Please type or select the requested information. Print completed forms, add appropriate paper attachments, and route through MSU’s curriculum process for recommendations and decisions.

| College: Science, Engineering and Technology | Proposal #: 890 |
| Department: Computer Science | Effective Date of Change: 80-07 |
| Program: Computer Science | (For Office Use Only) |
| Type of Change: COURSE PROPOSALS | Course Designator and Number |
| Proposed: New Course | Number of Credits |
| Title Current: Formal Languages/Abstract Machines | CS 410/510 3 |
| Title Proposed: Formal Lang/Abst Machine | (if applicable) |

Include a course or program description for the Bulletin (30-40 words maximum for courses, 100 for programs):

This course studies the theoretical underpinnings of modern computer science, focusing on three main models of computation: DFA, PDA, and Turing Machines. Students develop model capabilities and limitations are: what is and is not computable by each of them.

Pre: CS 310 and MATH 375 F

Rationale or Justification for change:

This is part of the CS program redesign and includes material from COMS 410.

***For General Education or Cultural Diversity Courses Only***

<table>
<thead>
<tr>
<th>General Education Course:</th>
<th>Cultural Diversity Course:</th>
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<tbody>
<tr>
<td>GE Category #</td>
<td>GE Category Name (Maximum of 3 Categories)</td>
</tr>
<tr>
<td>N/A</td>
<td>Core (At least 75% devoted to topics of race, gender, sexual orientation, age, class, and disabilities as they occur in United States Society.)</td>
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<tr>
<td>N/A</td>
<td>Related (At least 25% devoted to the above topics or to a global perspective on topics related to African American, Asian, Hispanic, and Native American inhabitants of the United States.)</td>
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<td>N/A</td>
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</table>

* For Writing Intensive Courses, attach a description of the kind and quantity of writing.
* For Upper Division Courses, include a description of the respects in which it is broad and general rather than narrow and specific, and suitable as GE.

Attach paper copies of the following:

a. Syllabus or course outline.
b. Course's student learning outcomes associated with each GE competency or CD designation.
c. List of strategies to be used to assess student achievement of each GE competency or CD designation.

***For New Courses***

<table>
<thead>
<tr>
<th>Instructional Type: Lecture</th>
<th>Course will be offered: Fall Semester</th>
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<tbody>
<tr>
<td>(Check all that apply:)</td>
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<tr>
<td>□ Course is an elective.</td>
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<td>□ Course is required for program</td>
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<tr>
<td>□ Pre- or Co-requisites:</td>
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<td></td>
<td>Prerequisites: CS 310 and MATH 375</td>
</tr>
<tr>
<td>□ Other courses are being changed or eliminated. (Explain.)</td>
<td></td>
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</tbody>
</table>

* Course content or title is similar to courses in other departments. (Attach copy of letter of agreement with other program(s) contacted. Indicate the nature of the discussions and/or resolution of differences or potential conflicts.)

Attach paper copies of the following:

a. Syllabus or course outline.
b. Course's student learning outcomes.
c. A list of resources required to offer and support this course.
d. A description of how teaching this course will affect department staffing.
e. If 400/500 level course, an explanation of added expectations of graduate students.
CS 410: Theory of Computation (3 credits)

Course Description:
This course studies the theoretical underpinnings of modern computer science. We focus on 3 main models of computation --- DFA, PDA, and Turing Machines --- determining what their capabilities and limitations are: what is and is not computable by each of them.

3 lecture hours per week.

Prerequisites: CS 310 and MATH 375

Proposed Text:
An introduction to formal languages and automata, Peter Linz, 2006.

Supplementary Reading:
1) Introduction to the Theory of Computation, Michael Sipser.

Schedule of Topics:
1) Languages: alphabets, strings, string operations, languages, language operations, string and language equalities. (~2.5 wks)
2) Regular languages: finite automata, regular expressions, non-determinism and Kleene's theorem, non-
regular languages and the pumping lemma. (~2.5 wks)
3) Context-free languages: regular grammars, context-free grammars, derivation trees, ambiguity, normal forms, pushdown automata, deterministic pushdown automata and DCFLs, pumping results for context-free languages. (~2.5 wks)
4) Turing machines: definitions, deterministic and non-deterministic Turing machines, universal Turing machines, Church-Turing thesis. (~2.5 wks)
5) Recursive and recursively enumerable languages: unrestricted grammars, Chomsky hierarchy, linearly bounded automata, languages which are not recursively enumerable. (~2.5 wks)
6) Solvability and unsolvability: halting problem, reductions, Rice's theorem, Post's correspondence problem. (~2.5 wks)

Student Outcomes:
Students who complete this course will be able to:
1) Understand the computational limits of various models of computation including automata, grammars and Turing machines.
2) Present a valid proof about computation using sound, logical deductions.
3) Be able to prove the computability or uncomputability in various models of computation for certain problems.
4) Have a working-level familiarity with the mathematics of theoretical computer science.

Added Expectations of Graduate Students
1) Graduate students will be held to a higher standard in all coursework, including assignments and exams.
2) Graduate students will also be expected to perform in depth and thorough independent investigation of the subject matter.

Grades will be assigned based on exams and assignments.

Required Resources & Departmental Staffing:
Resources currently in place within the department, the college, and the university library will support this new course. No new resources are required.

There is no impact on staffing requirements.