NOT FOR USE FOR CURRICULAR COURSE CHANGES
REQUEST FOR PROGRAM IMPROVEMENTS

NOTE: Changes to programs may require course changes, which must be processed electronically. Any questions should be directed to Associate Provost David Reinhold at 7-4564 or david.reinhold@wmich.edu

DEPARTMENT: Computer Science  COLLEGE: CEAS
PROPOSED EFFECTIVE FALL YEAR: Fall 2020

PROPOSED IMPROVEMENTS: Academic Program Proposed Improvements
☐ New degree*  ☐ New minor*
☐ New major*  ☐ Deletion*
☐ New curriculum*  ☐ Revised major
☐ New concentration*  ☐ Revised minor
☐ New certificate*

☐ Other (explain**)  ** Other:

Title of degree, curriculum, major, minor, concentration, or certificate: Bachelor of Computer Science

Chair, Department Curriculum Committee:  Date 10/11/2019

CHECKLIST FOR DEPARTMENT CHAIRS/DIRECTORS
☐ For new programs and other changes that have resource implications, the dean has been consulted.
☐ When appropriate, letters of support from department faculty are attached.
☐ When appropriate, letters of support from other departments in the same college are attached.
☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.
☐ The proposal has been reviewed by HIGE for possible implications for international student enrollment.
☐ The proposal is consistent with the departmental assessment plan, and identifies measurable learning outcomes for assessment.
☐ Detailed resource plan is attached where appropriate.
☐ All questions attached have been completed and supporting documents are attached.
☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair/Director:  Date 10/11/19

CHECKLIST FOR COLLEGE CURRICULUM COMMITTEE
☐ The academic quality of the proposal and the faculty involved has been reviewed.
☐ Detailed resource plan is attached where appropriate.
☐ Consistency between the proposal and the relevant catalog language has been confirmed.
☐ The proposal has been reviewed for effect on students transferring from Michigan community colleges. Detailed information on transfer articulation must be included with undergraduate proposals.
☐ Consistency between the proposal and the College and department assessment plans has been confirmed.
☐ Consistency between the proposal and the College and department strategic plans has been confirmed.
☐ All questions attached have been completed and supporting documents are attached.
☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Chair, College Curriculum Committee:  Date

Revised Sept. 2018. All previous forms are obsolete and should not be used.
CHECKLIST FOR COLLEGE DEANS

☐ For new programs and proposed program deletions, the provost has been consulted.
☐ For new programs, letter of support from University Libraries Dean indicating library resource requirements have been met.
☐ When appropriate, letters of support from other college faculty and/or chairs are attached.
☐ When appropriate, letters of support from other college deans, whose programs/courses may be affected by the change, are attached.
☐ The proposal has been reviewed for implications for accreditation, certification, or licensure.
☐ Detailed resource plan is attached where appropriate.
☐ All questions attached have been completed and supporting documents are attached.
☐ The proposal is written and complete as outlined in the Faculty Senate guidelines and the curriculum change guides.

Dean: ___________________________ Date: ______________

FOR PROPOSALS REQUIRING REVIEW BY:
GSC/USC; EPGC, GRADUATE COLLEGE, and/or FACULTY SENATE EXECUTIVE BOARD

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*needs review by

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1. Explain briefly and clearly the proposed improvement:
   The ABET Computing Accreditation Commission (CAC) has released new program criteria for “Computer Science” and similarly named computing programs. The following changes to the CS curriculum will be necessary to meet these new criteria and maintain our ABET accreditation.

   Drop CS 4540 – Operating Systems from the list of required classes for the Bachelor of Science in Computer Science degree and add the following as required courses (proposed in separate Curriculum Improvement proposals):

   CS 1210 – Introduction to C
   CS 3550 – Network Fundamentals
   CS 4541 – Computer Systems Fundamentals
   CS 4810 – Reusable Software Architectures
   CS 4850 – Foundations of Programming Languages

   The proposed catalog copy (Item 12) includes the changes above and has been updated to reflect Western Essential Studies. The sample 8-semester plan included in the proposed catalog copy satisfies Western Essential Studies requirements.

2. Rationale. Give your reason(s) for the proposed improvement.
   These changes will satisfy the ABET program criteria for substantial coverage of the concepts covered in these courses. These are new requirements that we must meet to maintain accreditation. The changes in ABET accreditation requirements for Computer Science curriculums are substantial, and these changes will ensure that our program meets those new requirements.

   The program requirements that lead to these changes are listed here:

   At least 40 semester credit hours (or equivalent) that must include:
   1. Substantial coverage of algorithms and complexity, computer science theory, concepts of programming languages, and software development.

   2. Substantial coverage of at least one general-purpose programming language.

   3. Exposure to computer architecture and organization, information management, networking and communication, operating systems, and parallel and distributed computing.

   4. The study of computing-based systems at varying levels of abstraction.

   5. A major project that requires integration and application of knowledge and skills acquired in earlier course work.

3. Effect on other colleges, departments, or programs. If consultation with others is required, attach evidence of consultation and support. If objections have been raised, document the resolution. Demonstrate that the program you propose is not a duplication of an existing one.
   None

4. Effect on your department’s programs. Show how the proposed change fits with other departmental offerings.
   These changes are required to satisfy ABET program criteria.

5. Alignment with college’s and department’s strategic plan, mission, and vision.
   Alignment remains unchanged. These changes are necessary to maintain ABET accreditation and bring our curriculum in line with WMU Essential Studies requirements.

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6. Effects on enrolled students: Are program conflicts avoided? Will your proposal make it easier or harder for students to meet graduation requirements? Can students complete the program in a reasonable time? Show that you have considered scheduling needs and demands on students’ time.

All newly required courses will be offered Fall and Spring semesters. That being the case, scheduling will not be difficult and the time required to complete a Bachelor of Science in Computer Science degree will not change.

7. Student or external market demand. What is your anticipated student audience? What evidence of student or market demand or need exists? What is the estimated enrollment? What other factors make your proposal beneficial to students?

Estimated audience is all undergraduate CS students.

8. Effects on resources. Explain how your proposal would affect department and University resources, including faculty, equipment, space, technology, and library holdings. If proposing a new program, include a letter and/or email of support from the university libraries affirming that the library resource issues have been reviewed. Tell how you will staff additions to the program. If more advising will be needed, how will you provide for it? What will be the initial one-time costs and the ongoing base-funding costs for the proposed program? (Attach additional pages, as necessary.)

This change will require us to teach fewer, larger sections in the 1st and 2nd years of the program. This is unavoidable due to a lack of increase in resources for the program.

9. List the learning outcomes for the revised or proposed major, minor, or concentration. The department will use these outcomes for future assessments of the program.

Graduates of the program will have an ability to:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program’s discipline
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

10. Describe how this change is a response to assessment outcomes that are part of a department or college assessment plan or informal assessment activities.

This change is necessary to meet new ABET CAC requirements.

11. (Undergraduate proposals only) Describe in detail how this change affects transfer articulation for Michigan community colleges. For new majors or minors, describe transfer guidelines to be developed with Michigan community colleges. For revisions to majors or minors, describe necessary revisions to Michigan community college guidelines. Department chairs should seek assistance from college advising directors or from the admissions office in completing this section.

There will be no effect on current articulation agreements. The addition of these classes may give students more options when transferring credits into the program.

12. Please offer both “Current Catalog Language” and “Proposed Catalog Language” if there is to be a change in the catalog description for a given program. For the “current” language, please copy and paste relevant language from the most current catalog and for the “proposed” language, please share the exact proposed new catalog language. As possible, bold or otherwise note the key changes in the new proposed catalog language.

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Current Catalog Copy

Computer Science

The Computer Science program has been accredited by the Computing Accreditation Commission of ABET, www.abet.org. The program contains both practical applications and underlying foundations of the discipline.

Program Educational Objectives:
1. Graduates will exhibit knowledge and skills sufficient for continued intellectual growth in computing.
2. Graduates will develop mentoring skills and assume project leadership roles in the computing field.
3. Graduates will be able to adapt to technological advances and become technical experts in at least one area of computing.
4. Graduates will gain an understanding of business and organizational concepts within the computing field.
5. Graduates will understand the roles of regulations and guidelines in their area of industry.

Student Outcomes:

Students will have:

a) an ability to apply knowledge of computing and mathematics appropriate to the discipline
b) an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
c) an ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
d) an ability to function effectively on teams to accomplish a common goal
e) an understanding of professional, ethical, legal, security and social issues and responsibilities
f) an ability to communicate effectively with a range of audiences
g) an ability to analyze the local and global impact of computing on individuals, organizations, and society
h) recognition of the need for and an ability to engage in continuing professional development
i) an ability to use current techniques, skills, and tools necessary for computing practice
j) an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices
k) an ability to apply design and development principles in the construction of software systems of varying complexity

Baccalaureate-Level Writing Requirement

Students in this program will satisfy the Baccalaureate-Level Writing Requirement by successfully completing CS 4900: Software Systems Development I: Requirements and Design.

Requirements

Revised Sept. 2018. All previous forms are obsolete and should not be used.
Students enrolling in the Computer Science Program are required to own a laptop computer with minimum specifications set by the department. These specifications will be posted on the department website.

Candidates for the Bachelor of Science in Computer Science must satisfy the following requirements in addition to those required by Western Michigan University:

1. Mathematics/Statistics and Laboratory Science

To satisfy CAC/ABET accreditation requirements, all students must complete at least thirty credit hours of mathematics, statistics and laboratory science requirements which must include one approved laboratory science and a minimum of 15 credit hours in mathematics/statistics. Mathematics/statistics course work must include:

- MATH 1220 - Calculus I Credits: 4 hours
  OR
- MATH 1700 - Calculus I, Science and Engineering Credits: 4 hours
- MATH 2300 - Elementary Linear Algebra Credits: 4 hours
- STAT 2600 - Data Analysis Using R Credits: 4 hours
- CS 1310 - Foundations of Computer Science Credits: 4 hours

(1 of the CS 1310 credits counts towards the 15 hour Math/Stat minimum)

Approved Mandatory Laboratory Science Courses

Students may meet the laboratory science requirement by taking one of the following:

- BIOS 1610 - Molecular and Cellular Biology Credits: 4 hours
- CHEM 1100 - General Chemistry I Credits: 3 hours
  And
- CHEM 1110 - General Chemistry Laboratory I Credits: 1 hour
- GEOS 1300 - Physical Geology Credits: 4 hours
- PHYS 2050 - University Physics I Credits: 4 hours
  And
- PHYS 2060 - University Physics I Laboratory Credits: 1 hour

Remaining Mathematics/Statistics and Laboratory Science

The remaining 10-11 credit hours of Mathematics/Statistics/LabScience courses must be approved by a department advisor.

2. General Education

A list of approved General Education courses can be found in the “Graduation and Academic Advising” section in this catalog.

General Education requirements include one course from each of the distribution areas I, II, III, IV, V, VII, and VIII with no more than two courses in the same department and at least two courses at the 3000-4000 level. A writing course is also required to satisfy Proficiency 1. The required lab science course (CHEM, GEOS and PHYS, though not BIOS) currently also satisfies distribution area VI.

3. Minimum Grades

Students may receive at most two grades below a “C” in the following courses:
• All courses with a CS prefix
• ECE 2500
• Courses used for the Math/Stat/Science 30 credit hour requirement including required Math/Stat courses, the required Science course and any courses included as the Math/Stat/Science electives

4. Complete 122 Semester Credit Hours

The schedule below is an example of one leading to graduation in eight semesters, beginning with the fall semester.

First Semester (14 hours)
• General Education Credits: 3 hours
• CS 1110 - Computer Science I Credits: 4 hours
• IEE 1020 - Technical Communication Credits: 3 hours
• MATH 1220 - Calculus I Credits: 4 hours
  OR
• MATH 1700 - Calculus I, Science and Engineering Credits: 4 hours

Second Semester (15 hours)
• General Education Credits: 4 hours
• CS 1120 - Computer Science II Credits: 4 hours
• ECE 2500 - Digital Logic Credits: 3 hours
• STAT 2600 - Data Analysis Using R Credits: 4 hours

Third Semester (16 hours)
• General Education Credits: 3 hours
• CCM 1040 - Public Speaking Credits: 3 hours
• CS 1310 - Foundations of Computer Science Credits: 4 hours
• CS 3500 - Introduction to Web Technologies Credits: 3 hours
• CS 4430 - Database Management Systems Credits: 3 hours

Fourth Semester (16 hours)
• General Education Credits: 3 hour
• Free WMU Elective Credits: 3 hours
• CS 2230 - Computer Organization and Assembly Language Credits: 3 hours
• CS 3310 - Data and File Structures Credits: 3 hours
• MATH 2300 - Elementary Linear Algebra Credits: 4 hours

Fifth Semester (16 hours)
• General Education Credits: 2 hours
• MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
• Laboratory Science Requirement (satisfies General Education Area VI) Credits: 4 hours
• CS 3240 - System Programming Concepts Credits: 3 hours
• CS 4310 - Design and Analysis of Algorithms Credits: 3 hours

Sixth Semester (16 hours)

Revised Sept. 2018. All previous forms are obsolete and should not be used.
• MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
• Free WMU Elective Credits: 3 hours
• Free WMU Elective Credits: 3 hours
• CS 4540 - Operating Systems Credits: 3 hours
• PHIL 3160 - Ethics in Engineering and Technology Credits: 3 hours

**Seventh Semester (16 hours)**

• Free WMU Elective Credits: 3 hours
• Free WMU Elective Credits: 3 hours
• Approved CS Elective Credit: 3 hours
• MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
• CS 4900 - Software Systems Development I: Requirements and Design Credits: 3 hours

**Eighth Semester (13 hours)**

• Approved CS Elective Credits: 3 hours
• Free WMU Elective Credits: 2 hours
• Free WMU Elective Credits: 2 hours
• General Education Credits: 3 hours
• CS 4910 - Software Systems Development II: Implementation, Testing Credits: 3 hours
• CS 4980 - The Computer Science Profession Credits: 1 hour

**Approved CS Elective**

The two CS Elective courses must be taken from the set of CS 5000-level courses covering specific computing topics described earlier. Students should consult with a departmental advisor before enrolling in one of these courses, as certain 5000-level offerings are not appropriate for undergraduates. No more than one lower-level elective CS course (e.g., CS 2000 or CS 2100) may be included as an elective.

**Free WMU Elective**

Free Elective means the student may choose without restriction any course offered at the University. That is, the course need not be a General Education course nor a course in computer science. Given the total number of free electives, a student may often be able to concentrate these into one discipline and earn a minor in that department.
Computer Science

The Computer Science program has been accredited by the Computing Accreditation Commission of ABET, www.abet.org. The program contains both practical applications and underlying foundations of the discipline.

Program Educational Objectives:
Graduates will:
1. Exhibit knowledge and skills sufficient for continued intellectual growth in computing.
2. Develop mentoring skills and assume project leadership roles in the computing field.
3. Be able to adapt to technological advances and become technical experts in at least one area of computing.
4. Gain an understanding of business and organizational concepts within the computing field.
5. Understand the roles of regulations and guidelines in their area of industry.

Student Outcomes:
Students will have an ability to:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Requirements
Students enrolling in the Computer Science Program are required to own a laptop computer with minimum specifications set by the department. These specifications will be posted on the department website.

Candidates for the Bachelor of Science in Computer Science must satisfy the following requirements in addition to those required by Western Michigan University:

1. Mathematics/Statistics and Laboratory Science
To satisfy CAC/ABET accreditation requirements, all students must complete at least thirty credit hours of mathematics, statistics and laboratory science requirements which must include one approved laboratory science and a minimum of 15 credit hours in mathematics/statistics. Mathematics/statistics course work must include:

- MATH 1220 - Calculus I Credits: 4 hours
  OR
- MATH 1700 - Calculus I, Science and Engineering Credits: 4 hours
- MATH 2300 - Elementary Linear Algebra Credits: 4 hours
- STAT 2600 - Data Analysis Using R Credits: 4 hours
- CS 1310 - Foundations of Computer Science Credits: 4 hours

(1 of the CS 1310 credits counts towards the 15 hour Math/Stat minimum)
Approved Mandatory Laboratory Science Courses

Students may meet the laboratory science requirement by taking one of the following:

- BIOS 1610 - Molecular and Cellular Biology Credits: 4 hours
- CHEM 1100 - General Chemistry I Credits: 3 hours
  And
- CHEM 1110 - General Chemistry Laboratory I Credits: 1 hour
- GEOS 1300 - Physical Geology Credits: 4 hours
- PHYS 2050 - University Physics I Credits: 4 hours
  And
- PHYS 2060 - University Physics I Laboratory Credits: 1 hour

Remaining Mathematics/Statistics and Laboratory Science

The remaining 10-11 credit hours of Mathematics/Statistics/Lab Science courses must be approved by a department advisor.

2. WMU Essential Studies

A list of approved WMU Essential Studies courses can be found in the “Graduation and Academic Advising” section in this catalog.

WMU Essential Studies requirements include one course from each of the following distribution areas: Writing, Communications, Quantitative Reasoning, Inquiry and Engagement: Critical Thinking in the Arts and Humanities, Personal Wellness, World Language and Culture, Science and Technology, Laboratory Science, Artistic Theory and Practice, Societies and Cultures, Local and National Perspectives, and Global Perspectives. No more than three WMU Essential Studies courses may be from any one course prefix.

3. Minimum Grades

Students may receive at most two grades below a “C” in the following courses:

- All courses with a CS prefix
- ECE 2500
- Courses used for the Math/Stat/Science 30 credit hour requirement including required Math/Stat courses, the required Science course and any courses included as the Math/Stat/Science electives

4. Complete 122 Semester Credit Hours

The schedule below is an example of one leading to graduation in eight semesters, beginning with the fall semester.

First Semester (15 hours)

- WMU Essential Studies Credits: 4 hours
- CS 1110 - Computer Science I Credits: 4 hours
- IEE 1020 - Technical Communication Credits: 3 hours
- MATH 1220 - Calculus I Credits: 4 hours
  OR
- MATH 1700 - Calculus I, Science and Engineering Credits: 4 hours

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Second Semester (14 hours)
- COM 1040 – Public Speaking Credits: 3 hours
- CS 1120 – Computer Science II Credits: 4 hours
- ECE 2500 – Digital Logic Credits: 3 hours
- STAT 2600 - Data Analysis Using R Credits: 4 hours

Third Semester (14 hours)
- WMU Essential Studies Credits: 3 hours
- CS 1210 – Introduction to C Credits: 3 hours
- CS 1310 – Foundations of Computer Science Credits: 4 hours
- CS 2230 - Computer Organization and Assembly Language Credits: 3 hours
- CS 3500 - Introduction to Web Technologies Credits: 3 hours

Fourth Semester (16 hours)
- WMU Essential Studies Credits: 3 hour
- MATH 2300 - Elementary Linear Algebra Credits: 4 hours
- PHIL 3160 – Ethics in Engineering and Technology Credits: 3 hours
- CS 3240 - System Programming Concepts Credits: 3 hours
- CS 3310 - Data and File Structures Credits: 3 hours

Fifth Semester (16 hours)
- WMU Essential Studies Credits: 2 hours
- MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
- Laboratory Science Requirement Credits: 4 hours
- CS 4310 - Design and Analysis of Algorithms Credits: 3 hours
- CS 4430 – Database Management Systems Credits: 3 hours

Sixth Semester (16 hours)
- WMU Essential Studies Credits: 3 hours
- MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
- CS 3550 – Network Fundamentals Credits: 3 hours
- CS 4541 – Computer Systems Fundamentals Credits: 3 hours
- CS 4850 – Foundations of Programming Languages Credits: 3 hours

Seventh Semester (16 hours)
- Free WMU Elective Credits: 3 hours
- Approved CS Elective Credit: 3 hours
- MATH/STAT/SCIENCE Approved Elective Credits: 4 hours
- CS 4610 – Reusable Software Architectures Credits: 3 hours
- CS 4900 - Software Systems Development I: Requirements and Design Credits: 3 hours

Eighth Semester (15 hours)
- Approved CS Elective Credits: 3 hours
- Free WMU Elective Credits: 3 hours
- Free WMU Elective Credits: 3 hours
- WMU Essential Studies Credits: 3 hours
- CS 4910 - Software Systems Development II: Implementation, Testing Credits: 3 hours

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Approved CS Elective

CS Elective courses must be taken from the set of CS 5000-level courses covering specific computing topics. Students should consult with a departmental advisor before enrolling in one of these courses, as certain 5000-level offerings are not appropriate for undergraduates. No more than one lower-level elective CS course (e.g., CS 2000 or CS 2100) may be included as an elective.

Free WMU Elective

Free Elective means the student may choose without restriction any course offered at the University. That is, the course need not be a WMU Essential Studies course nor a course in computer science.