




SACRAMENTO
STATE

CSC.B13-14.001

Revision
LIST #2

Program Proposal Form B

Academic Group (College): ECS	Date of Submission to College Dean: October 21, 2013
Academic Organization (Department): CSC	Requested Effective: Fall __, Spring <u>X</u> , 20 <u>14</u> .
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:	
<input checked="" type="checkbox"/> Modification in Existing Program: <input checked="" type="checkbox"/> Substantive Change <input type="checkbox"/> Non-Substantive Change <input type="checkbox"/> Deletion of Existing Program <input type="checkbox"/> New Programs <input type="checkbox"/> Initiation (Projection) of New Program on to Master Plan <input type="checkbox"/> New Degree Programs <input type="checkbox"/> Regular Process <input type="checkbox"/> Fast Track Process <input type="checkbox"/> Pilot Process <input type="checkbox"/> New Minor, Concentration, Option, Specialization, Emphasis <input type="checkbox"/> 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	

Note: w/ the implementation of GE Area D
reduction [F 114], the CSC major/BS
will be at 121.

Once signed by Kace, it's good to go
to Senate.

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

Change 1: The computer science faculty proposes to restructure the math and science requirements. The proposed structure provides students with more flexibility in choosing courses to meet the math and science requirements, i.e., options for choosing a calculus sequence, a statistics course, a physics course, and electives. This restructuring also reduces the required number of units for math and science courses from 26-29 to 24. (Note: A Form A is also submitted to change the prerequisites of CSC 28 accordingly.)

Justification: The BS in computer science program has been accredited since 1987 by ABET/CAC, the Computer Accreditation Commission of ABET, which accredits computer science programs. ABET/CAC recently changed its criteria for accrediting computing programs. The new criteria provide more flexibility both in terms of the type of math courses allowed and the proportion of math vs. science courses. The proposed change to the math and science requirements is guided by this new criteria. The proposed new structure of requirements makes it possible for computer science students to choose a set of math and science courses which meet the math and science requirements for the BS in computer science degree program and at the same time meet the requirements for the math or statistics minor program, or with only one additional course meet the requirements for the scientific computing and simulation certificate program offered by the Physics department. The proposed change also allows us to reduce the required number of units in math and science from 26-29 to 24. The reduction of two units for the math and science requirements helps the 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 of required computer science electives from 12 to 9-12. If the change is approved, students may take three CSC courses, totaling at least 9 units, to meet the elective requirements. They may also elect to choose a 12 unit concentration.

Justification: Prior to the Catalog of 2012, students were only required to complete 9 units of computer science electives. Completion of 9 units of upper division electives (3 courses) had been viewed sufficient for the BS degree program. The proposed change back to three courses (9 units) helps the program comply with the university mandate to reduce the number of units required for an undergraduate degree.

Approvals:

Department Chair: _____

Wizhang

Date: _____

9/16/2013

College Dean: _____

Jf

Date: _____

9/20/13

University Committee: _____

Karl Chalymers

Date: _____

12-16-13

Assoc Dean for Undergraduate Studies
or Dean for Graduate Studies: _____

Dry

Date: _____

~~9/15/13~~ *1/15/14*

**ANALYSIS OF PROGRAM CHANGE PROPOSAL
FOR THE B.S. IN COMPUTER SCIENCE
September 1, 2013**

1. Form B: Attached.

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

The new math and science requirements will impact the Mathematics and Physics departments. Both have been consulted and made aware of the changes.

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 changes are guided by the new curriculum criteria of ABET/CAC, the program accrediting board, and/or to comply with the university mandate to reduce the number of units required for an undergraduate degree. (Note: A Form A is also submitted to change the prerequisites of CSC 28 accordingly.)

If the proposed changes are approved, the units required for the major will be 82-85 and the minimum total units required for BS in computer science program will be 124. When the GE Area D unit reduction (3 units) becomes effective in Fall 2014, the minimum total units required for the BS will be 121.

This Form B is a revision of Form B CSCB13-14.001. The minor changes are: (1) BIO 15L and CHEM 6A are removed from the math and science elective list; and (2) PHYS 106 is added to the math and science elective list.

NEW PROGRAM REQUIREMENTS

Units required for Major: 82-85
 Minimum total units required for BS: 124 [121 F '14]
 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.

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)

B. Required Mathematics and Science Courses (24 units)

- (3) MATH 26A Calculus I for the Social and Life Sciences (MATH 11)
OR
- (4) MATH 30 Calculus I (MATH 29 or four years

OLD PROGRAM REQUIREMENTS

Units required for Major: 87-90
 Minimum total units required for BS: 129
 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.

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 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)

B. Required Mathematics +++ +++++ Courses (15-16 units)

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- (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)

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)

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OR

(4) MATH 31 Calculus II (MATH 30 or appropriate high school based AP credit)

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(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)

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(4) STAT 50 Introduction to Probability and Statistics (MATH 26A, MATH 30, or appropriate high school based AP credit)

OR

(2) ENGR 115 Statistics For Engineers (MATH 31)

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(4) PHYS 5A Mechanics, Heat, Sound (MATH 9)

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OR

(4) PHYS 11A Mechanics General Physics: Mechanics (MATH 30, MATH 31 or equivalent certificated high school courses; MATH 31 may be taken concurrently)

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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:

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(3-4) Any MATH or STAT course with calculus as a prerequisite

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(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)

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(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)

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

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(3) PHIL 160 in a programming language)
 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 11B General Physics: Heat, Light, Sound
 (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 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)

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(3-4) Select one of the following:
 MATH 32 Calculus III (MATH 31)
 MATH 45 Differential Equations for Science
 and Engineering (MATH 31)
 MATH 100 Applied Linear Algebra (MATH
 26B or MATH 31)
 MATH 102 Number Theory (MATH 31)
 STAT 155 Introduction to Techniques of
 Operations Research (MATH 31;
 STAT 50, STAT 103, or STAT
 115A; MATH 31 may be taken
 concurrently) OR another advanced
 math course with prior Computer
 Science department approval.

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C. Required Science Courses (11-13 units)
 (4) PHYS 11A General Physics: Mechanics
 (MATH 30, MATH 31 or
 equivalent certificated high school
 courses; MATH 31 may be taken
 concurrently)
 (4) PHYS 11C General Physics: Electricity and
 Magnetism, Modern Physics
 (MATH 31, PHYS 11A)
 (3-5) Select **one** of the following (the course
 cannot be used to satisfy the General Education B2
 requirement):
 BIO 10 Basic Biological Concepts
 BIO 22 Introductory Human Anatomy (BIO

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- BIO 102 1, BIO 2 or BIO 10)
The Natural History of Plants (A college biology course or instructor permission)
- BIO 103 Plants and Civilization (BIO 10 or equivalent)
- BIO 104 Physiology of Human Reproduction (BIO 1, BIO 2 or BIO 10)
- BIO/PSYC 115 Introduction to Neuroscience (PSYC 2, PSYC 101, physiology and chemistry background strongly recommended)
- BIO 120 Biology of Aging (BIO 1, BIO 2, BIO 10 or BIO 20)
- 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)
- CSC 148 Modeling and Experimental Design (MATH 31, STAT 50, proficiency in a programming language)
- ECON 141 Introduction to Econometrics (ECON 1A, ECON 1B, ECON 140; ECON 100A or ECON 100B recommended)
- ENGR 17 Introductory Circuit Analysis (MATH 45, PHYS 11C; either may be taken concurrently but not both)
- ENGR 45 Engineering Materials (CHEM 1A and MATH 30)
- PHYS 11B General Physics: Heat, Light, Sound (MATH 31, PHYS 11A)
- PHYS 115 Electronics and Instrumentation (PHYS 11C or PHYS 5B, with instructor permission)

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

Note: To satisfy the requirements of CAC, the Computing Accreditation Commission of ABET, Inc. which accredits Computer Science programs, students must have taken a total of four courses in a scientific discipline and/or quantitative science. The courses in a scientific discipline must be those typically taken by the majors in that discipline. As part of this requirement a two-semester sequence in a laboratory science must be included (PHYS 11A and PHYS 11C satisfies this requirement). Students ordinarily complete one of the remaining two courses by choosing an appropriate course in General Education Category B2 (BIO 10 is recommended). The second course is expected to be chosen from the list above. Hence, students must

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.

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 131 Computer Software Engineering (CSC 130; may be taken concurrently)
- (3) CSC 133 Object-Oriented Computer Graphics Programming (CSC 130, CSC 131)
- (3) CSC 134 Database Management and File Organization (CSC 130)
- (3) CSC 135 Computing Theory and Programming Languages (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 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 191 Senior Project: Part II (CSC 190)
- (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

have taken a total of four courses in this category.

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D. 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 131 Computer Software Engineering (CSC 130; may be taken concurrently)
- (3) CSC 133 Object-Oriented Computer Graphics Programming (CSC 130, CSC 131)
- (3) CSC 134 Database Management and File Organization (CSC 130)
- (3) CSC 135 Computing Theory and Programming Languages (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 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 191 Senior Project: Part II (CSC 190)
- (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

D. Electives (9-12 units)

In addition to the required lower-division and upper-division Computer Science courses, Computer Science majors must take ~~four~~ additional elective courses. ~~+++++~~ This requirement can be satisfied in one of two ways:

- (i) by completing a concentration (described below), or
- (ii) 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

E. Electives (12 units)

In addition to the required lower-division and upper-division Computer Science courses, Computer Science majors must take ~~four~~ additional elective courses, ~~totaling at least twelve (12) units~~. This requirement can be satisfied in one of two ways:

- (i) by completing a concentration (described below), or
- (ii) by ~~+++++~~ ~~choosing~~ 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.

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- (3) CSC 165 Computer Game Architecture and

- (3) CSC 155 Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)
Advanced Computer Graphics (CSC 133)
- (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)

Information Assurance and Security (12 units)

The Information Assurance and Security concentration 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)
- (3) Select one of the following:
 - CSC 159 Operating System Pragmatics (CSC 139)
 - CSC 170 Software Requirements and Specification (CSC 131)
 - CSC 179 Software Testing and Quality Assurance (CSC 131)

Software Engineering (12 units)

The Software Engineering concentration is designed to focus on the principles of designing, building, testing and maintaining reliable, efficient, and secure software systems. The concentration 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 155 Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)
Advanced Computer Graphics (CSC 133)
- (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)

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- (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 159 Operating System Pragmatics (CSC 139)
 - CSC 170 Software Requirements and Specification (CSC 131)
 - CSC 179 Software Testing and Quality Assurance (CSC 131)

Software Engineering (12 units)

The Software Engineering concentration is designed to focus on the principles of designing, building, testing and maintaining reliable, efficient, and secure software systems. The concentration 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)
- (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)

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)

- (3) CSC 179 Software Testing and Quality Assurance (CSC 131)
- (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)

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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.

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 - CSC 155 Advanced Computer Graphics (CSC 133)
 - CSC 165 Computer Game Architecture and Implementation (CSC 130, CSC 133, MATH 30, PHYS 11A)