, or MATH 30 and PHYS 11A, or MATH 105A concurrently)	(3)	PHYS 162	Scientific Computing: Basic Methods (MATH 26A or MATH 30 and PHYS 5A, or MATH 30 and PHYS 11A, or MATH 105A concurrently)
(3)	PHYS 163	Scientific Computing: Modeling, Simulation, and Visualization (PHYS 162)	(3)	PHYS 163	Scientific Computing: Modeling, Simulation, and Visualization (PHYS 162)

Note: To satisfy the requirement of CAC, the Computing Accreditation Commission of ABET, which accredits computer science programs, one or more electives must be from MATH, STAT or PHIL (MATH 100 recommended). Courses may not be selected with significantly overlapping topics. Students who select MATH 26A and MATH 26B for their calculus sequence must take STAT 50 and PHYS 5A. MATH 30, MATH 31, PHYS 11A and PHYS 11C are recommended for students considering graduate school or an engineering major. MATH 30, MATH 31 and STAT 50 are recommended for students considering a math or statistics minor. PHYS 5B, 11B, or 11C; and PHYS 162 are recommended for students considering a scientific computing and simulation certificate and willing to take PHYS 163 as an additional course. If CSC 148 is chosen as an elective to meet the math and science requirements, it cannot be used for a computer science

Note: To satisfy the requirement of CAC, the Computing Accreditation Commission of ABET, which accredits computer science programs, one or more electives must be from MATH, STAT or PHIL (MATH 100 recommended). Courses may not be selected with significantly overlapping topics. Students who select MATH 26A and MATH 26B for their calculus sequence must take STAT 50 and PHYS 5A. MATH 30, MATH 31, PHYS 11A and PHYS 11C are recommended for students considering graduate school or an engineering major. MATH 30, MATH 31 and STAT 50 are recommended for students considering a math or statistics minor. PHYS 5B, 11B, or 11C; and PHYS 162 are recommended for students considering a scientific computing and simulation certificate and willing to take PHYS 163 as an additional course. If CSC 148 is chosen as an elective to meet the math and science requirements, it cannot be used for a computer science

elective. An undergraduate handbook with further course selection advice is available at the department website.	elective. An undergraduate handbook with further course selection advice is available at the department website.
C. Required Upper Division Courses (33 units)	**C. Required Upper Division Courses (34 units)**
(3) CSC 130 Data Structures and Algorithm Analysis (CSC 20, CSC 28; CSC 28 may be taken concurrently)	(3) CSC 130 Data Structures and Algorithm Analysis (CSC 20, CSC 28; CSC 28 may be taken concurrently)
(3) CSC 131 Computer Software Engineering (CSC 130; may be taken concurrently)	(3) CSC 131 Computer Software Engineering (CSC 130; may be taken concurrently)
(3) CSC 133 Object-Oriented Computer Graphics Programming (CSC 130, CSC 131)	(3) CSC 133 Object-Oriented Computer Graphics Programming (CSC 130, CSC 131)
(3) CSC 134 Database Management and File Organization (CSC 130)	(3) CSC 134 Database Management and File Organization (CSC 130)
(3) CSC 135 Computing Theory and Programming Languages (CSC 28, CSC 35, CSC 130)	(3) CSC 135 Computing Theory and Programming Languages (CSC 28, CSC 35, CSC 130)
(3) ++ CSC 137 Computer Organization (CSC 28, CSC 35, CSC 130)	++ ~~(4)~~ CSC 137 Computer Organization (CSC 28, CSC 35, CSC 130)
(3) CSC 138 Computer Networks and Internets (CSC 35, CSC 60, CSC 130)	(3) CSC 138 Computer Networks and Internets (CSC 35, CSC 60, CSC 130)
(3) CSC 139 Operating System Principles (CSC 60, CSC 137; or equivalents)	(3) CSC 139 Operating System Principles (CSC 60, CSC 137; or equivalents)
(2) CSC 190 Senior Project: Part I (Senior status; GWAR Certification before Fall 09, or WPJ score of 70+, or at least a C- in ENGL 109M/W; CSC 130, CSC 131, and four additional 3-unit CSC upper division courses that fulfill the major requirements excluding CSC 192-195, CSC 198, CSC 199)	(2) CSC 190 Senior Project: Part I (Senior status; GWAR Certification before Fall 09, or WPJ score of 70+, or at least a C- in ENGL 109M/W; CSC 130, CSC 131, and four additional 3-unit CSC upper division courses that fulfill the major requirements excluding CSC 192-195, CSC 198, CSC 199)
(2) CSC 191 Senior Project: Part II (CSC 190)	(2) CSC 191 Senior Project: Part II (CSC 190)
(3) PHIL 103 Business and Computer Ethics	(3) PHIL 103 Business and Computer Ethics
(2) Select 2 units from the following: CSC 192 Career Planning (1 unit maximum) (CSC 190, may be taken concurrently) CSC 194 Computer Science Seminar (Upper division or graduate standing in CSC) CSC 195 Field Work in Computer Science (Instructor permission) CSC 195A Professional Practice CSC 198 Co-curricular Activities in Computer Science CSC 199 Special Problems	(2) Select 2 units from the following: CSC 192 Career Planning (1 unit maximum) (CSC 190, may be taken concurrently) CSC 194 Computer Science Seminar (Upper division or graduate standing in CSC) CSC 195 Field Work in Computer Science (Instructor permission) CSC 195A Professional Practice CSC 198 Co-curricular Activities in Computer Science CSC 199 Special Problems
D. Electives (9+++ units)	**D. Electives (9 ~~-12~~ units)**
In addition to the required lower-division and upper-division Computer Science courses, Computer Science	In addition to the required lower-division and upper-division Computer Science courses, Computer Science

majors must take additional elective courses, ++++++++++++++++++++++++++++++++++ ++++++++++++++++++++++++++++++ totaling at least nine units, from undergraduate Computer Science courses numbered CSC 140 or above (excluding CSC 192, CSC 194, CSC 195, CSC 195A, CSC 198, CSC 199). Course choices should be made with advisor consultation. With advance written approval from their advisor, the course instructor, and the Department Chair, students with a GPA of 3.0 or greater may take graduate courses as electives. In any case students must meet the prerequisite stated in the catalog prior to taking any elective course. ++++++++++++++++++++++ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++++++++ ~~++++++++++++++++++++~~ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++ ++++++++++++++++++++++++++++++ ++ ++++++++++++++++++++++++ ++++++++++++++++++ ++ ++ ++ +++++++++++++++	majors must take additional elective courses. ~~This requirement can be satisfied in one of two ways:~~ ~~(i) by completing a concentration (described below), or~~ (i) ~~by taking three courses,~~ totaling at least nine units, from undergraduate Computer Science courses numbered CSC 140 or above (excluding CSC 192, CSC 194, CSC 195, CSC 195A, CSC 198, CSC 199 Course choices should be made with advisor consultation. With advance written approval from their advisor, the course instructor, and the Department Chair, students with a GPA of 3.0 or greater may take graduate courses as electives. In any case students must meet the prerequisite stated in the catalog prior to taking any elective course. ~~*Additional Requirements for Concentration*~~ ~~Certain combinations of courses give students a deeper understanding of specialized areas in Computer Science. Completion of any of the following course lists allows the student to receive a notation on their permanent record that they completed a concentration in the particular area of study. Each student can receive only one such notation. The Computer Science Department will try to offer on a regular basis all courses required for each concentration. Course cancellations and scheduling conflicts do sometimes occur, however, causing students difficulty in completing a concentration. In such situations, students may need to forgo completion of their concentration and receive a degree without any concentration notation.~~ ~~**Game Engineering (12 units)**~~ ~~This concentration is intended to give students an opportunity to explore the science and engineering of computer games, and to prepare students for careers in those fields of computing which utilize or are heavily impacted by advances in computer gaming. These include such areas as video and strategy game development, 3-D graphics, modeling and animation and their support tools, intelligent decision making, specialized user interface hardware, machine learning, and working in interdisciplinary teams.~~ ~~(3) CSC 165 Computer Game Architecture and Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)~~ ~~(3) CSC 155 Advanced Computer Graphics (CSC 133)~~ ~~(3) CSC 180 Intelligent Systems (CSC 130, CSC 135, MATH 31, STAT 50)~~

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(CSC 131, CSC 134)

CSC 176 Advanced Database Management Systems (CSC 174)

CSC 177 Data Warehousing and Data Mining (CSC 134, STAT 50)

Systems Software (12 units)

The Systems Software concentration provides necessary background to participate in the development of low-level software for computer hardware and the software infrastructure needed by application developers. Understanding how such software operates makes students valuable additions to interdisciplinary teams where exploiting features of system tools is important. The concentration will also prepare students to design, implement, and be effective users of system tools such as language processors, utilities, and diagnostic tools.

(3) CSC 151 Compiler Construction (CSC 135)

(3) CSC 159 Operating System Pragmatics (CSC 139)

(6) Select two of the following:

CSC 142 Advanced Computer Organization (CSC 137)

CSC 148 Modeling and Experimental Design (MATH 31, STAT 50)

CSC 154 Computer System Attacks and Countermeasures (CSC 138)

CSC 155 Advanced Computer Graphics (CSC 133)

CSC 165 Computer Game Architecture and Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)

Requirements - Certificate - Web Development

Total units required for Certificate: 21 units.

A grade of "C-" or better required in all courses applied to this certificate program.

Courses in parentheses are prerequisites.

(3) Select **one** of the following:

CSC 8 Introduction to Internet Technologies (Basic computer literacy recommended)

CSC 8S Self-Paced Introduction to Internet Technologies (Basic computer literacy recommended)

(3) CSC 22 Visual Programming in BASIC (Intermediate Algebra)

(3) CSC 80 Web Development with HTML/XHTML and Tools (CSC 8, or equivalent computer and Internet

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Academic Certificates

In addition to completing the requirements for the Bachelor of Sciences in Computer Science degree program, students enrolled in the major may also complete one of the (optional) 9-12 unit Academic Certificate programs. Each certificate includes 9 required units which can overlap with elective coursework taken to satisfy major requirements, with some of the certificates requiring 3 additional units (1 additional course) beyond the degree requirements. Students interested in earning a certificate in addition to their degree should meet with an academic advisor.

Requirements for Certificates

Certain combinations of courses give students a deeper understanding of specialized areas in Computer Science. Completion of any of the following course

		~~experience)~~
~~(3)~~	~~CSC 120~~	~~Web Server Administration (CSC 80)~~
~~(3)~~	~~CSC 121~~	~~Client-Side Web Programming (CSC 22, CSC 80 or equivalents; or PCSC/CSC Major, CSC 60, CSC 130)~~
~~(3)~~	~~CSC 122*~~	~~Web Database Applications (CSC 10 or CSC 22; CSC 80, or equivalent)~~
~~(3)~~	~~CSC 123*~~	~~Web Application Development (CSC 22, CSC 121, CSC 122 or equivalent experience or PCSC/CSC Major, CSC 60, CSC 134)~~

~~*With advisor approval an elective course from CSC or Communication Studies (COMS) can be used in place of either CSC 122 or CSC 123, but not both.~~

~~**Requirements for Majors:** CSC 121 and CSC 123 in addition to completing CSC 60, CSC 130, CSC 134, CSC/CPE 138, and CSC 139. Prerequisites for majors taking CSC 121 are CSC 60 and CSC 130; prerequisites for majors taking CSC 123 are CSC 60 and CSC 134 (CSC/CPE 138 and CSC 139 are recommended as prerequisites and required for the final certificate).~~

~~Graduate students who are fully classified in either Computer Science or Software Engineering need only take CSC 121 and CSC 123.~~

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lists entitles the student to receive a certificate indicating that they concentrated their elective study in the particular area. The Computer Science Department will try to offer on a regular basis all courses required for each certificate, but course cancellations and scheduling conflicts do sometimes occur, causing students difficulty in completing their desired course of study. In such situations, students may need to forgo completion of their certificate. Printed certificates must be requested directly from the Computer Science Department office after a student graduates.

Requirements - Certificate - Cyber Defense and Operations (12 units)
Courses in parentheses are prerequisites

The Cyber Defense and Operations certificate includes the same courses as the Information Assurance and Security certificate, but additionally requires advanced study in operating systems. An understanding of operating system pragmatics better prepares students for the technical work needed in defending and hardening networked computer systems. Students will not be awarded the Information Assurance and Security certificate if they complete the requirements for the Cyber Defense and Operations certificate.

(3)	CSC 152	Cryptography (CSC 60, CSC 130, STAT 50)
(3)	CSC 153	Computer Forensics Principles and Practices (CSC 138 or CPE 138)
(3)	CSC 154	Computer System Attacks and Countermeasures (CSC 138 or CPE 138)
(3)	CSC/CPE 159	Operating System Pragmatics (CSC 139)

Requirements - Certificate - Game Engineering (12 units)
Courses in parentheses are prerequisites

This certificate is intended to give students an opportunity to explore the science and engineering of computer games, and to prepare students for careers in those fields of computing which utilize or are heavily impacted by advances in computer gaming. These include such areas as video and strategy game development, 3-D graphics, modeling and animation and their support tools, intelligent decision making, specialized user interface hardware, machine learning, and working in interdisciplinary teams.

(3)	CSC 155	Advanced Computer Graphics (CSC 133)

(3)	CSC 165	Computer Game Architecture and Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)
(3)	CSC 180	Intelligent Systems (CSC 130, CSC 135, MATH 31, STAT 50)
(3)	Select one of the following:	
	CSC 159	Operating System Pragmatics (CSC 139)
	CSC 177	Data Warehousing and Data Mining (CSC 134, STAT 50)
	ART 142	3D Computer Modeling (CSC 10 or ART 97)
	ART 143	3D Computer Animation (ART 142 or CSC 126)

Requirements - Certificate - Information Assurance and Security (9 units)
Courses in parentheses are prerequisites

The Information Assurance and Security certificate is designed to help students advance their technical skills to prepare for a leadership role in planning, managing, certifying and accrediting a security and incident response plan for their organization - including methods to combat threats to organization information resources, which in today's world is becoming a top priority for many businesses since most information is in electronic form.

(3)	CSC 152	Cryptography (CSC 60, CSC 130, STAT 50)
(3)	CSC 153	Computer Forensics Principles and Practices (CSC 138)
(3)	CSC 154	Computer System Attacks and Countermeasures (CSC 138)

Requirements - Certificate - Software Engineering (12 units)
Courses in parentheses are prerequisites

The Software Engineering certificate is designed to focus on the principles of designing, building, testing and maintaining reliable, efficient, and secure software systems. The certificate is designed to emphasize the knowledge, competencies, and skills needed to produce competent graduates to begin a professional career in the field of software engineering, or pursue graduate programs.

(3)	CSC 170	Software Requirements and Specification (CSC 131)
(3)	CSC 171	Software Engineering Project Management (CSC 131)
(3)	CSC 179	Software Testing and Quality Assurance (CSC 131)

Requirements - Certificate - Information Assurance and Security (9 units)
Courses in parentheses are prerequisites

(3)	CSC 152	Cryptography (CSC 60, CSC 130, STAT 50)
(3)	CSC 153	Computer Forensics Principles and Practices (CSC 138)
(3)	CSC 154	Computer System Attacks and Countermeasures (CSC 138)

(3)	Select one of the following:	
	CSC 154	Computer System Attacks and Countermeasures (CSC 138)
	CSC 174	Database Management Systems (CSC 131, CSC 134)
	CSC 176	Advanced Database Management Systems (CSC 174)
	CSC 177	Data Warehousing and Data Mining (CSC 134, STAT 50)

Requirements - Certificate - Systems Software (12 units)

Courses in parentheses are prerequisites

The Systems Software certificate provides necessary background to participate in the development of low-level software for computer hardware and the software infrastructure needed by application developers. Understanding how such software operates makes students valuable additions to interdisciplinary teams where exploiting features of system tools is important. The certificate will also prepare students to design, implement, and be effective users of system tools such as language processors, utilities, and diagnostic tools.

(3)	CSC 151	Compiler Construction (CSC 135)
(3)	CSC 159	Operating System Pragmatics (CSC 139)
(6)	Select two of the following:	
	CSC 142	Advanced Computer Organization (CSC 137)
	CSC 148	Modeling and Experimental Design (MATH 31, STAT 50)
	CSC 154	Computer System Attacks and Countermeasures (CSC 138)
	CSC 155	Advanced Computer Graphics (CSC 133)
	CSC 165	Computer Game Architecture and Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)