### Minnesota State University, Mankato

**Curriculum Proposal**

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

<table>
<thead>
<tr>
<th>College: Science, Engineering and Technology</th>
<th>X Undergraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department: Computer Science</td>
<td>X Graduate</td>
</tr>
<tr>
<td>Program: Computer Science</td>
<td>CIP # 11.010104</td>
</tr>
<tr>
<td>Type of Change: Proposed COURSE PROPOSALS</td>
<td></td>
</tr>
<tr>
<td>Title Current:</td>
<td></td>
</tr>
<tr>
<td>Title Proposed: Real-time and Embedded Systems</td>
<td></td>
</tr>
<tr>
<td>24-Char. Abbrev: Real-time &amp; Embedded Sys</td>
<td></td>
</tr>
</tbody>
</table>

**Course Designator and Number**

<table>
<thead>
<tr>
<th>Course Designator</th>
<th>Number of Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 425/525</td>
<td>3</td>
</tr>
</tbody>
</table>

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

This course provides an overview of embedded and real-time systems including design principles, methodologies, design tools and problem solving techniques. Students design and build a real-time operation system with a microprocessor to host real-time service data processing using sensor/actuator devices.

Pre: CS 210 and CS 320

**Rationale or Justification for change:**

This is part of the CS program redesign. Offerings of course electives will be on a two-year variable rotation.

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

<table>
<thead>
<tr>
<th>GE Category #</th>
<th>GE Category Name (Maximum of 3 Categories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
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<tr>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</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 so 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 students' achievement of each GE competency or CD designation.

### ***For New Courses***

<table>
<thead>
<tr>
<th>Instructional Type: Lecture</th>
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</thead>
<tbody>
<tr>
<td>Course is an elective.</td>
</tr>
<tr>
<td>X Course is required for program</td>
</tr>
<tr>
<td>Grading Format: X Grade P/N</td>
</tr>
<tr>
<td>Pre- or Co-requisites: Prerequisites: CS 210 and CS 320</td>
</tr>
<tr>
<td>Other courses are being changed or eliminated. (Explain.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course will be offered:</th>
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</thead>
<tbody>
<tr>
<td>X Fall Semester</td>
</tr>
<tr>
<td>X Spring Semester</td>
</tr>
<tr>
<td>X Summer Session</td>
</tr>
</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.

Revised September 2002
### Signature Page

**Department**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **Department Chair**
  **Date**

**College Curriculum Committee**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **Committee Chair**
  **Date**

**College Dean**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **Dean**
  **Date**

**General Education Subcommittee**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **General Education Subcommittee Chair**
  **Date**

**Undergraduate Curriculum and Academic Policy Committee**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **UCAP Faculty Chair**
  **Date**

**Faculty Association Graduate Committee**
- **Recommended**
- **Not Recommended**
  
  **Faculty Association Graduate Chair**
  **Date**

**Graduate Dean**
- **Recommended**
- **Not Recommended**
  
  **Graduate Dean**
  **Date**

**Academic Affairs Council**
- **Recommended** (Category/ies)
- **Not Recommended** (Category/ies)
  
  **Assistant Vice President**
  **Date**

**Senior Vice President and Vice President for Academic Affairs**
- **Approved** (Category/ies)
- **Not Approved** (Category/ies)
  
  **Sr. Vice President / Vice Pres. Academic Affairs**
  **Date**

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**Revised September 2002**
CS 425: Real-time and Embedded Systems (3 credits)

Catalog Description:
This course provides an overview of embedded and real-time systems and their development. Students will learn practical details of designing and integrating a real-time operation system with a microprocessor to host real-time service data processing. The course covers design principles, methodologies, and design tools. The course is divided into two parts. The first provides the basic principles for building embedded, real-time systems and techniques for solving common problems. In the second part, students design and build a microprocessor-based embedded system application requiring integration of sensor/actuator devices, a real-time operating system and application firmware and software.

3 lecture hours per week.

Prerequisites: CS 210 and CS 320

Proposed Text:

Schedule of Topics:
1) Embedded System Initialization (~ 1 wk)
2) Real-time Operating Systems (~ 2 wk)
3) Tasks (~ 1.5 wks)
4) Semaphores (~ 1 wk)
5) Message Queues (~ 1.5 wk)
6) Kernel Objects (~ 1.5 wk)
7) RTOS Services (~ 1.5 wk)
8) Exceptions and Interrupts (~ 1 wk)
9) Timer and Timer Services (~ 1 wk)
10) I/O Subsystem (~ 1 wk)
11) Memory Management (~ 1 wk)
12) Synchronization (~ 1 wk)

Student Outcomes.
Students who complete this course will be able to:
1) Identify the primary characteristics of real-time scheduling algorithms, such as rate monotonic, and describe their benefit to real-time systems.
2) Understand the characteristics of a real-time operating systems, including scheduling, synchronization mechanisms, and resource management
3) Discuss the significance of embedded system architectures such as system-on-chip, scalable bus architectures, memory subsystems
4) Integrate sensors and actuators with an embedded processor and appropriate application software.
5) Understand the use of real-time embedded test equipment, software debug tools, and methods of performance profiling and tracing.
6) Design a simple embedded systems using embedded systems tools and techniques.
7) Understand the aspects of high level languages appropriate to embedded and real-time systems development techniques.
8) Evaluate features of real-time schedulers, kernels and operating systems,
9) Evaluate alternative real-time strategies not based on operating systems.
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.