## 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.

| College: Science, Engineering and Technology | Proposal #: 891 |
| Department: Computer Science | Effective Date of Change: Academic Year 2006-07 |
| Program: Computer Science | (For Office Use Only) |
| CIP #: 11.010104 | |

### Type of Change
- COURSE PROPOSALS
- Proposed: New Course

### Title
- Current: High Performance Computing
- Proposed: High Performance Computing

### 24-Char. Abbrev.:
- High Performance Computing

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

High Performance Computing techniques used to address problems in computational science. Topics include application areas and basic concepts of parallel computing, hardware design of modern HPC platforms and parallel programming models, methods of measuring and characterizing serial and parallel performance.
Pre: CS 310, CS 350, and MATH 247

### Variable

**Rationale or justification for change:**

This is part of the CS program redesign and includes material from COMS 465. 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>
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<tbody>
<tr>
<td>N/A</td>
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* 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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<tbody>
<tr>
<td>Course will be offered:</td>
</tr>
<tr>
<td>Fall Semester</td>
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<td>Spring Semester</td>
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<tr>
<td>Summer Session</td>
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<tr>
<th>Grading Format: Grade</th>
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<tr>
<td>X</td>
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<tr>
<td>P/N</td>
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<table>
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<tr>
<th>Pre- or Co-requisites:</th>
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<tbody>
<tr>
<td>Computer Science</td>
</tr>
<tr>
<td>Prerequisites: CS 310, CS 350 and MATH 247</td>
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<tr>
<th>Other courses are being changed or eliminated. (Explain.)</th>
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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.
### Signature Page ###

**Department**
- [X] Recommended (Category/ies)
- [ ] Not Recommended (Category/ies)
- Comments:

<table>
<thead>
<tr>
<th>Department Chair</th>
<th>10/17/06</th>
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</table>

**College Curriculum Committee**
- [X] Recommended (Category/ies)
- [ ] Not Recommended (Category/ies)
- Comments:

<table>
<thead>
<tr>
<th>Karen C. Chen</th>
<th>11/2/06</th>
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</table>

**College Dean**
- [X] Recommended (Category/ies)
- [ ] Not Recommended (Category/ies)
- Comments:

<table>
<thead>
<tr>
<th>Dean</th>
<th>11/6/06</th>
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**General Education Subcommittee**
- [ ] Recommended (Category/ies)
- [X] Not Recommended (Category/ies)
- Comments:

<table>
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<tr>
<th>General Education Subcommittee Chair</th>
<th>Date</th>
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**Undergraduate Curriculum and Academic Policy Committee**
- [X] Recommended (Category/ies)
- [ ] Not Recommended (Category/ies)
- Comments:

<table>
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<tr>
<th>UCAP Faculty Chair</th>
<th>1/21/07</th>
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**Faculty Association Graduate Committee**
- [ ] Recommended
- [X] Not Recommended
- Comments:

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<tr>
<th>Faculty Association Graduate Chair</th>
<th>Date</th>
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**Graduate Dean**
- [ ] Recommended
- [X] Not Recommended
- Comments:

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<th>Graduate Dean</th>
<th>Date</th>
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**Academic Affairs Council**
- [X] Recommended (Category/ies)
- [ ] Not Recommended (Category/ies)
- Comments:

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<tr>
<th>Assistant Vice President</th>
<th>2/9/07</th>
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**Senior Vice President and Vice President for Academic Affairs**
- [X] Approved (Category/ies)
- [ ] Not Approved (Category/ies)
- Comments:

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<tr>
<th>Sr. Vice President / Vice Pres. Academic Affairs</th>
<th>Date</th>
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Revised September 2002
CS 415: High Performance Computing (3 credits)

Course Description: This course covers the ways that High Performance Computing (HPC) techniques can be used to address problems in Computational Science. After introducing the major scientific applications areas and basic concepts of parallel computing, it outlines the hardware design of modern HPC platforms and the parallel programming models that they support. The principal methods of measuring and characterizing serial and parallel performance are then covered. The final section of the course gives an introduction to grid technologies together with an overview of the opportunities and challenges associated with the computational grid.

3 lecture hours per week.

Prerequisites: CS 310, CS 350, and MATH 247


Schedule of Topics:
1) The field of Concurrent Computing (~ 1 wk)
2) Shared-Memory Computing: (~ 4 wks)
   a. Multiple Processes / Synchronization
   b. Locks and Barriers
   c. Semaphores
   d. Monitors
3) Distributed-Memory Computing: (~ 3 wks)
   a. Message Passing
   b. Remote Procedure Call
   c. Distributed Computing Paradigms
4) Parallel/Distributed Applications (~ 3 wks)
   a. Grid Computations
   b. Matrix Computations
5) High-Performance Computing Tools (~ 3 wks)
   a. Compilers
   b. Libraries
   c. Development Tools

Student Outcomes: Upon completion of the course, students should be able to:
1) Describe operational aspects of several parallel computing architectures.
2) Read and understand programs written in a language specific to High-Performance computing.
3) Write programs that use concurrency in the form of multiple threads.
4) Write programs that use the Message Passing Interface (MPI).
5) Measure, analyze and assess the performance of HPC programs.
6) Evaluate the suitability of different HPC solutions to standard problems in Computational Science.
7) Describe the potential benefits and issues of grid computing.

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.