1. Jimmy Diehl sitting in for Jason Keith; Called the meeting to order at 4:06 pm.
2. Minutes of 2/6/07: A discussion of Item 3 “Master’s Committee” took place. Primarily, what is next step now that GFC has passed the proposal?”; Dean Huntoon explained the resolution has gone to the Senate, and is being put in Senate format, and will be up for Senate vote soon. Dean Huntoon requested Anderson to track progress in Senate. Minutes were approved unanimously following a motion by Martin and a second by Goltz.
3. New Business: Nanotechnology Graduate Certificate proposal (John Jaszcak)
   - Please refer to handout and Powerpoint presentation (which summarizes handout).
   - Senate requires 15 credits for Certificate; ‘double-counting’ is allowed.
   - One required course: SS5820 ‘Societal Implications of Nanotechnology’.
   - No foreseen additional costs, space requirements, or Library resources.
   - Planned implementation is for Fall Semester 2007.
   - Question: Any limit to double counting? No
   - Question: Will this give a competitive edge to MS students? Will be helpful but don’t know.
   - Question: What companies are investigating in nanotech? 80 companies, 600 products, 20
     industrial areas. Wilson Institute’s website contains a complete list.
   - Will move this item to the next meeting under ‘Old Business’ where further discussion and
     vote are planned.
4. Old Business: ‘Last Term deadlines/Continuous Enrollment Policy’ (Dean Huntoon)
   - Reviewed the changes to policy which were suggested at last GFC meeting.
   - Motion by Davis, 2nd by Martin to accept the Policy as revised; Proposal was approved
     unanimously.
   - Dean Huntoon will take to the Senate.
5. New Business: Plan C M.S. degrees – proposal to allow written exams in addition to oral (Dean
   Huntoon)
   - Policy will be simply changed by inserting “written or” in front of “oral exam”.
   - A discussion as to which Departments actually use the Plan C option occurred and there are
     several Departments that use Plan C.
   - Consensus is favorable; Motion by Yarrow, 2nd by Gockenbach to accept Policy as revised
     was approved unanimously.
6. New Business: M.S. Thesis copying/copyright issues (Huntoon)
   - The Library is receiving requests for ILL loan of originals (or copies) of M.S. theses, which
     have not been copyrighted; currently requestor would need to get approval from the MS
     student to make copies.
   - Library does not wish to loan to ILL the original thesis due to the risk of loss or damage.
   - Dean Huntoon is working on a form which MS students would sign (prior to Graduation) to
     authorize the MTU Library to make a finite number of copies of the thesis.
7. New Business: International Applications Deadlines (Dean Huntoon)
   - FYI to Faculty: Visas for international students have been taking a long time to process. Dean
     Huntoon urges that applications from these international students to be processed ASAP (in
     the Department) such that the visa process will be hastened.
8. New Business: GRE issues (Huntoon)
   - eMail had previously been sent to GFC alerting members that GRE is changing their testing
     procedure to reduce cheating. This year applying students from China and India are affected
     and some students may have missed GRE testing dates. Faculty can intercede on their behalf
     to ask GRE to allow these students to take the test.
9. Mark Gockenbach move to Adjourn; Anderson 2nd; unanimously approved; Meeting adjourned 5:05
    pm
**Attendance (Affiliation)**
Jackie Huntoon (Grad School)
Nancy Byers-Sprague (Grad School)
Sonia Goltz (SBE)
Carl Anderson (ME-EM)
Jimmy Diehl (Geology/Mining)
Patrick Martin (Social Sciences)
Melissa Meyer (EE)
William Yarrough (Education)
Heather Youngs (Biology)
Seth Donahue (BME)
Brian Davis (Technology)
Mark Gockenbach (Math)
Zhenlin Wang (CS)
Judith Perlinger (EPD2)
Brian Fick (Physics)
John Jaszczaik (Nanotechnology Certificate)
Craig Friedrich (Nanotechnology Certificate)
David Tobias (GSC)
Proposal:  
Interdisciplinary Graduate Certificate in Nanotechnology

John A. Jaszczak  
Department of Physics  
Associate Director for Education and Outreach, Multi-Scale Technologies Institute

Craig Friedrich  
Department of Mechanical Engineering-Engineering Mechanics  
Director, Multi-Scale Technologies Institute

Bruce E. Seely  
Chair, Department of Social Sciences

1. General Description

This proposal recommends the establishment of a Graduate Certificate in Nanotechnology. This certificate would be available to all degree-seeking as well as non-degree-seeking students enrolled in the Graduate School at Michigan Technological University.

Title of Certificate:  Graduate Certificate in Nanotechnology  
[It has been suggested that an alternate name be Graduate Certificate in Nanoscale Science and Engineering (NSE), as this terminology is becoming more common, and is similar to our minor name.]

Catalog Description

The Graduate Certificate in Nanotechnology recognizes advanced study of scientific, technological, and engineering topics in nanotechnology, including aspects of (i) characterization, (ii) micro- to nano-scale fabrication and control, and (iii) devices, systems and integration. The certificate also requires study of the societal and ethical implications of emerging technologies.

2. Rationale

Nanotechnology is a rapidly developing field that seeks to understand, control, and exploit new physical properties that arise in systems at length scales between atoms and bulk materials. Applications of nanotechnology, which already are emerging, are highly interdisciplinary and include virtually all fields and disciplines in engineering and the natural sciences. Some enthusiasts are calling nanotechnology the next "industrial revolution.”

Michigan Tech has strong and growing research thrusts that deal with a broad range nanoscale science and engineering. Likewise, MTU has been moving to develop appropriate educational program in nanotechnology. While the National Academy of
Sciences has advised against rushing to start new engineering and science undergraduate degree programs in nanotechnology [1], Michigan Tech has successfully developed and started an interdisciplinary minor in Nanoscale Science and Technology in fall 2005. The new Multi-Scale Technologies Institute (MuSTI), under the direction of Craig Friedrich, serves as an umbrella organization to assist in the coordination and development of these and related research and educational efforts (http://www.me.mtu.edu/Institutes/MuSTI/). In this context, we believe that the Graduate Certificate in Nanotechnology is a necessary and appropriate educational opportunity for postgraduate students that will offer them an attractive supplement to their graduate degrees in this era of rapid paced technological change. In addition to a required course on nanotechnology's societal implications, students will choose elective courses to broaden their exposure to the science and applications of nanotechnology in other disciplines, as well as to deepen their understanding in their primary areas of interest.

The Graduate Certificate in Nanotechnology is designed to:
(1) deepen students' understanding of technical aspects of nanoscale science, technology, and engineering;
(2) encourage students to pursue related interdisciplinary coursework outside their major;
(3) be flexible to allow for participation by students in diverse majors;
(4) familiarize students with the real and perceived societal implications of nanotechnology and other emerging technologies, which span from economics to ethics to politics.

3. Related Programs

Graduate certificates in nanotechnology or closely related fields exist at a few other institutions, including Lehigh University, Drexel University, the University of Pennsylvania, University of Massachusetts Lowell, Stanford University, and George Mason University. A small number of universities offer M.S. and Ph.D. degrees in nanotechnology [2]. This proposal is modeled in part on the graduate certificate program at University of Pennsylvania [3]. Two primary differences between this proposal and the U. Penn program are (i) U. Penn requires attendance at 6 seminars related to Nanoscale Science and Technology which this proposal does not, however (ii) this proposal requires all certificate seekers to take SS 5820 Societal Implications of Nanotechnology.

4. Projected Enrollment

Based on likely faculty participants and current graduate enrollments, we estimate that approximately 20 students may be enrolled at any time. In time we anticipate that this program would become available to students via Distance Learning.

5. Scheduling Plans (Not applicable)

6. Curriculum Design
A total of 15 credits are required for this certificate. Students must earn a grade of B or higher in each of the courses counting toward the certificate. Double counting of courses toward their degrees and the certificate is allowed per Michigan Technological University policies. As an interdisciplin ary certificate, a maximum of 6 credits is allowed in courses at the 3000- and 4000- levels.

**Required Course:**
SS5820 Graduate Seminar in Societal Implications of Nanotechnology (2 credits)
This would be a new graduate-level version of SS 3820 Societal Implications of Nanotechnology, to be proposed in the curriculum binder-process in 2007. (See below.)

**Elective Courses:**
Students must take at least one course from each of the three topical groups in the following list of approved courses [3]. At least 3 credits must be outside of a student's home department unless their degree is already interdisciplinary (upon approval by MuSTI Associate Director for Education and Outreach, or in the absence of such an office, by a faculty member appointed by the Dean of the Graduate School). Remaining credits may be taken from any topical group or the Other Electives group, subject to the requirements above.

1. **Characterization**
   - BL 5040 - Electron Optical Methods of Analysis I: Principles and Techniques for Biologists (2)
   - BL 5050 - Electron Optical Methods of Analysis II: Principles and Techniques for Biologists (2)
   - BL 5060 - Biological Ultrastructure (4)
   - FW 5080 - Gene Profiling Analysis (2)
   - MY 4200 - Introduction to Scanning Electron Microscopy (2)
   - MY 5200 - Advanced Scanning Electron Microscopy (3)
   - MY 5250 - Transmission Electron Microscopy (3)
   - MY 5580 - Introduction to Scanning Probe Microscopy (2)

2. **Fabrication and Control**
   - BE 4700 - Biosensors: Fabrication and Applications (3)
   - BE 5940 - Introduction to Tissue Engineering (3)
   - EE 5470 - Semiconductor Fabrication (3) [co-listed with MY 5470]
   - EE 6480 - Thin Films (3) [co-listed with MY 6480]
   - MEEM 5640 - Micromanufacturing Processes (3)
   - MY 5470 - Semiconductor Fabrication (3) [co-listed with EE 5470]
   - MY 6480 - Thin Films (3) [co-listed with EE 6480]

3. **Devices, Systems, and Integration**
   - BE 5300 - Advanced Polymeric Biomaterials (3)
   - BE 5660 - Active Implantable Devices (3)
BE 5700 - Biosensors (3)
BE 5800 - Advanced Biomaterials Interfaces (3)
BE 5750 - Bioapplications of Nanotechnologies (2)
BL 5020 - Enzymology (3)
EE 5460 - Solid State Devices (3) [co-listed with MY 5460]
EE 5480 - Advanced MEMS (4) [co-listed with MY 5480]
MY 4240 - Introduction to MEMS (4)
MY 4240D - Introduction to MEMS (4)
MY 5480 - Advanced MEMS (4) [co-listed with EE 5480]
MY 4710 - Photonic and Micromechanical Materials and Devices (3)
MY 5750 - Bioapplications of Nanotechnologies (2)
MY 5460 - Solid State Devices (3) [co-listed with EE 5460]

Other Electives:
BE 5440 - Genetic Engineering (3)
BL 5030 - Molecular Biology (3)
*CH 5310 - Advanced Inorganic Chemistry (3)
*CH 5410 - Advanced Organic Chemistry I (3)
*CH 5420 - Advanced Organic Chemistry II (3)
CH 5509 - Environmental Organic Chemistry (3)
CH 5570 - Advanced Biophysical Chemistry (3)
EE 5430 - Electronic Materials (3)
FW 4089 - Bioinformatics (3)
FW 5085 - Functional Genomics and Biotechnology (3)
FW 5089 - Tools of Bioinformatics (4)
MY 5550 - Solid Surfaces (3)
MY 5430 - Electronic Materials (3)
MY 6100 - Computational Materials Science and Engineering (3)
*PH 3410 – Quantum Mechanics I (3)
*PH 3411 – Quantum Mechanics II (3)
*PH 5410 – Quantum Mechanics I (3)
*PH 5411 – Quantum Mechanics II (2)
PH 5530 - Selected Topics in Nanotechnology (2)

[*We are considering restricting these courses to count only for students taking them outside of their "home" discipline. We'll need faculty input on the choice and nature of such restrictions.]

Due to the rapid developments in the field of nanotechnology, other appropriate electives may be substituted upon approval of the Multi-Scale Technologies Institute's Associate Director for Education and Outreach (or in the absence of such an office, by a faculty member appointed by the Dean of the Graduate School).
7. New Course Descriptions

SS 5820 Graduate Seminar in Societal Implications of Nanotechnology (2 credits)
This would be a new graduate-level version of SS 3820 Societal Implications of Nanotechnology, to be proposed in the curriculum binder-process in 2007. SS 5820 would be taught concurrent with SS 3820. SS 3820 is currently being taught by visiting assistant professor Dr. Michael Bennett, and has been taught in the past by Dr. Bruce Seely. SS 5820 could be taught as soon as spring 2008.

Tentative catalog description:
Nanotechnology, which involves understanding and exploiting phenomena in materials or systems where at least one dimension is at the nanometer scale, spans virtually all scientific and engineering disciplines. This graduate course examines in a seminar format some of the likely implications of these developments for society. Attention will be given to the economic, social, ethical and moral, and political consequences of the unfolding development of science and engineering fields at the nanoscale.

Prior to the approval of this new course, students can satisfy the requirements of this certificate by taking SS 3820 plus one-credit independent study in SS 6500 - Independent Study/Directed Reading under the direction of the instructor of SS 3820.

8. Library and other Learning Resources.

No additional library or learning resources are required.

9. Computing Access Fees

No computing access fees are required beyond those normally incurred by enrolled graduate students.

10. Faculty Resumes

A list of affiliated faculty may be found at:
http://www.me.mtu.edu/Institutes/MuSTI/research.htm

11. Description of available/needed equipment.

No additional equipment is required beyond that currently available on campus. On campus facilities are extensive. Some of the facilities are listed under http://www.nano.mtu.edu/nanofacilities.htm at http://www.me.mtu.edu/Institutes/MuSTI/facilities.htm, but these lists are by no means exhaustive.

12. Program Costs
There are no additional direct costs associated with establishing this graduate certificate program at this time. The sustainability of offering SS 5820 in the longer term may depend upon additional resources or continuation/conversion of a temporary faculty line.

13. Space

No additional space is required.

14. Policies Regulations and Rules

All policies, regulations and rules are described in Section 6 and follow University Senate policy for Graduate Certificates.

15. Accreditation      (Not applicable)

16. Internal Status of the Proposal

Submitted to the Provost office, Dean of the Graduate School and President of the Graduate Faculty Council for advice and approval.

17. Planned Implementation

This program could begin starting in Fall semester, 2007.

Citations:


Listing of Prerequisites to Required and Elective Courses

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Proposal: Graduate Certificate in Nanotechnology

John Jaszczyk (Physics)
Craig Friedrich (MEEM)
Bruce Seely (Social Sciences)
Background

- Nano-scale Science and Engineering is impacting virtually all disciplines at MTU
- Research in nano-related areas has been strong and is growing.
- Minor in Nanotechnology started in Fall 2005
  - MTU was one of the first in the US to offer such
  - Good recruiting tool
  - ~10 students formally enrolled
- MuSTI (Multi-Scale Technologies Institute) serves as an umbrella organizational structure to support research, educational and outreach activities in nano- and micro-scale areas of science, technology and engineering.
Background

- Graduate Certificates in Nano are offered at other universities (George Mason, U. Penn, Drexel, etc.)
  - None that I know of in Michigan
- Some schools now offer M.S. and Ph.D. degrees in Nanotechnology
Graduate Certificates at MTU

- 15 credit hours
  - 6 credits maximum at 3000 to 4000-level for interdisciplinary program
  - 3 credits maximum in research
- Minimum grade B
- Double counting of credits is allowed
Graduate Certificate in Nanotechnology Proposal

- 15 Credits
- 1 Required Course (new):
  - SS 5820 Societal Implications of Nanotechnology (based on SS 3820)
- Elective Courses
  - Diversity of disciplines
  - 3 credits outside of home discipline
  - (at least one course from each of 3 topical groups)
    - Characterization
    - Fabrication and Control
    - Devices, Systems, Integration
  - At least 3 credits from department outside of students “home” department
Additional Details

- No foreseen additional costs, space, or library resources needed.
- Ability to teach SS 5820 currently facilitated by a visiting asst. professor appointment in SS (Michael Bennett).
- Planned implementation in Fall 2007.
- Supervision through MuSTI.