The University of Michigan
College of Engineering
Curriculum Committee

Agenda
February 01, 2005
1:30-3:30 p.m.
GM Room
Fourth Floor Lurie Engineering Center

1. Approval of Minutes from December 21, 2004 Meeting

2. 5-Yr. BS/MS Program between Xavier and BME – Matt O'Donnell

3. Proposed Change in Pass/Fail Rule – from ARWG

4. Course Approval Forms

5. Discussion of LSA Grading Proposals

University of Michigan
College of Engineering
Curriculum Committee Meeting
Tuesday December 21, 2004
1:30-3:30 p.m.
Lurie Engineering Center GM Room
Minutes

Jeff Fessler called the meeting to order at 1:40 p.m.

Members Present: J.Fessler, J. Day, G. Herrin, S. Holleran, G. Hulbert, , S. Montgomery, J. Patel, H. Peng, R. Robertson, S.Takayama, L. Thompson

Members Absent: C.Cesnik (AERO), J. Holloway (NERS), C. Lastoskie (CEE), S. Pang, M.Parsons (NAME), P. Samson (AOSS)

Guests: Kathleen Vargo, Leslie Olsen, Tom Wolff (MSU), Doug Noll

Motion to approve the minutes of the last meeting

The minutes of the last meeting were approved

BME Program Change – Revised

The revised BME program change was in the meeting packet and revised copies of the BME course approval forms were available.

Jeff Fessler asked for a motion to approve the Biomedical Engineering Program Changes. Moved and Seconded Discussion.
Motion Carried (approved) This proposal will go to the Faculty Meeting on February 14.

Curriculum Committee Representation for Tech Comm Program

Leslie Olsen represented the Technical Communications Department.
Jeff Fessler noted that it was suggested to have a Tech Comm representative on the Curriculum Committee on an ex officio basis.
Leslie stated that a number of people in her department also had that suggestion, since they previously had a person on this Committee and it was useful to be aware of issues being brought up at the Committee.

Susan Montgomery moved that this recommendation go to the Rules Committee. Discussion.
Jeff Fessler noted that the rules committee is in the midst of examining the proposed membership changes that were dealt with just recently when adding somebody from the interdisciplinary program, so this is a good time to do this. The Director of the Department will appoint the representative. Gary Herrin and Leslie Olson will look for a good person for this position.
Motion Carried (approved)

Proposed Change in Pass/Fail Rule – from ARWG

Kathleen Vargo from the Academic Rules Committee presented this topic.
A memo was included in the meeting packet regarding the Pass/Fail topic discussed at the last CC meeting.
The ARWG had discussed the impact to the MDDP (Multiple Dependent Degree Program) students whose home department is in Engineering, since LS&A allows more P/F courses than Engineering does. The memo showed the rule as it is and a recommended paragraph. The ARWG recommended eliminating the maximum number of credit part of the rule a student can elect a course optional pass/fail.

Jeff Fessler asked for a straw vote to allow any amount of pass/ fail courses but only 14 credit hours of those will count toward an Engineering undergraduate degree. A consensus was reached on this part.
There was a question on the proposed sentence that read: *Courses elected pass/fail which exceeds the limitations stated above* ***cannot be applied in any way to a degree program and*** *will revert to the grade earned.* Kathleen questioned how the bold words became part of the rule.

Kathleen said the ARWG will rewrite this proposed change and the Curriculum Committee will look at it again in January.

ABET Information from Tom Wolff – MSU

Jeanne Murabito introduced Tom Wolff, Associate Dean for undergraduate studies in the College of Engineering at Michigan State University, who had run their ABET visits very successfully.
He was at the meeting to give some helpful regarding this visit.
He also plans to return some time in January to meet with the Colleges ABET coordinators.

Correction of ChE Sample Schedule to account for Physics 140 Prerequisites – Susan Montgomery

This was a correction of the ChE sample schedule. Susan Montgomery said that the prerequisite requirements are now met.
Jeff Fessler asked for a motion to approve this modification of the ChE sample schedule. Moved and Seconded. **Motion Carried (approved)**

Change in ChE 341 Prerequisites – Susan Montgomery

Jeff Fessler asked for a motion to approve this modification for ChE 341. Moved and Seconded.
Motion Carried (approved)

Course Approval Forms

The Following Courses Were Approved:

BME 211 New Course

BME 221 New Course

BME 231 New Course

BME 311 New Course

BME 321 New Course

BME 331 New Course

BME 332 New Course

BME 417(X-Listed with EECS 417) Modification – Changed Prerequisites from: EECS 206 and 215 or Graduate Standing ***to: BiomedE 211, EECS 215 or EECS 314 or Graduate Standing***

BME 430 Modification – Changed terms of offering from: yearly ***to alternate years***

BME 450 Modification – Changed Prerequisites from: none ***to: Biomed E211, Biomed E221, BiomedE 231, ENGR 100 and senior standing***

BME 456(X-Listed with ME 456) Modification – Changed Title, Changed Description, Changed Prerequisites from: ME 211, ME 240 ***to: BiomedE 231 or ME 211 and ME 240***

BME 458(X-Listed with EECS 458) Modification – Changed Prerequisites from: none ***to: BiomedE 211 or EECS 215 or EECS 314 or Graduate Standing***

BME 476(X-Listed with ME 476) Modification – Changed Prerequisites from: ME 330 or Equivalent, or consent of instructor ***to: BiomedE 331 or ME 320 or ChemE 341. Recommended BiomedE 221***

BME 479 Modification – Changed Prerequisites from: Math 216, ME 330 or permission of Instructor ***to: BiomedE 331 or ME 320 or Chem E 341. Recommended BiomedE 221***

BME 482(X-Listed with NERS 482) Deletion

BME 483 Deletion

BME 485 Deletion

BME 530 Modification – Changed terms of offering from: yearly ***to alternate years***

BME 550 Modification – Changed terms of offering from: WN ***to: FA***

BME 561 Modification – Changed terms of offering from: WN ***to: FA***

BME 575 (X-Listed with Dentistry) Modification – Deleted BME as x-listing

CHE 341 Modification – Changed prerequisites from: Physics 140, P/A ChE 230 and Math 216 ***to: Phys 140, ChE 230, Math 215, P/A by Math 216***

EECS 590 New Course

Jeff Fessler called for a motion to approve the following courses. This was moved and seconded.

Motion Carried (approved)

This Course was Tabled

BME 552 New Course

Adjournment: Motion to adjourn was made and seconded
Motion carried (approved)

Next Meeting
Tuesday, February 1, 2005
1:30-**3:30** p.m.
GM Room – Fourth Floor LEC

UNIVERSITY OF MICHIGAN
COLLEGE OF ENGINEERING
BIOMEDICAL ENGINEERING

1107 CARL A. GERSTACKER BLDG.
2207 BONISTEEL BLVD.
ANN ARBOR, MICHIGAN 48109-2099
734 764-9588 FAX 734 936-1905
http://www.bme.umich.edu

January 3, 2005

To: CoE Curriculum Committee
From: Matt O'Donnell
Re: 5-Yr. BS/MS Program between Xavier and BME

This is a little unusual, but important. For several years we've had a combined (5-year) BS/MS program between the Department of Biomedical Engineering (BME) in the College of Engineering (CoE) and the Physics and Dual Degree Engineering Department in the College of Arts and Sciences at Xavier University of Louisiana in New Orleans, LA. This program is patterned after existing BME-SGUS (sequential graduate/undergraduate studies) programs in the CoE. It was initiated informally several years ago, along with a similar program at Tuskegee University in Tuskegee, AL. We just found out recently that this program was never formally approved by Rackham. In trying to reconstruct the paperwork, I sent the attached memo to Rackham. They were receptive, but Dean Homer Rose said he needed some kind of confirmation from the CoE that this program was approved. Again, we have not been able to find the original paperwork in either Stella Pang's or our office. Frankly, I'm not sure that there was any "official" paperwork – the original informal agreement started before I was chair. Consequently, I want to start the formal process to get this program approved by the CoE.

We've had one student matriculate through the program and another ready to start next fall. We only found out that it didn't have Rackham approval when the first student graduated. We can avoid this problem with the next student with your approval. The attached memorandum of agreement between Xavier and UM has been approved by the General Counsel's office and was used to steer our first student through the program. I hope we can expedite CoE approval. Please let me know if you have any questions so I can address them as soon as possible.

Thanks for your consideration.

Matthew O'Donnell

UNIVERSITY OF MICHIGAN
COLLEGE OF ENGINEERING
BIOMEDICAL ENGINEERING

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September 7, 2004

To: Christophe Pierre
From: Matt O'Donnell
Re: 5-Yr. BS/MS Program between Xavier and BME

This memo requests Rackham approval of a combined (5-year) BS/MS program between the Department of Biomedical Engineering (BME) in the College of Engineering (CoE) and the Physics and Dual Degree Engineering Department in the College of Arts and Sciences at Xavier University of Louisiana in New Orleans, LA. This program is patterned after existing BME-SGUS (simultaneous graduate/undergraduate studies) programs in the CoE. It was initiated informally several years ago, along with a similar program at Tuskegee University in Tuskegee, AL. We now request formal Rackham approval for the Xavier degree program and also request a unique program code to track students as they matriculate.

The program is described in the attached memorandum of agreement between BME and Xavier, and is detailed in the attached FIPSE proposal that initiated the informal program several years ago. Students must fulfill all BME departmental and Rackham degree requirements for the MS, as well as all Xavier requirements for an undergraduate degree from the Physics and Dual Engineering Degree Department in the College of Arts and Sciences.

There are two program features that must be carefully administered to guarantee long-term success. First, students may double count up to 6 credits. The BME Department will carefully audit student progress to certify that all double-counted credits do indeed satisfy both departmental and Rackham MS requirements. No credits will be transferred from Xavier to UM. BME will also work with the Director of Engineering Programs in the Physics and Dual Degree Engineering Department to ensure that these same credits satisfy Xavier undergraduate degree requirements. Second, both degrees will be awarded simultaneously. Xavier requested this as a motivational tool to retain students through the complete 5-year program. To remove complications related to awarding the MS degree without a prior undergraduate degree, the Director of Engineering Programs at Xavier will send a letter to Rackham, with a copy to BME, during the term in which Rackham will award the MS to a student stipulating that the student has satisfied all Xavier undergraduate degree requirements. We understand this complicates normal Rackham procedures, but request that it be approved to give Xavier a powerful motivational tool.

We request formal Rackham approval of the Xavier 3-2 program with an effective start date of 1/1/05. Thank you for your attention to this matter. If there is anything else you need, please contact me.

Memorandum of Agreement between Xavier University of Louisiana and University of Michigan

Xavier 3-2

Dual Degree, B.S.-M.S.E., Program in Engineering

1.) This agreement has been developed in the firm belief that it provides a valuable educational opportunity for students using the existing facilities of Xavier University and the University of Michigan.

2.) This agreement establishes a continuing cooperative engineering program of five (5) years undergraduate/graduate study at Xavier University (XU) and the University of Michigan (UM) wherein Xavier undergraduate students may earn a B.A. or B.S. in Physics from XU and an M.S. in Biomedical Engineering from the UM.

3.) Undergraduate students will typically attend XU for three (3) years and the UM for two (2) years. The dual-degree program is carefully constructed to meet all degree requirements of both institutions.

4.) Students entering this program must be academically acceptable to XU and the UM at the time they enter their respective universities.

5.) After successfully completing the prescribed curriculum in approximately three (3) years at XU, the student will submit a complete application for the Graduate Division of the School of Engineering at the UM and a recommendation from the Director of Engineering Programs at XU to the XU/UM B.S.-M.S. Committee for admission to the program. The application fee will be waived for this program. Upon admission, the students will be assigned an academic advisor at the UM, who will advise them on the courses they need to take.

6.) The Director of Engineering Programs at XU will advise dual-degree students during the first three years to insure that the requirements for the B.A. or B.S. degree at XU and the entrance requirements for the Graduate Division of the School of Engineering at the UM have been met. The Director will also arrange to have forwarded the academic records of dual-degree students at the time they transfer to the UM. The Biomedical Engineering Department at the UM will insure that the students meet the admission requirements at the UM and that dual-degree students are properly advised after transferring to the UM. In addition, the Biomedical Engineering Department will insure that all degree requirements have been satisfied for the Master of Science degree in Engineering when dual-degree students complete their programs.

7.) The students enrolled in this program at XU will ordinarily follow the prescribed curriculum for three (3) years as approved by the the Chair of the

Physics and Dual Degree Engineering Department and the Director of Engineering Programs at Xavier. Upon satisfactory preparation in the course work at XU, the students will be required to successfully complete the course requirements in the Biomedical Engineering Department at the UM. The Director of Engineering Programs at Xavier and the Biomedical Engineering Department of the University of Michigan will assure that the curriculum will meet all requirements of both universities.

8.) Satisfactory preparation in course work at Xavier is defined as follows:

a grade of B or better in each course taken to satisfy degree requirements in the fields of mathematics, physics, chemistry, biology, engineering, and other fields necessary to satisfy degree requirements at the UM;
an overall cumulative grade point average (GPA) of 3.5 or better earned at Xavier University.

9.) The UM, in principle, makes no guarantees of financial assistance to graduate applicants. However, students accepted under this agreement will be accorded all considerations for financial assistance consistent with that provided any other student accepted into similar masters graduate programs in the University.

10.) At the UM, students may choose from any subfield within the Department of Biomedical Engineering.

11.) Successful completion of the course work at the UM means that students have satisfied all degree requirements for their respective programs and have achieved a GPA of at least 5.0/8 in their graduate course-work.

12.) A minimum of 24 (24) credits of graduate course-work at the UM is normally required for the degree. All 500-level and higher-level courses within the major must be completed at the UM.

13.) After successful completion of the course work at the UM, the students will receive:

a degree of Master of Science in Engineering with parenthetic designation of the major, from the University of Michigan, and
a degree Bachelor of Arts or Bachelor of Science from Xavier University.

14.) The XU/UM Committee will be appointed by the Chair of the Department of Biomedical Engineering at the UM, and the Dean of Arts and Sciences at Xavier University. Xavier University and the University of Michigan will each appoint committee members to conduct periodic reviews of the program, consider course and curricula changes, develop mechanisms of faculty exchanges, recommend changes to admission and scholarship policies, and conduct other relevant

academic matters not specifically described in this agreement. The committee should be comprised of: Director of Engineering Programs at XU, Associate Dean for Graduate Studies in the College of Engineering at the UM, Chair of the Graduate Education Committee in the Biomedical Engineering Department at the UM, one (1) faculty member from the Department of Physics and Dual Degree Engineering at XU, one (1) faculty member from the Department of Biomedical Engineering at UM , an alumna or alumnus from the dual-degree program, and two (2) students currently participating in the program (one registered in full-time status at the UM and one registered full-time status at XU.)

15.) This agreement will be in effect when signed by the designated officials from both institutions, and may be terminated by appropriate written notice of at least 180 days by either party.

Signature of Responsible Authorities at the Cooperating Institutions:

Xavier University

Dean of Arts & Sciences
Xavier University

University of Michigan

3/12/02

Chair, Biomedical Engineering Dept.
University of Michigan

TUSKEGEE UNIVERSITY - UNIVERSITY OF MICHIGAN
UNDERGRADUATE PREPARTORY PROGRAM FOR BIOMEDICAL ENGINEERING
AT TUSKEGEE UNIVERSITY
(UPBEAT)

It is well documented that private industry and academia all suffer from the under-representation of minorities in science and engineering. According to Jesse Lewis, the NSF's Minority Graduate Education coordinator, "This failure to prepare and develop SME capability in such a large segment of the U.S. population is wasteful of precious human capital resources and has serious consequences for the nation's ability to compete in a world economy driven by technological advances." (1) Further, in the area of biomedical engineering, this failure is particularly acute. The under-representation of minority graduate biomedical engineering students negatively impacts minority communities which suffer disproportionately from lack of access to high quality medical care. The field of biomedical engineering, which plays an increasingly important role in the medical environment, offers minority students unprecedented opportunities for participation in the expansion of crucial knowledge and the humane and practical application of such knowledge.

While large research institutions typically offer state of the art facilities, access to research funds and a wide array of opportunities, it has been Historically Black Colleges and Universities that often graduate the largest numbers of under-represented minority students from engineering programs. (2)

Tuskegee University's College of Engineering, Architecture and the Physical Sciences proposes to develop a formal graduate feeder program with the University of Michigan's Office of Graduate Education in the College of Engineering and their Biomedical Engineering Department. Within the last five years, almost half of the graduates from Tuskegee who go on to graduate school have entered Michigan. Therefore, this project proposes to ***institutionalize*** this

relationship to encourage more students and feed a pre-selected graduate program. The program would couple the strengths of Tuskegee University, a Historically Black University with a reputation for excellent undergraduate preparation in engineering and a solid recruitment, retention and graduation rate of under-represented minority engineers (100 annually), with the unique resources available at a large research institution. While Tuskegee University offers such specialized research centers such as the Center for Bio-Technology and a Flow Cytometry Facility, and the University of Michigan offers a top ten medical school in close proximity to a top-rated graduate biomedical engineering program, multidisciplinary research programs and nine biomedical research centers, and a new interdisciplinary program which will offer graduate education and support research in the emerging scientific field of bio-informatics. Such resources complement each other and ensure this collaboration will enhance learning at both institutions.

The goals of the program are to:

- develop a sustainable pipeline of under-represented minority students into the University of Michigan's Biomedical Engineering Department;
- help enhance the engineering curriculum development at Tuskegee University;
- increase the numbers of underrepresented minority students earning graduate degrees in biomedical engineering;
- increase minority students' awareness of opportunities in biomedical engineering;
- initiate the planning of a 3-2 dual degree program in engineering and biomedical engineering.

Program Model:

Students would complete an engineering curriculum (eg. mechanical, electrical, chemical) or chemistry or physics at Tuskegee University, and later enroll in graduate school at the University of Michigan. Approximately five students interested in biomedical engineering will be identified in their sophmore year, and be required to spend at least two summers at Michigan to learn more about biomedical engineering through research, seminars, and workshops. After graduating from Tuskegee, the student will be familiar with the biomedical engineering curriculum, meet admissions requirements, and be prepared to complete the graduate degree in biomedical engineering. Close interaction with faculty from both institutions will help mentor each student

at the undergraduate and graduate level for potential enrollment in the doctoral program and/or applying to medical school. Admission criteria will include a minimum 3.2 g.p.a. with recommendations, and performance as a undergraduate student during the summers. Students would identify areas of interest and choose from among the department tracks: Biomechanics, Biotechnology, Rehabilitation Engineering and Ergonomics, Biomedical imaging, Bioelectrical and Micro-sensing and Measurement or Biomaterials. ***This program would be expanded to other engineering majors at Michigan within the three year project.***

Student Enrichment Components:

Introduction to Biomedical Engineering: A multimedia presentation, featuring a broad overview of biomedical engineering that includes current developments in the field, research applications, post-graduate options and career opportunities will be developed jointly and offered to first, second and third year students at Tuskegee University.

Career Exploration Component:

Students would participate in existing self-assessment workshops, and career exploration sessions currently offered by the University of Michigan. Self-assessment will help students understand and capitalize on their learning styles and unique strengths.

Summer Research Opportunities and Internships:

Students would participate in the University of Michigan's faculty-supervised program, the Summer Research Opportunity Program (SROP). Students will work under the mentorship of experienced faculty members as part of a research team that may also include graduate students, research scientists, and other SROP students for eight weeks. Participants will develop a variety of research skills and contribute to research that is a vital part of the academic experience. Students would also have access to internships developed by the Biomedical Engineering

Department. This is unique in that students who successfully complete the program would receive automatic admission to Michigan's graduate programs.

Annual Faculty-Staff Exchange:

A faculty member from Tuskegee University's College of Engineering, Architecture and the Physical Sciences and a faculty member from the University of Michigan's College of Engineering will engage in a 4-6 month faculty exchange program beginning in 2001.

Academic Resource and Pipeline Development:

Tuskegee University faculty and the University of Michigan faculty will develop a "shared academic credit model" that can be replicated by various departments and institutions.

Evaluation:

- One-on-one mentoring of academic performance at the undergraduate/graduate level grades in all classes will be monitored throughout the student's participation. This performance data will be compared to those of students not participating in the program.
- An extensive pre- and post- survey will be developed jointly and administered to student participants to determine quality of classroom experience, research opportunity experience, overall graduate experience and career readiness.
- A student focus group will be conducted to identify factors that contribute to, or detract from, student success.
- Additional pre- and post surveys will be administered to first, second and third year Tuskegee students who attend the *Introduction to Biomedical Engineering* presentation.
- Faculty and administrators from both institutions will review the program curriculum annually.

The following program budget reflects initial costs for both institutions and cost-sharing components with the University of Michigan's Rackham School of Graduate Studies. At the end of three years, we anticipate that the University of Michigan's College of Engineering and the Tuskegee University College of Engineering, Architecture and the Physical Sciences will institutionalize all components of this program and replicate this model to include 2 other departments. This model will also be used by Michigan to include two additional Historically Black Colleges and Universities in 2002. Dissemination of the model will include presentations at professional conferences, articles submitted to relevant publications and on or off-site consultation.

References:

1-The Human Capital Liabilities of Underrepresented Minorities in Pursuit of Science, Mathematics and Engineering Doctoral Degrees. *Research News on Minority Graduate Education* Vol.1, No 2 July 1999.p. 11-16

2-Georges, Annie."Keeping What We've Got: The Impact of Financial Aid on Minority Retention in Engineering" *NACME Research Letter* Volume 9, No 2. NACME, New York, NY 1995.

ORGANIZATION:

S. Keith Hargrove, Principal Investigator
Associate Professor of Mechanical Engineering
Gregory Pritchard, Head, Department of Chemistry
Tuskegee University

James Bean, Co-PI, Associate Dean for Graduate Education
Charles Cain, Co-PI, Chair of Biomedical Engineering Department
Debbie Taylor, Co-PI, Office of Graduate Education
The University of Michigan

Dual Degree Curriculum:

Undergraduate work done at Xavier or Tuskegee and completed at UM, plus the following course-work for the masters.

Required Program Subjects:	Hours	First semester	Second semester
Advanced Math	3-4		3-4
Advanced Statistics	3-4	3-4	
BiomedE 500, Biomedical Engineering Seminar	1	1	
BiomedE 550, Ethics and Enterprise	1	1	
BiomedE 590, Directed Study	2-3		2-3
Life Sciences	7-8	4	3-4
MS Concentration requirements	7-8	3-4	4
TOTAL	24+	12-14	12-15

BIOMED E BIOELECTRICAL CONCENTRATION

MS: 30 total credit hours minimum
Advisor: Daryl Kipke, Ph.D. (dkipke@umich.edu)

Bioelectrical:

BIOMED E 417	Electrical Biophysics (4) (I)[1]

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics & Enterprise (1) (I)

Biomedical Research and Design (one course):

BIOMED E 450	Biomedical Design (4) (II) - for MS only students
BIOMED E 590	Directed Research (2) (I,II,III)

Mathematics (one course):

BIOMED E 464	Inverse Problems (3) (II)
Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Math Modeling in Biology (3) (II)
Math 556	Methods of Applied Math I (3) (I)
Math 557	Methods of Applied Math II (3) (II)
Math 571	Numerical Methods for Scientific Comp I (3) (I,II)
Math 572	Numerical Methods for Scientific Comp II (3) (II)
Math 651	Topics of Applied Mathematics I (3) (I)
Math 652	Topics of Applied Mathematics II (3)[2]
Math 656	Intro Partial Differential Equations (3)[2]

Bioinstrumentation (one course):

BIOMED E 458	Biomedical Instrumentation and Design (4) (I, II)

Statistics (one course)[3]:

EECS 501/Aero. 552	Probability and Random Processes (4) (I)
Statistics 525/Math 525	Probability (3) (I,II)

Life Science (two courses):

Required:

BIOMED E 519	Quantitative Physiology (4) (I)

And one of the following:

Neurosci. 570	Neuroanatomy (3) (I)
Neurosci. 693/Phys. 693	Cellular Integrative Neurophysiology (4) (II)
BIOMED E 401	The Human Body (4) (I)
BIOMED E 418	Quantitative Cell Biology (4) (II)

Technical Electives:

The student must select the remaining credit hours needed to fulfill the minimum MS degree requirement of 30 credit hours from graduate level[4] engineering courses. This may include EECS 451 for students needing DSP. No more than 2 credit hours of seminar courses may be applied to the 30 credit hours needed to fulfill the MS degree requirement.

Sample Course Sequence:

Fall	BIOMED E 417 (4), BIOMED E 458 (4), BIOMED E 500 (1), BIOMED E 501 (4)
Winter	BIOMED E 418 (4), BIOMED E 590 (2), Adv. Math
Fall	BIOMED E 519 (4), BIOMED E 550 (1), technical elective (3 or 4)

Recommended Technical Electives:

EECS 451	Digital Signal Processing and Analysis (4) (I,II)
EECS 559	Advanced Signal Processing (3) (II)
BIOMED E 482	Fundamentals of Ultrasonics with Medical Applications (2) (II)
BIOMED E 510	Medical Imaging Laboratory (3) (II)
BIOMED E 516	Medical Imaging Systems (3) (I)
BIOMED E 599	Neural Implants and Neuroprosthetic Systems (3) (I)
EECS 414	Introduction to MEMS (4) (I)
EECS 425	Integrated Microsystems Laboratory (4) (II)

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[1] I- fall, II - winter, III - spring-summer, IIIa - spring half, IIb - summer half.
[2] Refer to the Mathematics department for current offering.
[3] Stat 412: not recommended.
[4] Please see Horace H. Rackham School of Graduate Studies guidelines.

BIOMED E BIOMATERIALS CONCENTRATION

MS: 30 total credit hours minimum
Advisor: David Kohn, Ph.D. (dhkohn@umich.edu)

Biomaterials:

BIOMED E 410	Design and Applications of Biomaterials (4) (I)[1]

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics & Enterprise (1) (I)

Biomedical Research and Design (one course):

BIOMED E 450	Biomedical Design (4) (II) – for MS only students
BIOMED E 590	Directed Research (2) (I,II,III)

Mathematics (one course):

BIOMED E 464	Inverse Problems (3) (II)
ME 501	Analytical Methods in Mechanics (3) (II)
ME 502	Meth. of Differential Equations in Mechanics (3) (I)
ME 504	Principles & Applications of Variational Methods (3) (I)
Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 450[2]	Mathematics for Engineers I (4) (I,II,IIIb)
Math 454	Boundary Value Problems for Partial Differential Equations (3) (I,II,IIIa)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Math Modeling in Biology (3) (II)
Math 556	Methods of Applied Mathematics I (3) (I)
Math 557	Methods of Applied Mathematics II (3) (II)
Math 651	Topics in Applied Mathematics I (3) (I)
Math 656	Intro Partial Differential Equations (3) (refer to Math Dept)
Microbiol 510	Mathematical Models of Infectious Diseases (3) (I-even years)

Bioinstrumentation (one course, either electrically or chemically based, from the following):

Biol Chem 516	Intro Biochemistry Lab (3) (I)
MCDB 429	Lab in Cellular & Molecular Biology (3) (II)
BIOMED E 458	Biomedical Instrumentation & Design (4) (I,II)
MSE 414	Applied Polymer Processing (3) (II)
MSE 465	Structural and Chemical Characterization of Materials (3) (II)

Statistics (one course)[3]:

Biostats 503	Introduction to Biostatistics (4) (I)
Biostats 553	Applied Biostatistics (4) (I)
Biostats 602	Biostatistical Inference (4) (II)
Biostats 650	Applied Statistics I: Linear Regression (4) (I)
Biostats 651	Applied Statistics II: Extensions of Linear-Regression (3) (II)
ChemE 509	Statistical Anal. of Eng. Exper. (3) (II)
IOE 465	Design & Analysis of Industrial Experiments (4) (II)
Statistics 470	Design of Scientific Experiments (4) (II)
Statistics 500	Applied Statistics I (3) (I)
Statistics 501	Applied Statistics II (3) (II)

Life Science (two courses minimum):

Required:

BIOMED E 519	Quantitative Physiology (4) (I)

And one of the following:

Biol Chem 451[4]	Intro. Biochemistry (4) (I)
Biol Chem 515	Introductory Biochemistry (4) (I)
BIOMED E 401	The Human Body (4) (I)
BIOMED E 418	Quantitative Cell Biology (4) (II)
CDB 530	Cell Biology (3) (I)

MCDB 411	Protein Structure and Function (4) (I)
MCDB 427[5]	Molecular Biol. (4) (I)
MCDB 428[5]	Cell Biology (4) (II)
MCDB 435[5]	Intracellular Trafficking (3) (varies)
MCDB 469[5]	Signal Transduction (3) (varies)
Pathology 580	General Pathology for Biomedical Scientists (3) (I)
Pathology 581[5]	Cellular and Molecular Basis of Disease (3) (II)

Technical Electives:

4-8 hours of graduate level engineering or life science courses (technical electives). No more than 2 credit hours of seminar courses may be applied to the 30 credit hours needed to fulfill the MS degree requirement.

Technical Electives Applicable to Biomaterials Option:

BIOMED E 417	Electrical Biophysics (4) (I)
BIOMED E 456	Tissue mechanics (3) (II)
BIOMED E 476	Thermal-Fluid Sci. in Bioengineering (3) (II)
BIOMED E 518	Engineering Fundamentals in Biological Systems (3) (II-alternate years)
BIOMED E 525	Cellular & Molecular Networks (3) (II)
BIOMED E 584	Tissue Engineering (3) (I)
BIOMED E 616	Analysis of Chemical Signaling (3) (II)

Other Thrust Areas/Courses Applicable to Biomaterials:

Advanced Materials:

Ceramics:	MSE 440, 542, 543, 544
Polymers:	MSE 412, 414, 511, 512
Composites:	MSE 514, 515; AE 515, 516

Mechanisms:

Mechanical Aspects of Biomaterials:
MSE 420, 520, 577; ME 412, 505, 512, 514, 517, 519, 521, 556, 580, 581, 589, 605; ChemE 527

Physical Aspects of Biomaterials:
MSE 430, 435, 532, 535, 560; ChemE 542

Surface Aspects of Biomaterials:
MSE 465, 505, 562, 622, 662; ChemE 470, 519

Sample Course Sequences for Biomaterials Option in BioMedical Engineering:

Note that foci in biomaterials may be developed in one of three ways:

1) Materials (i.e., metals, ceramics, polymers, composites)
2) Mechanisms (i.e., mechanical, physical, surface science)
3) Application (i.e., materials for hard tissue, soft tissue, blood contact, biosensors, controlled release)

Example I - Focus on Mechanical/Physical Aspects of Biomaterials:

Fall	Biol 427, BIOMED E 410, BIOMED E 500, BIOMED E 550, Biostats 553
Winter	BIOMED E 456, BIOMED E 458, BIOMED E 590, Math 463
Fall	BIOMED E 519, MSE 514, ME 505 or ChemE 548

Example II - Focus on Biopolymers:

Fall	Biol 427, BIOMED E 410, BIOMED E 500, BIOMED E 550, Biostats 553
Winter	MCDB 429, BIOMED E 590, Math 463
Fall	BIOMED E 519, BIOMED E 584, MSE 511

Example III - Focus on Cell/Surface Aspects of Biomaterials:

Fall	Biol. 427, BIOMED E 410, BIOMED E 500, BIOMED E 550, Biostats 553
Winter	MCDB 429, BIOMED E 525 or BIOMED E 616, MSE 562, Math 463
Fall	BIOMED E 519, BIOMED E 584, BIOMED E 590 or Biol 427

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[1] I - fall, II - winter, III – spring-summer, IIIa - spring half, IIIb - summer half.

[2] Recommended primarily for students with non-engineering backgrounds.

[3] Stat 412: Not recommended.

[4] Students that have received their undergraduate degree at U of M and have taken Biol. 310 or 311 will not get credit for taking Biol. Chem. 451.

[5] These life science courses are not recommended without appropriate prerequisites.

BIOMED E BIOMECHANICS CONCENTRATION

MS: 30 total credit hours minimum
Advisor: Joseph L. Bull, Ph.D. (joebull@umich.edu)

Biomechanics: (one course)

BIOMED E 456	Tissue Mechanics (3) (II)[1]
BIOMED E 476	Thermal-Fluid Science in Bioengineering (4) (II)

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics & Enterprise (1) (I)

Biomedical Research and Design (one course):

BIOMED E 450	Biomedical Design (4) (II) ñ for MS only students
BIOMED E 590	Directed Research (2) (I,II,III)

Mathematics (one course):

Math 404	Intermediate Differential Equations (3) (I-sporadically)
Math 417	Matrix Algebra I (3) (I,II,III)
Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 420	Matrix Algebra II (3) (refer to math dept.)
Math 450	Advanced Math for Engineers I (4) (I,II,IIIb)
Math 454	Boundary Value Problems (3) (I,II,IIIa)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Mathematical Modeling in Biology (3) (II)
Math 471	Intro to Numerical Methods (3) (I,II,IIIb)
Math 555	Introduction to Functions of a Complex Variable with Applications (3) (I,II,IIIa)
Math 556	Methods of Applied Math I (3) (I)
Math 557	Methods of Applied Math II (3) (II)
Math 558	Ordinary Differential Equations (3) (refer to math dept.)
Math 559	Topics in Applied Math (3) (refer to math dept.)
Math 561	Linear Programming 1 (3) (I,II)
Math 571	Numerical Methods for Scientific Comp I (3) (I,II)
Math 572	Numerical Methods for Scientific Computation II (3) (II)
ME 501	Analytical Methods in Mechanics (3) (II)
ME 502	Methods of Differential Equations in Mechanics (3) (I)
ME 507	Approximate Methods in Mechanical Engineering (3) (II)
ME 605	Advanced FEM in Mech (3) (I)
ME 626	Perturbation Methods for Fluids (3) (II)
MSE 554/ChemE 554	Computational Methods in MSE and ChemE (3) (I)
ChemE 510	Mathematical Methods in Chemical Engineering (3) (II)

Bioinstrumentation (one course):

BIOMED E 458	Biomedical Instrumentation & Design (4) (I,II)

Statistics (one course)[2]:

Biostatistics 503	Introduction to Biostatistics (4) (I)
Biostatistics 553	Applied Biostatistics (4) (I)
IOE 465	Design & Analysis of Industrial Experiments (4) (I)
Statistics 400	Applied Statistical Methods (4) (I,II)
Statistics 470	Design of Scientific Experiments (4) (II)
Statistics 500	Applied Statistics I (3) (I)
Statistics 501	Applied Statistics II (3) (II)

Life Science (two courses):

Required:

BIOMED E 519	Quantitative Physiology (4) (I)

And one of the following:

Anat 715	Stem Cell Biology (3) (II, odd years)
Biol 427[3]	Molecular Biol. (4) (I,II)
Biol Chem 451	Intro. Biochemistry (4) (I)
BIOMED E 401	The Human Body (4) (I)
BIOMED E 418	Quantitative Cell Biology (4) (II)
MCDB 428[3]	Cell Biology (4) (I)
Neurosci 570	Neuroanatomy (3) (II)

Neurosci/Phys 693
Cellular Integrative Neurophysiology (4) (II)

Technical Electives:

5 hours of graduate level* engineering courses (technical electives).
No more than 2 credit hours of seminar courses may be applied to the 30 credit hours needed to fulfill the MS degree requirement.

Sample Course Sequences:

Biofluids concentration:

Fall	BIOMED E 500, BIOMED E 550, BIOMED E 519, ME 520
Winter	BIOMED E 458, BIOMED E 476, Math 454, ME 521
Fall	Biostats 553, BIOMED E 479, BIOMED E 590

Tissue Mechanics concentration:

Fall	MCDB 428 or Biol. Chem. 451, BIOMED E 458, BIOMED E 500, BIOMED E 519, BIOMED E 550
Winter	BIOMED E 418, BIOMED E 590 or 450, ME 501, ME 505
Fall	BIOMED E 401, BIOMED E 506, Biostats. 553

Whole Body Dynamics concentration:

Fall	BIOMED E 458, BIOMED E 500, BIOMED E 519, BIOMED E 550, BIOMED E 590
Winter	BIOMED E 456 or 534, ME 501, ME 560, BIOMED E 646
Fall	BIOMED E 401, ME 543, Biostats. 553

Technical Electives with BioFluids Content:

ChemE 527	Fluid Flow (3) (1)
ChemE 542	Intermediate Transport Phenomena (3) (I)
ME 521	Advanced Fluid Mechanics II (3) (II)
ME 523/Aero. 523	

BIOMED E BIOMECHANICS OPTION
Computational Fluid Dynamics I (3) (I)

ME 524	Advanced Engineering Acoustics (3) (II)
ME 527	Multiphase flow (3) (II)
CEE 528	Flow & Transport in Porous Media (3) (II)
ME 520	Advanced Fluid Mechanics I (3) (I)
ME 562	Dynamic Behavior of Thermo-Fluid Processes (3) (II alternate years)
ME 622	Inviscid Fluids (3) (II)
ME 623	Hydrodynamic Stability (3) (I)
ME 625	Nonhomogeneous Fluids (3) (I,II)
ME 627	Wave Motion in Fluids (3) (I)

Other courses of interest to Fluid Mechanics students:

AE 521	Experimental Methods in Fluid Mechanics (3) (II)
BIOMED E 479	Biotransport (4) (II)
ME 530	Advanced Heat Transfer (3) (I)
ME 617	Mechanics of Polymers II (3) (II-alternate years)

Technical Electives with Biomechanics content:

BIOMED E 534	Occupational Biomechanics (3) (II)
BIOMED E 506	Computational Modeling of Biological Tissues (3) (I,II)
BIOMED E 599	Special Topics I,II (1-6) (I,II)
BIOMED E 635	Laboratory in Biomechanics and Physiology of Work (2) (II)
BIOMED E 646	Mechanics of Human Movement (3) (II, alternate years)
IOE 567	Work Related Musculoskeletal Disorders (3) (II)

Technical Electives with Connective Tissue Content:

BIOMED E 410 Design and Applications of Biomaterials (4) (I)
BIOMED E 525 Cellular & Molecular Networks (3) (II)
BIOMED E 584 Tissue Engineering (3) (I)
BIOMED E 561 Micro- and Nanotechnology for Biology (3) II
ME 505 FEM in MEAM (3) (I,II)
ME 511 Theory of Solid Continua (3) (I)
ME 512 Theory of Elasticity (3) (II)
ME 517 Mechanics of Polymers I (3) (II)

Technical Electives with Dynamics/Control Content:

EECS 562/Aero 551 Nonlinear Systems & Control (3) (II)
ME 440 Intermediate Dynamics & Vibrations (4) (I,IIIa)
ME 540/Aero. 540 Intermediate Dynamics (4) (I)
ME 543 Analytical & Computational Dynamics I (3) (I)
ME 560/Mfg 562 Modeling Dynamic Systems (3) (II)
ME 561 Design of Digital Control Systems (3) (I,II)

Technical Electives with Rehabilitation Engineering:

BIOMED E 530 Rehabilitation Engineering and Technology Lab (1) (I)

Dual Degree (Second Masters, in ME for example) (20 additional credits):

ME requirements: 30 credits total (10 of BIOMED E MS credits can double-count towards 30 required for ME MS) including:

12 credits in ME at 500 level or above.
6 credits maximum of ME 590.
6 credits advanced math courses (any engineering related course for which Math 215 and/or Math 216 is prerequisite).

6 credits elected cognate courses outside your program (flexible, Math, BIOMED E count, but not ME).

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[1] I - fall, II - winter, III - spring-summer, IIIa - spring half, IIIb - summer half.
[2] Stat 412: Not recommended.
[3] These life science courses are not recommended without appropriate prerequisites.
[4] Please see Horace H. Rackham School of Graduate Studies guidelines.

BIOMED E BIOMEDICAL IMAGING CONCENTRATION

MS: 30 total credit hours minimum
Advisor: Luis Hernandez, Ph.D. (hernan@umich.edu)

Biomedical Imaging:

BIOMED E 516[1]	Medical Imaging Systems (3) (I)[2]

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics and Enterprise (1) (I)

Biomedical Research and Design (one course):

BIOMED E 450	Biomedical Design (4) (II) ñ for MS only students
BIOMED E 590	Directed Research (2) (I,II,III)

Mathematics (one course):

BIOMED E 464	Inverse Problems (3) (II)
Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Math Modeling in Biology (3) (II)
Math 513	Introduction to Linear Algebra[3] (3) (I,II)
Math 556	Methods of Applied Math I (3) (I)
Math 557	Methods of Applied Math II (3) (II)
Math 562	Continuous Optimization Methods (3) (I)
Math 571	Numerical Methods for Scientific Comp. I (3) (I,II)
Math 572	Numerical Methods for Scientific Comp. II (3) (II)
Math 651	Topics of Applied Mathematics I (3) (I)
Math 652	Topics of Applied Mathematics II (3)[4]
Math 656	Intro Partial Differential Equations (3)[5]
Math 658	Dynamical Systems and Geometric Dynamics (3)[5]

Bioinstrumentation (one course):

BIOMED E 458	Biomedical Instrumentation and Design (4) (I,II)
BIOMED E 510	Medical Imaging Laboratory (3) (II)
Biophysics 608	Biophysical Principles of Microscopy (3) (I ñ alternate years)

Statistics (one course):

EECS 501/Aero. 552	Probability and Random Processes (4) (I)
Statistics 525/Math 525	Probability (3) (I,II)

Life Science (two courses):

Required:

BIOMED E 519	Quantitative Physiology (4) (I)

And one of the following:

BIOMED E 401	The Human Body (4) (I)
BIOMED E 418	Quantitative Cell Biology (4) (II)

Technical Electives:

The student must select the remaining credit hours needed to fulfill the minimum MS degree requirement of 30 credit hours from graduate level[5] engineering. This may include EECS 451 for students needing DSP. No more than 2 credit hours of seminar courses may be applied to the 30 credit hours needed to fulfill the MS degree requirement.

Sample Course Sequences:

For a student that has not had DSP:

Fall	BIOMED E 458, BIOMED E 500, EECS 451, EECS 501
Winter	BIOMED E 418, EECS 556, Math 513
Fall	BIOMED E 516, BIOMED E 519, BIOMED E 550, BIOMED E 590

For a student that has had DSP:

Fall	BIOMED E 458, BIOMED E 500, BIOMED E 516, EECS 501
Winter	BIOMED E 418, BIOMED E 510, EECS 556, Math 513
Fall	BIOMED E 519, BIOMED E 550, BIOMED E 590

Recommended Technical Electives:

BIOMED E 417	Electrical Biophysics (4) (I)
BIOMED E 482	Fundamentals of Ultrasonics (2) (II)
BIOMED E 599-section 127	Biomedical Optics (3) (I)
EECS 556	Image Processing (3) (II)
EECS 559	Advanced Signal Processing (3) (II)

For Doctoral Students the following courses are recommended:

BIOMED E 510	Medical Imaging Laboratory (3) (II)

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[1] Officially EECS 451 (Digital Signal Processing) is a prerequisite, but taken concurrently is adequate for students with a good background in linear systems and Fourier transforms (e.g. EECS 316). Students who consider concurrent enrollment should consult with the EECS 516 instructor.

[2] I - fall, II - winter, III - spring-summer, IIIa - spring half, IIIb - summer half.

[3] Prerequisites: Math 412.

[4] Refer to the Mathematics Department for current offering.

BIOMED E BIOTECHNOLOGY CONCENTRATION

MS: 30 total credit hours minimum
Advisor: Alan Hunt, Ph.D. (ajhunt@umich.edu)

Biotechnology (one course):

BIOMED E 410	Design and Application of Biomaterials (4) (I)[1]
BIOMED E 556	Cellular and Molecular Biomechanics (3) (I)
BIOMED E 584	Tissue Engineering (3) (I)
BIOMED E 561	Micro and Nanotechnology for Biology (3) (II)

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics & Enterprise (1) (I)

Biomedical Research and Design (one course):

BIOMED E 450	Biomedical Engineering Design (4) (II) - for MS only students
BIOMED E 590	Directed Research (2) (I,II,III)

Mathematics (one course):

Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 450	Advanced Mathematics for Engineers I (4) (I,II,IIIb)
Math 454	Boundary Value Problems for Partial Differential Equations (3) (I,II,IIIa)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Math Modeling in Biology (3) (II)
Math 556	Methods of Applied Math I (3) (I)
ChemE 507	Mathematical Modelling in Chemical Engin. (3) (I)
ChemE 554/MSE 554	Computational Methods in MSE and ChemE (3) (I)
ChemE 510	Applied Mathematical Methods in Chemical Engineering (3) (II)

Bioinstrumentation (one course):

BIOMED E 458	Biomedical Instrumentation and Design (4) (I,II)
MCDB 429	Laboratory in Cell and Molecular Biology (3) (II)
Biol Chem 516	Intro Biochemistry Lab (3) (I)
Biophysics 608	Biophysical Principles of Microscopy (3) (I ñ alternate years)

Statistics (one course)[2]:

Biostatistics 503	Introduction to Biostatistics (4) (I)
Biostatistics 553	Applied Biostatistics (4) (I)
ChemE 509	Statistical Analysis of Engineering Experiments (3) (II)
IOE 465	Design and Analysis of Industrial Experiments (4) (II)
Statistics 470	Design of Scientific Experiments (4) (II)
Statistics 500	Applied Statistics I (3) (I)
Statistics 501	Applied Statistics II (3) (II)

Life Science (two courses):

Required:

Biol. Chem. 451[3]	Intro Biochemistry (Biotechnology only)[4] (4) (I)
BIOMED E 519	Quantitative Physiology (Tissue Engineering only)[5] (4) (I)

And one of the following:

Anatomy 715	Stem Cell Biology (3) (II,alternate years)
Biol 427[6]	Molecular Biology (4) (I)
BIOMED E 418	Quantitative Cell Biology (4) (II)
BIOMED E 479	Biotransport (4) (II)

Technical Electives:

At least one graduate level[7] engineering and biology course. For technical electives outside of those listed, you must obtain approval from the biotechnology advisor.

Sample Course Sequence:

Fall	Biol. Chem. 451 or BIOMED E 519, BIOMED E 500, BIOMED E 550, Statistics 400, technical elective
Winter	BIOMED E 418, MCDB 429, technical electives
Fall	BIOMED E 584, ChemE 508, BIOMED E 590

Technical Electives with biotechnology content:

BIOMED E 410	Design and Applications of Biomaterials (4) (I)
BIOMED E 476	Biofluid Mechanics (3) (II)
BIOMED E 584	Tissue Engineering (3) (I)
BIOMED E 616	Analysis of Chemical Signalling (3) (II)
ChemE 528	Chemical Reactor Engineering (3) (I)
ChemE 538	Statistical and Irreversible Thermodynamics (3) (II)
ChemE 542	Intermediate Transport Phenomena (3) (I)
ChemE 617/Mfg 617	Advanced Biochemical Technology (3) (II)

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[1] I - fall, II - winter, III - spring-summer, IIIa - spring half, IIIb - summer half.

[2] Stat 412: not recommended.

[3] Students that have received their undergraduate degree at U of M and have taken Biol. 310 or 311 will not get credit for taking Biol. Chem. 451.

[4] For students that are following the Biotechnology track.

[5] For students that are following the Tissue Engineering track.

[6] This life science course is not recommended without the appropriate prerequisite.

[7] Please see Horace H. Rackham School of Graduate Studies guidelines.

BIOMED E REHABILITATION ENGINEERING AND ERGONOMICS CONCENTRATION[1]

MS: 30 total credit hours minimum

Advisors: Simon P. Levine, Ph.D. (silevine@umich.edu) and Thomas J. Armstrong (tja@umich.edu)

Rehabilitation Engineering:

BIOMED E 430	Rehab. Engineering and Assistive Technology (3) (I)[2]
BIOMED E 530	Rehab. Eng. and Technology Lab (1) (I)

General:

BIOMED E 500	Biomedical Engineering Seminar (1) (I)
BIOMED E 550	Ethics & Enterprise (1) (I)

Research, Design, Internship[3] (2 hours min):

BIOMED E 450	Biomedical Design (4) (II) (required for ergonomics focus)
BIOMED E 590	Directed Research (2) (I,II,III)
PM&R 539	Rehab. Eng. Clinical Internship (2-6) (I,II,III)

Mathematics (one course):

Math 419/EECS 400	Linear Spaces and Matrix Theory (3) (I,II)
Math 450	Advanced Math for Engineering (4) (I,II,IIIb)
Math 454	Boundary Value Problems for PDE (3) (I,II,IIIa)
Math 462	Mathematical Models (3) (II-sporadically)
Math 463	Math Modeling in Biology (3) (II)
Math 471	Introduction to Numerical Methods (3) (I,II,IIIb)
Math 556	Methods of Applied Math I (3) (I)
Math 557	Methods of Applied Math II (3) (II)
Math 571	Numerical Methods for Scientific Comp I (3) (I,II)
Math 572	Numerical Methods for Scientific Comp II (3) (II)
ME 501	Analytical Methods in Mechanics (3) (II)
ME 502	Methods of Differential Equations in Mechanics (3) (I)
ME 507	Approximate Methods in Mech. Engineering (3) (II)

Bioinstrumentation (one course):

BIOMED E 458	Biomedical Instrumentation & Design (4) (I,II)

Statistics (one course):

Biostatistics 503	Introduction to Biostatistics (4) (I)
Biostatistics 553	Applied Biostatistics (4) (I)
EECS 501/Aero 552	Probability and Random Processes (4) (I)
IOE 465	Design and Analysis of Industrial Experiments (4) (I,II)
Statistics 470	Design of Scientific Experiments (4) (II)
Statistics 500	Applied Statistics I (3) (I)
Statistics 501	Applied Statistics II (3) (II)

Life Science:

BIOMED E 519	Quantitative Physiology (4) (I)
PM&R 510	Disability and Rehabilitation Methods (3) (I)

Technical Electives:

Human Factors (one course):

EECS 493	User Interface Development (4) (II)
EECS 593	The Human as an Information Processing Syst. (3) (I, odd years)
IOE 436	Human Factors in Computer Systems (4) (II)
IOE 533	Human Factors in Engineering Systems I (3) (I)

Biomechanics/Ergonomics (one course):

BIOMED E 534	Occupational Biomechanics (3) (II)
IOE 567	Work Related Musculoskeletal Disorders (3) (II)

Sample Course Sequence[4]:

Fall	BIOMED E 500, BIOMED E 519, BIOMED E 530
Winter	IOE 436, Math 450
Sp/Sum	PM&R 510, PM&R 539
Fall	BIOMED E 458, BIOMED E 550
Winter	BIOMED E 534

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[1] Students in the Rehabilitation Engineering Option can apply for a two-year clinical internship, taken in conjunction with the RE/Ergo option, at the University of Michigan Medical Center.

[2] I- fall, II - winter, III- spring-summer, IIIa - spring half, IIIb - summer half.

[3] Only students accepted into the clinical internship are eligible to take PM&R 539. Other students must satisfy this requirement with Biomed E Design or Directed Research. A minimum of 2 hours of Directed Research is required for any student proceeding on to the Ph.D.

[4] Students in the clinical internship are normally limited to less than 9 hours/term of formal class hours.

COURSE APPROVAL FORMS

For February 1, 2005 CoE CC Meeting

EECS 284 (X-Listed with CS 284)	Deletion
EECS 486	Deletion
EECS 506	Deletion
EECS 577	Deletion
EECS 585 (X-Listed with CS 585)	Deletion

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Print

Form Number 1473

Action Requested

- ○ New Course
- ○ Modification of Existing Course
- ◉ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

Date 1/24/2005
Effective Fall 2005

A. CURRENT LISTING

Home Department: EECS | Div #: 252 | Course Number: 284

Cross Listed Course Information:

Course Title: Introduction to a Programming Language or Syst

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces: Prog Lang/System
- Transcript Max = 20 Spaces: Prog Lang

Course Description: A minicourse covering a complex computer system or programming language. Specific languages or systems to be offered will be announced in advance.

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites: Some programming knowledge
○ Enforced ◉ Advised

Credit Restrictions:

Level of Credit:
☒ Undergrad only
☐ Rackham Grad
☐ Non-Rckhm Grad
☐ Ugrad or Rckhm Grad
☐ Ugrad or Non-Rckhm Grad
☐ All Credit types
☐ Rckhm Grad w/add'l Work

Credit Hours: Min 1 | Max 1

Contact Hrs/Wk: 2
Number of Wks: 7

B. REQUESTED LISTING

Home Department | Div # | Course Number

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces:
- Transcript Max = 20 Spaces:

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites:
○ Enforced ○ Advised

Credit Restrictions:

Level of Credit:
☐ Undergrad only
☐ Rackham Grad
☐ Non-Rckhm Grad
☐ Ugrad or Rckhm Grad
☐ Ugrad or Non-Rckhm Grad
☐ All Credit types
☐ Rckhm Grad w/add'l Work

Credit Hours: Min ___ | Max ___

Contact Hrs/Wk:
Number of Wks:

C.

Repeatability (Indi Research, Dir. Study, Dissertation:
Is this course repeatable? ○ Yes ◉ No
Maximum Hours? ___ Maximum Times? ___
Can it be repeated in the same term? ○ Yes ○ No

Printing Information (Optional)
☐ Print the course in the Bulletin
☐ Print the course in the Time Schedule

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ___

Graded Section: ◉ Lec ○ Rec ○ Sem ○ Lab ○ Dis ○ Ind ○ Other

Grading: ☒ A-E ☐ CR/NC ☐ S/U ☐ P/F ☐ Y

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Terms & Freq. of Offering: ■ I ■ II ☐ IIIa ☐ IIIb ☐ III
■ Yearly ☐ After Years ☐ Even Years ☐ Odd Years

Half term: ☐ 1st ☐ 2nd

Cognizant Faculty Member: T. Toeney | Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval
- ☐ Curriculum Comm.
- ☐ Faculty
- ☐ Rackham
- ☐ Cross listed Unit 1
- ☐ Cross listed Unit 2

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.
Name, Signature & Department
Home Dept. EECS
Cross-listed Dept(s).

Form Number

1473

SUPPORTING STATEMENT

This course has been not offered for long time and we don'thhave a plan to support it.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Print

Form Number 1474

Action Requested

- ○ New Course
- ○ Modification of Existing Course
- ⊙ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

Date 1/24/2005
Effective Fall 2005

A. CURRENT LISTING

Home Department: EECS | Div #: 252 | Course Number: 486

Cross Listed Course Information:

Course Title: Object-Oriented Methodology

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces: O-O Soft Meth
- Transcript Max = 20 Spaces: O-O Soft Meth

Course Description:
Object-based requirement analysis and design concepts such as program abstraction, encapsulation, polymorphism, inheritance, generalization, and reusability. Object oriented system decomposition and class design. Use of an OO Modeling and design methodology such as UML or OMT. Implementation of a software system based on OO requirement and design analysis is required.

PROGRAM OUTCOMES:
☒ a ☐ b ☒ c ☐ d ☒ e ☐ f ☒ g ☐ h ☐ i ☐ j ☒ k

Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ⊙ Tech Elective ○ Other

Prerequisites: EECS 281 or Graduating Standing ⊙ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☒ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work

Credit Hours: Min 4 Max 4

Contact Hrs/Wk: 4

Number of Wks: 14

B. REQUESTED LISTING

Home Department | Div # | Course Number

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces:
- Transcript Max = 20 Spaces:

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other

Prerequisites: ○ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/add'l Work

Credit Hours: Min Max

Contact Hrs/Wk:

Number of Wks:

C.

Repeatability (Indl Research, Dir. Study, Dissertation:
Is this course repeatable? ○ Yes ○ No
Maximum Hours? ____ Maximum Times? ____
Can it be repeated in the same term? ○ Yes ○ No

Printing Information (Optional): ☐ Print the course in the Bulletin ☐ Print the course in the Time Schedule

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☒ Dis ☐ Ind ☐ Other ____

Graded Section: ⊙ Lec ○ Rec ○ Sem ○ Lab ○ Dis ○ Ind ○ Other

Grading: ☒ A-E ☐ CR/NC ☐ S/U ☐ P/F ☐ Y

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Terms & Freq. of Offering: ☐ I ☐ II ☐ IIIa ☐ IIIb ☐ III ☐ Yearly ☐ Alter Years ☐ Even Years ☐ Odd Years

Half term: ☐ 1st ☐ 2nd

Cognizant Faculty Member: Toby Teorey | Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval
- ☐ Curriculum Comm.
- ☐ Faculty
- ☐ Rackham
- ☐ Cross listed Unit 1
- ☐ Cross listed Unit 2

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.
Name, Signature & Department
Home Dept. EECS
Cross-listed Dept(s).

Form Number

1474

SUPPORTING STATEMENT

This course has been not offered for long time and we don'thhave a plan to support it.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Print

Form Number 1477

Action Requested

- ○ New Course
- ○ Modification of Existing Course
- ⊙ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

Date 1/24/2005
Effective Fall 2005

A. CURRENT LISTING

Home Department: EECS | Div #: 252 | Course Number: 506

Cross Listed Course Information:

Course Title: Computing System Evaluation

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces: Comp Sys Evaluation
- Transcript Max = 20 Spaces: Comp Sys Eval

Course Description:
Theory and application of analytic methods for evaluating the performance and reliability of computing systems. Measures of performance, reliability, and performability. Reliability evaluation: classification and representation of faults, stochastic process models, coherent systems. Performance evaluation: Markovian queueing models, networks of queues. Unified performance-reliability evaluation.

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites: EECS 183 or EECS 280, and EECS 370 and EECS 501
○ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/addl Work

Credit Hours: Min 3 Max 3

Contact Hrs/Wk: 3
Number of Wks: 14

B. REQUESTED LISTING

Home Department | Div # | Course Number

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces:
- Transcript Max = 20 Spaces:

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites: ○ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ Rackham Grad ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad ☐ All Credit types ☐ Rckhm Grad w/addl Work

Credit Hours: Min ___ Max ___

Contact Hrs/Wk: ___
Number of Wks: ___

C.

Repeatability (Indl Research, Dir. Study, Dissertation:
Is this course repeatable? ○ Yes ○ No
Maximum Hours? ___ Maximum Times? ___
Can it be repeated in the same term? ○ Yes ⊙ No

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ___

Graded Section: ⊙ Lec ○ Rec ○ Sem ○ Lab ○ Dis ○ Ind ○ Other

Grading: ☒ A-E ☐ CR/NC ☐ S/U ☐ P/F ☐ Y

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

Printing Information (Optional): ☐ Print the course in the Bulletin ☐ Print the course in the Time Schedule

Terms & Freq. of Offering: ☐ I ☒ II ☐ IIIa ☐ IIIb ☐ III ☒ Yearly ☐ Alter Years ☐ Even Years ☐ Odd Years

Half term: ☐ 1st ☐ 2nd

Cognizant Faculty Member: Toby Teorey | Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval
- ☐ Curriculum Comm.
- ☐ Faculty
- ☐ Rackham
- ☐ Cross listed Unit 1
- ☐ Cross listed Unit 2

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.
Name, Signature & Department
Home Dept. EECS
Cross-listed Dept(s).

Form Number

1477

SUPPORTING STATEMENT

This course has been not offered for long time and we don'thhave a plan to support it.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Print

Form Number 1475

Action Requested

- ○ New Course
- ○ Modification of Existing Course
- ⊙ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

Date 1/24/2005
Effective Fall 2005

A. CURRENT LISTING

Home Department: EECS | Div #: 252 | Course Number: 577

Cross Listed Course Information:

Course Title: Reliable Computing System

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces: Reliable Comp. Syst.
- Transcript Max = 20 Spaces: Reliable Comp. Syst.

Course Description:
An introduction to models and methods used in the analysis and design of reliable hardware systems, software systems and computing systems. Aspects of reliability considered include fault tolerance, fault detection and diagnosis, reconfiguration, design verification and testing, and reliability evaluation.

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other

Prerequisites: EECS 280 and 478
○ Enforced ⊙ Advised

Credit Restrictions:

Level of Credit:
- ☐ Undergrad only
- ☐ Rackham Grad
- ☐ Non-Rckhm Grad
- ☒ Ugrad or Rckhm Grad
- ☐ Ugrad or Non-Rckhm Grad
- ☐ All Credit types
- ☐ Rckhm Grad w/add'l Work

Credit Hours: Min 3 | Max 3

Contact Hrs/Wk: 3
Number of Wks: 14

C. Repeatability (Indi Research, Dir. Study, Dissertation:
Is this course repeatable? ○ Yes ⊙ No
Maximum Hours? ____ Maximum Times? ____
Can it be repeated in the same term? ○ Yes ○ No

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ____

Graded Section: ⊙ Lec ○ Rec ○ Sem ○ Lab ○ Dis ○ Ind ○ Other

Grading: ☒ A-E ☐ CR/NC ☐ S/U ☐ P/F ☐ Y

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

B. REQUESTED LISTING

Home Department | Div # | Course Number

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION
- Time Sched Max = 19 Spaces:
- Transcript Max = 20 Spaces:

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Core Course ○ Free Elective ○ Tech Elective ○ Other

Prerequisites: ○ Enforced ○ Advised

Credit Restrictions:

Level of Credit:
- ☐ Undergrad only
- ☐ Rackham Grad
- ☐ Non-Rckhm Grad
- ☐ Ugrad or Rckhm Grad
- ☐ Ugrad or Non-Rckhm Grad
- ☐ All Credit types
- ☐ Rckhm Grad w/add'l Work

Credit Hours: Min ____ | Max ____

Contact Hrs/Wk: ____
Number of Wks: ____

Printing Information (Optional): ☐ Print the course in the Bulletin ☐ Print the course in the Time Schedule

Terms & Freq. of Offering: ☐ I ☐ II ☐ IIIa ☐ IIIb ☐ III ☐ Yearly ☐ After Years ☐ Even Years ☐ Odd Years

Half term: ☐ 1st ☐ 2nd

Cognizant Faculty Member: Toby Teorey | Title: Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval
- ☐ Curriculum Comm.
- ☐ Faculty
- ☐ Rackham
- ☐ Cross listed Unit 1
- ☐ Cross listed Unit 2

Submitted By: ☐ Home Dept. ☐ Cross-listed Dept.
Name, Signature & Department
Home Dept. EECS
Cross-listed Dept(s).

Form Number

1475

SUPPORTING STATEMENT

This course has been not offered for long time and we don'thhave a plan to support it.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

THE UNIVERSITY OF MICHIGAN -- COLLEGE OF ENGINEERING
Course Approval Request
College Curriculum Committee, 1420 Lurie Engineering Center Building

Print

Form Number 1476

Action Requested

- ○ New Course
- ○ Modification of Existing Course
- ⊙ Deletion of Course

Complete the following sections:
New Courses - B & C completely
Modifications - A modified information, B & C completely
Deletions - A & C completely

Date 1/24/2005
Effective Fall 2005

A. CURRENT LISTING

Home Department: EECS | Div #: 252 | Course Number: 585

Cross Listed Course Information:

Course Title: Web Technologies

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces	Web Technologies	
Transcript Max = 20 Spaces	Web Technologies	

Course Description:
Web-related client-server protocols and performance issues; web proxies; web caching and prefetching; dynamic web content; server-side web applications support; scalable web servers; security topics such as user authentication, secure sockets layer and secure HTTP; electronic payment systems; web-based virtual communities; information discovery.

PROGRAM OUTCOMES:
☒ a ☒ b ☒ c ☒ d ☒ e ☐ f ☒ g ☒ h ☐ i ☒ j ☒ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites: EECS 482 or EECS 485 or Permission of instructor
⊙ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ All Credit types ☐ Rackham Grad ☐ Rckhm Grad w/add'l Work ☐ Non-Rckhm Grad ☒ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad

Credit Hours: Min 3 Max 3
Contact Hrs/Wk 3
Number of Wks 14

C. Repeatability (Indl Research, Dir. Study, Dissertation:
Is this course repeatable? ○ Yes ⊙ No
Maximum Hours? ____ Maximum Times? ____
Can it be repeated in the same term? ○ Yes ○ No

Class Type(s): ☒ Lec ☐ Rec ☐ Sem ☐ Lab ☐ Dis ☐ Ind ☐ Other ____

Graded Section: ⊙ Lec ○ Rec ○ Sem ○ Lab ○ Dis ○ Ind ○ Other

Grading: ☒ A-E ☐ CR/NC ☐ S/U ☐ P/F ☐ Y

Location: ☒ Ann Arbor ☐ Biological Station ☐ Camp Davis ☐ Extension

B. REQUESTED LISTING

Home Department | Div # | Course Number

Cross Listed Course Information:

Course Title:

TITLE ABBREVIATION		
Time Sched Max = 19 Spaces		
Transcript Max = 20 Spaces		

Course Description for Official Publication (Max = 50 words):

PROGRAM OUTCOMES:
☐ a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ h ☐ i ☐ j ☐ k

Degree Requirements: ○ Degree Requirement ○ Tech Elective ○ Core Course ○ Other ○ Free Elective

Prerequisites: ○ Enforced ○ Advised

Credit Restrictions:

Level of Credit: ☐ Undergrad only ☐ All Credit types ☐ Rackham Grad ☐ Rckhm Grad w/add'l Work ☐ Non-Rckhm Grad ☐ Ugrad or Rckhm Grad ☐ Ugrad or Non-Rckhm Grad

Credit Hours: Min ____ Max ____
Contact Hrs/Wk ____
Number of Wks ____

Printing Information (Optional): ☐ Print the course in the Bulletin ☐ Print the course in the Time Schedule

Terms & Freq. of Offering: ☒ I ☐ II ☐ IIIa ☐ IIIb ☐ III ☐ Yearly ☒ Alternate Years ☐ Even Years ☐ Odd Years
Half term: ☐ 1st ☐ 2nd

Cognizant Faculty Member: A. Prakash / J.Patel
Title: Professor / Asst. Professor

Grad Course: Attach nomination if Cognizant Faculty is not a regular graduate faculty

Approval
- ☐ Curriculum Comm.
- ☐ Faculty
- ☐ Rackham
- ☐ Cross listed Unit 1
- ☐ Cross listed Unit 2

Submitted By: ☒ Home Dept. ☐ Cross-listed Dept.
Name, Signature & Department
Home Dept. EECS
Cross-listed Dept(s)

Form Number

1476

SUPPORTING STATEMENT

This course has been not offered for long time and we don'thhave a plan to support it.

Are any special resources or facilities required for this course? ☐ Yes ☐ No

Detail the Special requirements

"W" SUBCOMMITTEE REPORT
January 13, 2005

Paige Butler (Chair), Jayne Brownell, Tim Chupp, Marjorie Horton, Robert Megginson, Benjamin Sonday

---

The subcommittee recommends the following regarding the "W" proposal:

1. The policy would apply only to *first-term* LSA students in all courses in which they are enrolled, both LSA and non-LSA courses.

2. We recommend that the policy *not apply* to students who transfer into LSA from another College within UM, i.e. these students would *not* have the "W" expunged from their transcripts during their first semester within LSA.

3. Since the "W" proposal is intended to ease the student's transition into his/her first full term, we recommend that *spring/summer* not be counted as a first term. We think they do not give students a true college experience in the way that fall and winter terms do. Therefore, we recommend that the language in the proposal read: *For all courses taken during the student's first term in the College* ***(excluding spring/summer term)****, all "Ws" for approved drops will be expunged from the official transcript.*

4. We recommend that if a student completely withdraws from his/her first term, the "W" policy will apply during the first term in which the student returns. We also recommend that students have only one opportunity to start over in this way.

5. The Registrar suggested that the change in the "W" policy should be noted on the transcript key for the official transcript for the purposes of accurate record keeping. Our recommendation is that a note be placed on the back of each student's transcript to indicate what a "W" means and to indicate that they are not recorded on a student's transcript for the first term. We would again need to state that for all courses taken during the student's first term in the College (excluding spring/summer term), all "Ws" for approved drops are expunged from the official transcript.

6. We recommend that although "W"s will be expunged only for first-term LSA undergraduates, the College of LSA should notify other colleges within the University that for first-term LSA students, the W from any non-LSA course also will be expunged.

7. We think it is important to emphasize (especially to orientation advisors and orientation students) that the change in the "W" policy does not change the drop/add deadline nor does it change the procedure for dropping a course. Only the way a W is recorded is being changed.

8. While we recognize that the Registrar needs time to implement this change, the College aims to have this change implemented by Fall 2005.

Median Grade on Transcript Subcommittee Report
January 14, 2005

Marjorie Horton (Chair), Paige Butler, Derek Collins, Bob Megginson, Andrew Yakhind

---

Committee members met to discuss several implementation issues not specified in the original proposal approved at the October 4, 2005 LSA Faculty Meeting. In addition to issues raised by the subcommittee members, the group discussed questions from the October LSA faculty meeting and from Paul Robinson, University Registrar.

The recommendations of the subcommittee for implementing the approved faculty code amendment, B 5.13, Sec 13, Reporting Grades, are presented below:

1. The median course grade and size of the course are only reported on the transcripts of LSA undergraduates. This amendment does not apply to graduate students or to undergraduates from other academic units. (See item 4 below for the recommendation on how the policy applies to dual degree students).

2. The calculation of the median course grade will use the standard simplified definition of the median. In the following ordered array of nineteen scores: 2, 3, 3, 4, 5, 7, 7, 8, 8, 8, 8, 9, 10, 12, 14, 15, 17, 19, 19, the median is the tenth score in the array. Counting over from left to right, we find the tenth score to be 8.

   In brief, if the grades given in a course were C, C, C, C, B, B, B, A-, A, we would consider the median to be the middle grade among the nine, namely, B. I f the median falls halfway between two grades, say a B+ and A-, then the median grade in such a case would be reported in the form B+/A-.

3. The recording of the median grade should be in letter format rather than numeric. To avoid confusion with the student's earned grade, the median grade will appear either within parentheses or in a different font. The committee has requested a copy of the Dartmouth transcript from the University Registrar as an example of presenting median grade and class size information.

3. The median class grade will be calculated twice: The first calculation will be done at the end of the term, for all undergraduate courses with enrollments of ten or more students, if ten or more grades are reported. The second and final calculation will be done at the end of the next Fall or Winter term. (Operationally, for Fall term this means that the second and final computation would be at the end of the subsequent Winter term. For Winter, Spring, and Summer terms, the final computation will be at the end of the subsequent Fall term.)

4. For any LSA student in a dual degree program, the median course grade and the course size will be reported only for the terms when the College of LSA is the student's primary school.

5. The grades of all undergraduate students, regardless of their home academic unit(s), will be used in the computation of the median course grade, and the number of total students (undergraduate and graduate) in the course will be recorded as the class size.

6. For non-LSA courses with enrollments of ten or more students, the official transcripts of the LSA undergraduates in these courses will report the median course grade computed across all undergraduate students and the total course size.

7. The subcommittee approves of a transcript key to provide information about the median course grade and course size information on the transcript.

8. The subcommittee recommends that the median course grades and course sizes also be posted on the unofficial transcript, but not on the "View Grades" report that students can access online.

9. The default for multi-section courses is that median grades should be computed based on the student's particular section. Departments should also have the ability to request that the computation be for the entire course, instead. (Note: These two options accommodate different types of multi-section courses, i.e., a course in which the section instructors cover substantially different topics with different types of students vs. a course covering the same topics across sections and for which there is concerted effort in enforcing uniform grading across all sections.)

Committee members also discussed how this change in grade reporting would impact the self-assessment, academic self confidence, and retention of students who frequently or typically receive grades below the course median. The committee concluded that this issue needs to be addressed further.

Grade Reporting in LSA

(excerpted from CC minutes of 3/30/04)

The LSA Curriculum Committee ***approved*** the two new grade-reporting proposals (attached). If accepted by the Executive Committee, the proposed changes to the faculty code would be presented at an LSA Faculty meeting in the Fall, followed by a discussion and vote in Winter term, with implementation targeted for **Fall 2005**.

1. **The first grade-reporting proposal recommends expunging a "W" on official transcripts for *first-semester* students who drop a class past the 9-week deadline.** This change in policy would *include* transfers from other schools but *exclude* cross-campus transfers. *(The latter point needs to be added to the proposed changes to the faculty code.)* This proposal was ***approved*** by a vote of 6 in favor, 1 opposed, and no abstentions. Two faculty and two student members of the committee were absent.

   Rationale and Discussion: The primary intent of this proposal is to help new students who "get in over their heads" before realizing that most UM classes require more time and effort. Despite repeated reassurance from faculty and academic advisors, students typically have a lot of anxiety about the W as punitive and damaging. The college's position is that the W is intended to reflect the *record of academic activity* rather than *performance*, and that a few W's don't carry much weight on a transcript, especially in the first year. Some fear that students might respond by enrolling in more classes than they would otherwise, with the intent of dropping the ones with the lowest grade. This was considered unlikely since academic advisors work so closely with first-term students during the registration process. First-term students who want to drop classes will need to consider possible implications regarding financial aid. Phil Gorman, Associate Director of Academic Advising, objected to expunging data from a student transcript on the grounds that it represents a "first bite" out of the college's high standards regarding the integrity of the transcript. Associate Dean Owen pointed out that the experience of other Big Ten schools implementing such a policy has been positive, with the overall net effect being a better transition from high school to college. LSA Student Government also backs this proposal.

2. **The second proposal is to include on all student transcripts the median grade and class size in addition to the individual grades.** After extensive discussion as summarized below, this proposal was ***approved*** by a vote of 6 in favor, 2 opposed, and no abstentions. Two faculty and two student members of the committee were absent.

   Rationale and Discussion: A primary goal behind the inclusion of median grades and class size on the transcript is to offset disparities in grades across different academic disciplines. Generally speaking, national data indicates that student GPAs in the Sciences and Economics are lowest, Social Sciences in the middle, and Humanities the highest. Proponents of the proposal argued that the inclusion of median grades would provide contextual information, thus giving a more level playing field for students whose transcripts are reviewed for various honors, awards, employment opportunities, and professional schools admissions. Due to grade inflation in general and "plain-vanilla" letters of recommendation, some graduate admissions committees have had to place more weight on GRE scores. On the other hand, some faculty members of the committee reported having no difficulty evaluating grades submitted by applicants to their graduate programs.

   Some members of the committee strongly objected to what they viewed as an unfair devaluation of the academic integrity of courses in the Humanities and Social Sciences, as well as the underlying assumption that high median grades equate with less rigor and/or lower standards. They pointed out that grading disparities between disciplines reflect real differences in pedagogical style, such as the types of assignments used and the reiterative process of producing a final paper or research project. Others on the committee did not think such negative

connotations were intended by this proposal. Rather, it would recognize and allow for the normal disparities in grading style between various faculty and schools. Importantly, it would preserve the freedom of each faculty to grade in the way they deemed appropriate. The committee agreed that **deleting point 7 from the rationale** would be helpful.

Assistant Dean Evans Young raised a question about the possible correlation between grading disparities across the disciplines and class levels. Recent LSA data from four terms at UM (Winter 02, Fall 02, Winter 03, and Fall 03) indicate a gradual progression of median grades across the disciplines: a median grade of 3.0 or 3.3 for classes at the 100-level up to 3.7 at the 400 level. The exceptions to this pattern—Mathematics, English, and Psychology—dominate the divisional data and shape the impression of distinct grading behavior by the different divisions.

In view of literature indicating a correlation between teaching evaluations and student grades, another goal of this proposal is to provide some scale of comparison in awarding faculty/merit awards. It also is meant to address the tendency of students in general and women in particular to be discouraged by "low grades" in science classes and thus change fields, when in fact these students may be doing better than their peers. A positive impact also is anticipated in other issues as well, for example the imbalance between honors students in the sciences as compared with other fields and the retention of concentrators in the sciences.

A Proposal to Modify the Reporting of "W" for Course Withdrawals for First-Term LSA Students[1]
March 2004

Introduction

This document addresses the College policy on undergraduate students' withdrawal from courses after the official drop/add period. Current policy provides a three-week period from the beginning of classes for students to drop courses without incurring, for approved withdrawals, a "W" on their official transcript. This proposal recommends that any "Ws" that LSA students earn during their first term of study at the university will be expunged from the official transcript. This revised policy would apply both to first-term LSA undergraduates and to first-term LSA transfer students. The rationale for this policy change, reviewed in more depth below, is to promote academic exploration and ease the transition to academic life at the university.

Background

Typically, LSA Student Government approaches the College each year with concerns about its policy on course withdrawals. Students petition for lengthening the Drop/Add beyond three weeks and for greater leniency and flexibility in the use of the "W" notation on the transcript. They argue that a longer time period is needed for students to assess whether their selected classes are a good fit in terms of their intellectual interests, potential academic performance, and overall academic workload. Students also view the "W" on the official transcript as overly punitive, with negative consequences when students pursue graduate and professional school admissions or employment.

In the mid-nineties, students campaigned unsuccessfully to extend the period for dropping classes without incurring a "W" on the transcript to nine weeks. Most recently, the 2002-2003 LSA Student Government formally proposed that the College lengthen this period from three to four weeks for fall and winter terms. Its survey of peer school practices showed that the College's three-week time frame for students to drop courses without receiving "W" on the transcript was longer than that of several peer schools, and shorter than several other schools' time frames. Deans Shirley Neuman and Robert Owen considered this proposal and rejected it, in part due to problems that arise when the deadlines differ for the Drop and Add periods.

The College perspective on the purpose of the "W" is that it serves the purpose of accurate record keeping for a student's course activity, and is not intended to be punitive. The three-week drop/add period is upheld as striking the appropriate balance between flexibility for students to explore courses as well as assess interest and workload, and stability of the classroom environment, which enables faculty and students to move forward with the course curriculum in a timely manner.

Proposal for modifying the reporting of "W" on the official transcript

This proposal recommends a revision in the use of the "W" on the official transcript. Specifically, it proposes that any "Ws" earned during an LSA student's first term of study at the university be expunged from the official transcript, with this policy applying to first-term, first year students and first-term transfer students. This policy would apply to all LSA students, for all courses in which they enrolled during their first term on campus, regardless of the academic unit offering the course. It would not apply to non-LSA students who are electing LSA classes. These students would need to follow the policy of the school in which they are enrolled.[2]

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[1] Submitted by Robert Owen, Associate Dean for Undergraduate Education, College of Literature, Science and the Arts

[2] All units on campus adhere to the three-week drop/add deadline for course enrollment. It would serve the campus well for all schools and colleges offering undergraduate courses to adopt the same policy change as proposed here, to minimize confusion among students and to simplify the administration of the policy for the Registrar's office and other offices impacted. According to Paul Robinson, University Registrar, Michigan has a philosophy translated into practice that there is one "official" university transcript. Suppressing or expunging the first-term "Ws" for LSA students would introduce a significant change to the official transcript.

For both academic and administrative purposes, it is vital that the student's complete academic record, including any history of course withdrawals, be maintained and accessible to multiple offices within the University, including LSA Academic Advising, the Registrar's Office and the Office of Financial Aid. This academic record, also referred to as the unofficial transcript, would show all classes in which the student was enrolled at the end of the drop/add period, including those from which the student later withdrew.[4] The university policy on tuition charges would not be impacted, in that tuition is based on the number of credits for the classes in which the student is originally enrolled at the end of the third week of the term, i.e., the end of the drop/add period. The level of financial aid granted to a student would also not be impacted for the term in which the student withdraws from one or more courses after the drop/add period, as long as the student remains enrolled for at least one class.

Because the academic record is what students can obtain through Wolverine Access as their unofficial transcript, this record will require a notation indicating that any first-term Ws are not reported on the official transcript. This should minimize student confusion about the difference between the academic record and the official transcript.

This policy change would not impact the three-week drop/add period in any other way.

Nor would it impact the College policy on granting an official withdrawal from the course. The Office of Student Academic Affairs would continue to consider exceptions to the rules governing changes of elections, on an individual basis, as stated in the current Faculty Code. [5]

Rationale

The aim of the proposed policy revision is to ease students' transition to the rigors of academic work at the university. This change in policy acknowledges that students can have difficulty assessing what course load to take, as well as what levels of courses to take. Transfer students may be even more challenged in this regard, because they typically transfer from less competitive schools, and need to learn how to pursue their courses at the level of academic challenge at UM. This proposed change will allow first term students who have difficulty gauging the right level of course work in their first term at Michigan to make late adjustments to their course loads without the added anxiety about getting "Ws" on their transcript. It should also promote greater academic risk tasking at the beginning of students' time on campus, giving them the opportunity to enroll in more challenging courses with less anxiety about poor academic performance.

Proposed change to the Faculty Code (B 3.02, Section 2):

Changes in Elections

Original version:

Every student is expected to complete the program of courses which were originally elected. When circumstances warrant, however, changes in elections may be made by filing with the Registrar a Change-of-election worksheet. This worksheet must bear the signed approval of the student's faculty counselor if the student is a first-year student or transfer student, if the change is made after the third week of the term (second week for terms), or approval of overloads or underloads.

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[3] The policy would not apply to students who are cross campus transfers from other units on campus.

[4] The Office of Financial Aid currently does not have access to the academic record, but with this policy change, it would need this access in order to accurately monitor each student's coursework completion rate and to comply with audit requirements.

[5] It is possible that SAA would experience an increase in requests from students for exceptions to the policy, for reasonable causes for withdrawal, such as health, accidents, and family emergencies, once there is a precedent for expunging "Ws". SAA would continue to have the latitude to make exceptions, and may find it important to clearly articulate for students the grounds for making exceptions.

No courses may be added to or dropped from the original elections after the third week without the permission of the appropriate faculty counselor. All approved drops will be recorded on the transcript with a "W". Unofficial drops will be recorded on the transcript with an "ED."

Exceptions to the rules governing changes of elections may be made in individual cases by the Office of Student Academic Affairs only when warranted by extraordinary circumstances.

Revised version:

Only the 2nd paragraph from above is changed, as shown below.

No courses may be added to or dropped from the original elections after the third week without the permission of the appropriate faculty counselor. For all courses taken during the students' first term in the College, all "Ws" for approved drops will be expunged from the official transcript. For all courses taken during the students' second term, or in subsequent terms in the College, all approved drops will be recorded on the transcript with a "W". Unofficial drops will be recorded on the transcript with an "ED."

A Proposal to Enhance the Reporting of Grades in LSA[6]

March 2004

Introduction

This proposal addresses faculty concerns about grade inflation and disparity in grading patterns across the College. Not all faculty members have these concerns, at least to the same degree, due to differing philosophies and grading practices. There are also different perspectives about grading practices across the disciplines. Individual faculty view grading as a component of academic freedom; i.e., they have the right to grade as they see fit. The recommendation in this proposal to enhance grade reporting makes no imposition on this freedom. Instead, it recommends that the median grade and class size accompany the grade reported for each of the student's classes. The rationale for the addition of this contextual information is provided below, after an overview of recent research on grade inflation, and on the relationship between grading practices, student evaluation of teaching effectiveness and student course selections.

Background

In the past several years, grade inflation at the university level has been the subject of renewed concern and scrutiny at several prominent institutions, including Columbia, Duke, Harvard, Princeton, Smith and Washington University. Also, some experts in higher education see grade inflation in American high schools to be on the rise. In 2002, more than 44% first year college students reported having an "A" average as high school seniors, according to the annual survey of first year college students administered by UCLA's Higher Education Research Institute. Alexander Astin, the founder of the survey, interprets this finding as evidence of increasing grade inflation at the high school level. This pattern of high school grades likely shapes entering college students' expectations for high marks.

Research evidence from the early 1990's as well as from a major study in the late 90's of grading patterns at Duke University indicates that college grading patterns impact students' evaluations of teaching effectiveness and course selections. The Duke study was lead by Valen Johnson, formerly a professor of statistics and decision sciences at Duke and now a biostatistics professor in the School of Public Health at the University of Michigan. In this project Johnson and several colleagues from Duke's Committee on Grades examined the influence of grades on student course evaluations and course selections. First year students completed teaching evaluations for courses twice, once before receiving their final grades, and then afterwards, allowing researchers to measure the effects of students' grades on their evaluations of their professors. Students in the study also had the opportunity to look at the summaries of teaching evaluations completed by other students along with the mean grades of courses taught the previous semester.

[6] Submitted by Robert Owen, Associate Dean for Undergraduate Education, College of Literature, Science and the Arts.

The results of this study confirm earlier findings that student course evaluations are highly correlated with grading patterns. Students expecting to receive higher grades are more likely to provide favorable evaluations. After receiving their grades, students changed their assessments to be more in line with their actual grades. In other words, students who received higher grades than expected gave higher teaching evaluations, and students whose grades were lower than expected lowered their evaluations. The Duke study also showed that course selection is strongly influenced by faculty grading patterns, with students more likely to select the higher-grading instructor over a lower-grading instructor, both when selecting between two different instructors of the same course and when choosing among different courses.

Differences in grading practices across disciplines

Grading patterns, on average, vary across disciplines. Several studies have shown that mean grades earned by students in humanities, social sciences and natural science courses differ, with humanities grades being the highest and natural science grades being the lowest.[7] The recent Duke study revealed such differences as well. Within the College of LS&A, an in-depth statistical study of grading practices in the mid-nineties showed that students in humanities courses received the highest grades, with students in social science courses also receiving higher grades than students in natural science courses. This pattern is also reflected in the more recent grading data for LSA, including the tables of departmental grading data shared with Chairs and Directors in 2002 in an effort to bring greater attention to departmental grading patterns. Disparities in grading practices across divisions are seen by many faculties as indicative of differences in grading philosophies, pedagogical styles, subject matter, and class size. Others argue these differences reflect differences in grading rigor.

Differences in grading patterns across disciplines can result in inequities that impact both faculty and students. Val Johnson argues that differences in grading philosophies and practices distort student and faculty assessments. Student eligibility for academic awards and honors within one's college or university and nationally can be inequitable when grade point averages and class rank are the primary criteria. Students may avoid taking courses in harder-graded fields, or after taking one such course, not pursue additional ones for fear of lower grades or because they interpret the relatively lower grade as evidence of their weakness in this subject. Research at Williams College by Sabot and Wakeman-Linn showed that students are more likely to take courses from higher-grading departments and to avoid the lower-grading departments, such as mathematics, even when their grades indicate their comparative standing is higher in the lower-graded course compared to the higher-graded course. On a larger scale, differential grading practices can potentially impact enrollment patterns, and are often cited as a primary factor in the serious enrollment and retention challenges in the natural sciences and mathematics at the undergraduate level.[8]

Differential grading practices can also significantly impact faculty assessments, when teaching evaluations and class enrollment sizes are used as indices of teaching effectiveness and considered in decisions about tenure, promotion and salary without consideration of faculty grading practices. In the mid-1990's Professors Robert Owen and Rob Van der Voo conducted a study of course evaluation data for LSA science and math courses on behalf of the LSA Science Department Chairs. This analysis showed that LSA science instructors typically receive significantly lower course evaluation scores relative to the college median scores.

Recent measures in LSA related to faculty grading

The College now requests summary grading data to be included in departmental and program long term plans, self studies for external reviews, and chairs' annual reports to the Dean. Additionally, the grading

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[7] For example, average course grades in the humanities are cited as higher than in other fields, particularly the sciences, at Dartmouth, Harvard, Princeton, University of Pennsylvania and Cornell.

[8] From his research, Val Johnson warns that these differences could lead to a 50% reduction in the number of elective science and mathematics courses students take.

patterns of faculty members are considered in nominations for Excellence in Education awards. These considerations each signal to departments that grading is important to the College.

Proposal for adding contextual information to the student transcript

This proposal recommends that the median course grade and course size be included on students' official transcripts and academic records (unofficial transcripts), for all LSA classes with an enrollment of ten or more students at the end of the drop/add period.[9] This practice will provide useful information to the students themselves as well as to others evaluating the students' records. [10] Table 1 presents further information on the grade reporting practices of several peer schools, including those schools that do report additional information on the student's transcript.

Rationale

In addition to the arguments reviewed in the Background above for this proposal, there are several specific benefits of the proposed practice:

1) The information highlights students' performance relative to their peers and will assist students in meaningfully interpreting their level of mastery in their courses. It will also assist students in lower-graded courses to see when their course performance is actually stronger than they may initially believe from looking only at their grade. This can work against the tendency for students to switch to higher-grade courses under the assumption they do not have the ability to perform well in the lower-graded disciplines/courses. This could also help students continue to pursue coursework based on their academic interests rather than prematurely switch fields due to lack of confidence in their abilities or preoccupation with getting high grades.

2) Providing students more information about their course performance relative to their peers may reduce early attrition from mathematics and science courses. This may be the case particularly for female students, who are reported to have a greater tendency to attribute their lower grades in science courses to themselves than do their male counterparts. It may also reduce students' avoidance of science and mathematics courses.

3) Applications to graduate school and professional school programs typically are evaluated on the basis of grades, letters of recommendation and standardized test scores. Among these, standardized test scores are the most controversial because numerous studies have shown that certain minority students generally score significantly lower on these tests. Yet faculty at UM and other institutions report that they are now placing increased emphasis on standardized test scores because widespread grade inflation and the lack of confidentiality cause them to de-emphasize the significance of grades and letters of recommendation. Reporting median grades will help counter this trend. Surely our faculty members want our students to be evaluated more heavily on the basis of their performance in courses as undergraduates in LSA rather than how they did on a single test administered for a few hours on a Saturday morning!

4) Students may be less inclined to seek a preponderance of "easy" courses, to avoid such a pattern of selection being evident to prospective employers and graduate and professional school admissions committees.

5) For consideration of student honors and awards traditionally based on academic achievement indices such as class rank and cumulative GPA, the transcripts will assist reviewers in interpreting the

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[9] Discussion with the Registrar would be needed to determine the possibility of including this contextual information for courses in other academic units, e.g., Engineering, that LSA students take.

[10] Canadian universities (e.g., McGill, University of Toronto) have had similar practices in place for several years, reporting the class average on transcripts. In 1994 Dartmouth College instituted the practice of including median course grades and course size, for courses with enrollments of 10 or more students. The Dartmouth student transcript also includes summary information showing performance relative to the median in all courses, by including the number of courses above, at, and below the median.

grade-based measures. This may reduce the penalizing of students in lower-graded fields such as the sciences. (For example, if the College institutes general liberal arts honors and specifies a required GPA, the specific GPA could be high for some fields and low for others. The addition of median grade information, even at a summary cumulative level, could be useful in assessing students' relative achievement.)

6) Evaluation of student records for graduate and professional school admissions, internships and employment will be more informed.

7) The policy may influence some particularly lenient graders to increase the stringency of their grading.

8) This may be a strong signal to faculty that the College does attend to grades. (Consideration of median grades assigned, apart from the reporting on student transcripts, should assist department and program chairs in faculty evaluations and interpretation of OEE scores on teaching effectiveness.)

Proposed change to the Faculty Code (Section B 5.13, Section 13):

Reporting Grades

Original version:

The grades and credit hours for all students shall be reported by the instructors to the Registrar. The Registrar shall record all such grades, credits and points. The Registrar shall prepare from time to time, and at least once every five years, a statement of the grades reported by courses, make a statistical study of their distribution by departments and make this information available for distribution to Chairs and Directors.

The grades of all students are due in the Office of the Registrar no later than four days after the final exam for the course (including Saturday and Sunday and not including University holidays).

Revised version:

Only the 1st paragraph from above is changed, as shown below.

The grades and credit hours for all students shall be reported by the instructors to the Registrar. The Registrar shall record all such grades, credits and points. In addition, for all classes with enrollments of ten or more students, the Registrar shall record the class size and median class grade. The Registrar shall prepare from time to time, and at least once every five years, a statement of the grades reported by courses, make a statistical study of their distribution by departments and make this information available for distribution to Chairs and Directors.

Table 1: Grade Reporting Practices of Peer Schools

Brown	Reports course grade
California Institute of Technology	Reports course grade
University of Chicago	Reports course grade
Columbia	Reports course grade and the percentage of grades in the A range (from A- to A+) for classes with enrollments of 12 or more students who take the course for a grade.

The purpose of this practice is to put grading in a frame of reference, addressing differences in grading practices between the humanities, social sciences, and natural sciences. Columbia's Deans Office reports that it has not received student complaints about the practice, instituted in the mid-1980s. Faculty like the practice because it contextualizes the A and conveys the value of the A, which would not be captured if the median grade were reported instead. Columbia's Registrar reports that feedback from employers and graduate school and professional school admissions offices is positive; people in these positions appreciate the additional information. The Registrar is unaware of the practice having any negative impact on students' career searches or admissions into professional and graduate schools.

Cornell	Reports Course Grade.

Implementation of a faculty resolution adopted in 1996 to include the median grade and course enrollment on the transcript is delayed indefinitely due to computer implementation constraints.

Dartmouth	Reports median course grade and course size for classes with enrollments over 10.

Faculty can request exemption through the curriculum committee. Typically exemptions are for independent readings and research courses. The Registrar's Office reports that the additional transcript information is very useful internally and that departments study their grading practices annually. The Registrar also reports that her office does not receive any complaints from students about this reporting practice disadvantaging them in pursuit of employment and graduate school admissions, nor do they receive any feedback from employers or admissions committees.

Harvard	Reports course grade
Indiana	Reports course grade

Students may request an Expanded Context Transcript. This transcript shows, for each of the student's courses that has 5 or more students who receive grades for the course enrolled, a grade index, the instructor's name, and grade context information. The grade index shows the number of students in the course who received the same grade or higher, compared to the total number of students in the course who received grades. Grade context information shows the grade distribution (i.e., number of students receiving each of the possible grades), average course grade, percentage of students in the course whose major school or department matches the school or department offering the course, and average GPA for students enrolled in the course, incorporating the grades awarded for the semester displayed. Due to the planned implementation of PeopleSoft and workload concerns, the Registrar's Office anticipates discontinuing its practice of offering this additional contextual information.

MIT	Reports course grade
Northwestern	Reports course grade
University of Pennsylvania	Reports course grade
Princeton	Reports course grade
Yale	Reports course grade