THE OHIO STATE UNIVERSITY

College of Engineering

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Date: 28 September 2010

To: Randy Smith
Vice Provost, Office of Academic Affairs

From: Ed McCaul
Secretary, College of Engineering Committee on Academy Affairs (CCAA)

Subject: Semester Conversion Proposal for the BS Degree in Materials Science and Engineering

Attached is a letter from Rudy Buchheit, Department Chair of Materials Science and Engineering, a letter their External Advisory Committee, as well as a semester conversion proposal for their BS degree.

This proposal was reviewed by a subcommittee of CCAA. After reviewing the proposal and having some changes made to it the subcommittee recommended to the full committee that it be approved. After a discussion, CCAA unanimously approved the proposal on the 27th of September 2010 and requested that I forward the proposal to you for consideration by CAA. If you have any questions concerning this proposal please let me know.

BS MSE Program Questions

With regard to the BS in MSE proposal:

1. *Could you clarify the difference between Technical Electives and MSE Technical Electives. In Attachment 1 both are described.*

   MSE Technical Electives are non-core 5000 level or higher courses within the MSE Department.

   Technical Electives are 4000 or higher level courses from College of Biological Sciences, College of Engineering, and College of Math and Physical Sciences outside the MSE Department. The department may also pre-approve lower than 4000 level courses offered outside the MSE Department as technical elective.

2. *On page 6 of your proposal 4th bullet down, you note that elective courses fall into one of four categories of materials or material functions and a 5th cross-cutting category. What are the 4 categories? The MSE Technical Electives listed in Attachment 1would be clearer if they were organized by categories.*

   Our four materials categories are (i) metallic materials, (ii) ceramic materials, (iii) electronic materials, and (iv) biomaterials. We cannot organize the MSE Technical Electives by these categories as some courses fall into more than one, i.e. the Electroceramics course can be classified in the ceramics as well as the electronic materials categories.

3. *Attachment 5 the Proposed Semester Advising Sheet: The course titles do not always match the course titles listed in Attachment 1 MSE Core. Please revise the Advising sheet to include the actual course titles.*

   The course titles in attachment 5 have been corrected to match course titles in attachment 1. A few titles in attachment 1 have also been modified to better reflect the course content.

4. *Attachment #7 in the Semester Column the area under English is blank should GECs be listed under English as they are in the Quarter Column?*

   The GECs will be called General Education courses in Semester curriculum. GenEd has been added in Semester Column under English in attachment #7.

MSE Program Proposal

THE OHIO STATE UNIVERSITY

Department of Materials Science and Engineering

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To: The Office of Academic Affairs

From: Yogeshwar Sahai, MSE Department Acting Chair

Date: August 31, 2010

Re: Changes / addition to the Semester Program Proposal for ***BS in Materials Science and Engineering (BSMSE)*** submitted in May 2010.

We have revised the Semester Program Proposal for Bachelor of Science in Materials Science and Engineering (BSMSE) degree based on the comments from the CCAA subcommittee B. The following changes / additions are made.

1. On page 1, the word "expensive" has been changed to "extensive".
2. The MSE External Advisory Committee has enthusiastically endorsed the proposed semester based curriculum. Their comments can be seen in the attached letter at the end of the proposal.

I recommend that with these changes the proposal be approved.

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To: The Office of Academic Affairs

From: Rudolph G. Buchheit, MSE Department Chair RG Buchheit

Date: May 4, 2010

Re: Semester Program Proposal for ***BS in Materials Science and Engineering (BSMSE)***

On behalf of faculty members of the materials Science & Engineering Program, I am pleased to submit the proposed curriculum for the Bachelor of Science in materials Science & Engineering degree under the proposed semester calendar.

The MSE Department currently administers the following academic programs. Listed with each one is its current status relative to semester conversion.

- PhD in Materials Science and Engineering (a graduate program in Engineering; its program proposal is being submitted to the Engineering College Committee on Academic Affairs on xx May 2010).
- MS in Materials Science and Engineering (a graduate program in Engineering; its program proposal is being submitted to the Engineering College Committee on Academic Affairs on xx May 2010).
- ***BS in Materials Science and Engineering*** **(a program in Engineering; the program proposal is attached)**
- PhD in Welding Engineering (a graduate program in Engineering; its program proposal is being submitted to the Engineering College Committee on Academic Affairs).
- MS in Welding Engineering (a graduate program in Engineering; its program proposal is being submitted to the Engineering College Committee on Academic Affairs).
- BS in Welding Engineering (a program in Engineering; its program proposal was submitted to the Engineering College Committee on Academic Affairs on April xx, 2010).

None of these academic programs is being withdrawn. All will be converted to semesters. The attached BSMSE proposed semester curriculum has been developed by extensive consultation with faculty, academic advisors, departmental external advisory committee, and students of the department.

Majority of students liked the depth of central MSE topics, breadth of MSE discipline, work load, flexibility, balance between the lecture and labs in the proposed program and thought that it is an overall improvement over the existing curriculum.

The external advisory committee has twice reviewed the proposed curriculum: once in October

2009 and again in April 2010. The 2009 EAC report and comments on the early version of the curriculum and that report is attached to the curriculum proposal. The committee is preparing its written comments from its April 2010 meeting. Those will be appended to this proposal when they become available.

The MSE program faculty voted on the proposed curriculum and the vote was 17 in favor and 1 opposed to the proposed curriculum. There were no abstentions. We are confident that the proposed curriculum addresses the need of the changing and emerging trends of the MSE discipline, and will cater to the need of our students, their employers, and other stakeholders. I recommend that the proposal be approved.

Materials Science and Engineering (MSE) Program Proposal

Primary Contact: Yogeshwar Sahai (sahai.1, 292-1968)

GENERAL PROGRAM INFORMATION

1. Name of Program

Materials Science and Engineering

2. Name of Degree

Bachelor of Science in Materials Science and Engineering (BSMSE)

3. Responsible Academic Unit

Department of Materials Science and Engineering

4. Type of Program

a. Undergraduate bachelors degree program

5. Semester Conversion Designation

a. Re-envisioned with significant changes to curricular requirements (core requirements, structural changes to tracks / options / courses), but no changes to program goals

PROGRAM REQUIREMENTS

6. Program Learning Goals

Because of a requirement to use the terminology of the MSE program's accrediting body (ABET, Inc.), program goals are separated into "objectives" and "outcomes". Roughly speaking, the former are broad statements that describe what program graduates will be prepared to do after graduation, while the latter are narrower statements that describe knowledge and skills students will have attained by the time of graduation.

The *objectives* of the BSMSE program are that our graduates:

a. Will competently apply the essential elements of MSE, which are defined by the interrelationships among composition, structure, properties, processing and performance of engineering materials.

b. Will devise, design and conduct experimental, analytical and computational exercises necessary to further explore the essential elements of materials science and engineering.

c. Will be able to communicate effectively.

d. Will help solve complex engineering problems by applying the related principles of the engineering disciplines and by functioning effectively within multidisciplinary teams.

e. To demonstrate the global, societal and ethical awareness expected of practicing engineering professionals.

The *outcomes* of the BSMSE program are that students will attain:

a. an ability to apply knowledge of mathematics, science, and engineering;

b. an ability to design and conduct experiments, as well as to analyze and interpret data;

c. an ability to design a system, component, or process to meet desired needs within appropriate constraints related to economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations;.

d an ability to function on multi-disciplinary teams;

e. an ability to identify, formulate, and solve engineering problems;

f. an understanding of professional, ethical, legal, security and social issues and responsibilities;

g. an ability to communicate effectively with a range of audiences;

h. an ability to analyze the local and global impact of materials science and engineering on individuals, organizations, and society;

i. a recognition of the need for, and an ability to engage in life-long learning and continuing professional development;

j. a knowledge of contemporary issues;

k. an ability to use the techniques, skills, and modern engineering tools necessary for practice as a MSE professional.

7. Proposed Program Requirements

See Attachment #1: BSMSE Proposed Program Requirements. The following notes apply to the pick-lists in the requirements:

- The designated General Education course ("Culture and Ideas: Ethics") will be chosen from a set to be designated by the College of Engineering once other department's offerings and General Education approved courses are known.
- Mathematics courses will be two courses on Engineering Calculus I and II, which are part

of the College of Engineering core. In addition, there will be one more course which will be largely on differential equations but will have some linear algebra content. Detailed syllabi of these courses are being prepared by the Mathematics department.

- The proposed MSE curriculum has two courses in Chemistry: general Chemistry for Engineers and Organic Chemistry for Engineers. Organic Chemistry is not a required subject in the current curriculum but Organic Chemistry was considered important for the future of the MSE curriculum, particularly considering the importance of bio-materials in the MSE curriculum.
- The MSE curriculum also has two semester-long Physics courses, which is equivalent to three quarter courses in the current curriculum. There is not much change in the Physics content.
- There are two sequences of laboratory courses; experimental labs and computational labs. Every MSE student will take the three experimental and three computational labs included in the core curriculum. Students will also develop technical writing and data analysis skills in the experimental laboratories.
- Materials Selection will be taken by all students and Capstone Design projects will be selected by students in their senior year in consultation with an academic advisor and faculty advisor, depending on the student's interests and background.
- "Technical Elective" (non-MSE and MSE) courses will be chosen in consultation with an academic advisor, from MSE upper division undergraduate courses (4000 or above), and from a set of non-MSE courses to be designated by the MSE Undergraduate Studies Committee once other departmental course offerings are known. MSE program faculty members have developed 16 elective lecture courses and four laboratory courses at the 5000 level. Students will consult with an academic advisor and faculty advisor to select any four lecture courses and one laboratory course from this list to partially fulfill the technical elective requirement.

8. Current and Proposed Advising Sheets

See Attachments #2, #3, and #4 (current program requirement sheets and associated advising sheet) and Attachment #5: BSMSE Proposed Advising Sheet.

9. Curriculum Map

The curriculum map is provided in Attachment #6.

10. Rationale for Program Changes and Description of Changes

The MSE Quarter to Semester (Q2S) committee comprising six MSE faculty members and an undergraduate advisor (staff person) began meeting weekly at the start of Au 2009 to plan the semester conversion. Data collected during these deliberations included historical feedback from MSE graduates (compiled as part of accreditation-based assessment processes over the past several years), input from the MSE Department External Advisory Committee, a survey on various issues requested from all MSE faculty, and comparisons with about a dozen Materials Science and Engineering, Materials Science, and similarly named programs at major peer institutions. The most important principles emerging from these deliberations were:

- Most MSE semester courses should be 3 sem-cr-hrs, the laboratory classes were either 2 or 1 cr-hr. An average course load for a single term of 16 sem-cr-hrs per semester would be required to graduate in four years.
- General Education courses constitute 24 sem-cr-hrs of the proposed program, compared to 35 qtr-cr-hrs now. MSE currently requires five 5-qtr-cr-hrs of GEC courses, and 10 qtr-cr-hrs of English composition and communication classes. The proposed General Education model for semesters was suggested by ULAC and was accepted during our deliberations. The current 35 qtr-cr-hr translate $\approx$ to 35(2/3) or 23.33 sem-cr-hr. The overall cr-hr in the semester program is fairly close to the quarter program.
- Much of the breadth of the existing MSE major should be retained as the MSE core curriculum, with some compromise because students are taking only about 2/3 as many different courses as under quarters. The rationale here was that MSE is an extremely broad, fast-changing discipline, and premature specialization by undergraduate students could be detrimental to their career development as it could limit their adaptability in the face of future shifts in the field. We felt that achieving a better understanding of fundamental principles that have withstood the test of time, across a rather wide swath through the field, would best serve MSE students.
- Our current curriculum requires students to choose elective courses within a specialization area. The proposed curriculum gives students more flexibility in choosing their elective classes. A set of 16 lecture courses and four laboratory courses were designed. The majority of the elective courses fall into one of four categories of materials or material functions, with at least two courses and one lab in each category, and with the remaining courses falling into a 5th "cross-cutting" category. Our four materials categories are (i) metallic materials, (ii) ceramic materials, (iii) electronic materials, and (iv) biomaterials. In consultation with a faculty advisor and the MSE undergraduate advisor, students will select any four lecture and one laboratory classes from this list of elective courses. The intent is to offer the students the flexibility to explore a range of interests and yet maintain the option to specialize in single area if they want. Thus, the proposed set of electives courses offers the opportunity for breadth as well as depth.
- Students should have considerable flexibility in making their own trade-offs between depth and additional breadth when choosing technical electives. The reason for this conclusion (in light of the previous comments) was that some students might know that they would like to specialize in an area of the field that is reasonably stable and well-developed, and that the program should support this kind of educational objective.

The Engineering Core is significantly streamlined compared to its current quarters-based format. Like students in all other Engineering programs, MSE majors will take an Engineering Survey, two semesters of Introduction to Engineering (the freshman engineering program), two semesters of Engineering Calculus, and one semester of Physics. Any change to program quality from this part of the proposed new MSE program will arise from improvements in the Engineering Core courses themselves, as there is no significant change in the MSE program requirements in this dimension. The primary consequence of a 30%+ reduction in the total number of courses overall, however, is a reduction in the breadth of exposure to other Engineering disciplines compared to

the current situation. This was deemed unavoidable: most Engineering courses now are 3-qtr-cr-hrs, and we agreed at the College of Engineering level as well as in the MSE Department that it would be untenable to turn these into 2-sem-cr-hr courses in order to preserve the breadth of the current Engineering programs. There was a conscious decision to favor, in the conversion, depth in the major over breadth across Engineering. The net effect is that program quality improvements will come from students being better prepared overall in the major, as the courses are completely restructured and older topics are being dropped in favor of depth in new and emerging areas and technologies in Materials Science & Engineering.

11. Credit Hour Changes

Program credit hour requirements	A) Number of credit hours in current program	B) Calculated result for 2/3rds of current quarter credit hours	C) Number of credit hours required for proposed program
Total credit hours required for completion of program	191	127.33	127
Prerequisite credit hours required for admission to program which are not counted toward total hours	0	0	0
Required credit hours offered by the unit	85	56.66	56
Required credit hours offered outside of the unit	106	70.66	71

12. Rationale for Significant Change in Credit Hours

Not applicable.

TRANSITION POLICY

13. Policy Statement from the Chair of the Department

No MSE major who began the degree program under quarters will have progress toward graduation impeded by the transition to semesters. Graduation requirements beginning Summer 2012 will be those in force for MSE majors under semesters; but *every* quarter-credit-hour that would have counted toward the MSE major under the quarter-based MSE program will count (as 2/3 of a semester-credit-hour) toward the requirements for graduation under the semester-based MSE program. Additional advising support will be provided for MSE majors to assist in planning course schedules for the last year of quarters (2011-2012) and for at least the first year of semesters (2012-2013). If it is determined that the "normal" conditions covered by the generic MSE major transition worksheet would result in a particular student facing an unavoidable delay in graduation compared to quarters, due to circumstances related to the change to semesters rather than the student's failure to make satisfactory progress through the program, then a revision of specific requirements will be worked out for that student by the advising staff with approval by the MSE Undergraduate Studies Committee.

Rudolph G. Buchheit
MSE Department Chairman

Transition Plan Details

The transition policy is based on the following principles:

- The switch to semesters will not impede any student's progress toward graduation.
- All students who graduate under semesters, even during the first semester, will do so by meeting the requirements of the semester program.
- Each semester program requirement may be met either by taking an appropriate semester course (or sequence), or by substituting a substantially equivalent quarter course (or sequence) for the corresponding semester course (or sequence).
- Excess equivalent credit-hours resulting from such substitutions—either positive or negative—will be credited against technical elective requirements.

Attachment #7 is a list of courses in quarter curriculum and their equivalent courses in the proposed semester curriculum. This list will be used in determining the effect of observing these principles for every student. The academic advisors in the MSE office have been instructed to advise students not to deviate from the set quarter schedules. This will significantly reduce the transition problems. MSE academic advisor will prepare a plan for each student at the time when he or she will declare major. They will be advised to follow the plan to avoid any unnecessary delays.

Attachment #8 shows the list / plan of courses for students who will complete their undergraduate program in the semester system. The plan shown here is only for students who started or will start in Autumn quarter (2009 to 2011) and will complete all courses as shown. Students who complete their junior year in the SP2012 quarter will move to the semester curriculum in their senior year starting AU2012. Similarly students who complete their sophomore year in SP2012 quarter will move to the semester curriculum in their junior year starting in AU2012.

Juniors will start with most of their MSE major course work with the exception of 'Structure and Characterization' lecture and laboratory courses, the 'Thermodynamics' course, and the first 'Modeling and Simulation' laboratory course. Since Thermodynamics is currently (in the quarter system) offered in the junior year, they will take thermodynamics in the SP2012 quarter of their sophomore year before starting in the semester system. In addition, they will be advised not to take MSE361 (Mechanical Behavior of Materials) and MSE371 (Electronic Materials) in their Sophomore year as they will be offered in the SP2013 semester of their junior year. Also, students will also be advised not to take Eng198A 'Manufacturing and Processing Plant visits' course as it is not required in the semester curriculum and it adjusts the total semester credit hour to 127.

In addition, attachment #8 also shows the plan for students who will complete their freshman year in SP2012 and move on to the semester system in their sophomore year. They will have only one change. They will be advised not to take the quarter version of MSE205 (Introduction to Materials) in their freshman year, but wait and take the semester version in AU2012 of their sophomore year.

Students who are out of sequence will be handled on a case- by-case basis. The student, the

MSE Advising Office, and if necessary the MSE Undergraduate Studies Committee will negotiate custom arrangements to fill any gaps through a combination of allowing substitutions, offering independent studies to make up deficiencies, and/or granting waivers in limited situations. Accreditation issues might arise if students were permitted to graduate without substantially meeting all the MSE program requirements, so students who find their progress toward graduation impeded by a failing grade in any course, or by their own failure to schedule and complete courses as advised, may find themselves with little recourse. The transition worksheet will, therefore, be accompanied by a transition advising plan (similar to the existing College of Engineering application for graduation, which includes a three-quarter scheduling plan) that shows exactly how the student should expect to complete the program without being impeded by the switch to semesters. Students will be asked to sign their own personalized transition worksheet and transition advising plan at the advising appointment where such details are worked out with an academic advisor. These meetings will take place starting in SP2011, with students when they have sufficient number of credit-hours remaining to graduation.

14. Assessment Practices

We have implemented a carefully developed assessment plan that we have used over many years. Details of the plan are discussed in item 15 (will be submitted via the assessment plan survey form). All of the essential components of the plan will be carried over to the new program as we switch to the semester system, as they are not impacted by the change to semesters.

15. Assessment Plan on File with OAA

MSE has a detailed assessment plan on our department web site. We will fill out the on-line assessment plan and submit it to our curricular Dean for final submission to OAA.

Attachment #1:

BSMSE Proposed Program Requirements

General Education	Course Number	Cr-hrs
Writing Level 1		3
Writing Level 2		3
Literature		3
Arts		3
Historical Study		3
Social Science 1		3
Social Science 2		3
Culture & Ideas: Ethics		3
Total Liberal Arts Portion of Gen Ed (= 24)		**24**

Engineering Core	Course Number	Cr-hrs
Engineering Survey		1
Introduction to Engineering I		2
Introduction to Engineering II		2
Engineering Calculus I		5
Engineering Calculus II		5
Physics I		5
Total Engineering Core cr-hrs (= 20)		**20**

Other Technical Core and Elective	Course Number	Cr-hrs
Chemistry for Engineers		4
Organic Chemistry for Engineers		4
Physics II (E&M)		5
Mathematics		4
Statics & Strength of materials		4
Technical Elective		3
Technical Elective		3
Total Other Tech. Core & Elective cr-hrs (= 27)		**27**

MSE Core	Course Number	Cr-hrs
Introduction to Engineering Materials	2010	3
Structure and Characterization	2241	3
Thermodynamics of Materials	2251	3
Modeling and Simulation in MSE I	2321	3
Structure and Characterization Lab	2331	2
Transformation and Processing of Materials	3141	3
Transport Phenomena and Kinetics	3151	3
Mechanical Behavior of Materials	3261	3
Electronic Properties	3271	3
Modeling and Simulation in MSE II	3321	2
MSE Experimental Lab I	3331	2
MSE Experimental Lab II	3332	2
Materials Selection	4181	2
Modeling and Simulation in MSE III	4321	3
Design and Professional Practice I	4381	3
Design and Professional Practice II	4382	3
Total MSE Core cr hrs (=43)		**43**

MSE Technical Electives	Course Number	Cr-hrs
Advanced Metals Laboratory	5431	1
Physical Metallurgy	5441	3
Process Metallurgy	5451	3
Ceramics Processing Laboratory	5531	1
Electronic, Optical, and Magnetic Properties Lab.	5532	1
Structure and Properties of Amorphous Materials	5541	3
Ceramic Processing	5551	3
Nanoscale Synthesis & Processing of Electronic Matls	5552	3
Electroceramics	5571	3
Materials for Energy Technology	5572	3
Materials for Medicine	5611	3
Biomaterials Laboratory	5631	1
Structure-Property Relationship of Polymers	5641	3
Biomaterials Processing	5651	3
Introduction to Composite	5711	3
Mechanical Behavior of Crystalline solids	5761	3
Mechanical Behavior of Noncrystaline Solids	5762	3
Fracture and Fatigue of Engineering Materials	5763	3
Corrosion and failure Analysis	5951	3
Solid State Science	5971	3
Total MSE Technical Elective cr-hrs (=13)		

Grand Total = 127

Attachment #2

Materials Science and Engineering
2008-2009

Megan Daniels, Advisor
477 Watts Hall
(614) 292-3145
daniels.313@osu.edu

Name: _____

New to OSU: _____ email: _____@osu.edu

Consider this sheet as a guideline only. Quarters these classes are offered are subject to change.

YEAR	AUTUMN	WINTER	SPRING*
1	Math 151 (Calc & Analyc Geom)..... 5____ Chem 121 (Gen Chem)..... 5____ Engr 181 (Intro to Engr I)..... 3____ Engr 100.11 (Engr Survey) ..... 1____	Math 152 (Calc & Analyc Geom).....5____ En Graph 167 (Prob Slv Prog Engr)4____ Physics 131 (Partcls & Motion).....5____ Engr 183 (Intro to Engr II).....3____	Math 153 (Calc & Analyc Geom) .... 5____ Physics 132 (Electrcty & Magntsm) 5____ English 110.XX (1st Yr English Comp)5____ MSE 205 (Intro to MSE)..... 3____ **Apply for acceptance to MSE Dept. this qtr.**
2	Math 254 (Calc & Analyc Geom) .... 5____ ISE 410 (Ind Quality Control)..... 4____ Physics 133 (Elctrdynmc & Quant). 5____ **MSE 341** (Atomic Scle Struct Mtrls). 3____ **MSE 281** (Mtrls Processing Lab)..... 1____	ME 410 (Statics).....4____ Chem 125 (Chem for Engr).....4____ GEC.....5____ **MSE 342** (Microstruc & Character Mtls)...3____ **MSE 282** (Mtrls Character Lab).....1____	Math 415 (Ord Part Dff Equat)..... 4____ ME 420 (Intro Strength Materials) .... 4____ **MSE 361** (ME Behvr of Mtrls) ..... 3____ **MSE 371** (Electronic Mtrls)..... 3____ **Engineering 198A** (Intro to Engr)1____
3	**MSE 401** (Mtrls Thermodynamics)... 4____ **MSE 526** (Transport & Kinetics)..... 3____ **MSE 581.01** (Mtrls Sci Lab I)..... 2____ **MSE 595.02** (Jr Seminar II).....1____ GEC ..... 5____	**MSE 525** (Phase Diagrams).....3____ **MSE 564** (ME Behv Mtrl Microstur) ..3____ **MSE 581.02** (Mtrls Sci Lab II) .....2____ GEC.....5____ GEC.....4____ **Specialization Form due by the end of this quarter.**	**MSE 533** (Mtrls Proc Methods)..... 3____ **MSE 543** (Struc Transformations) ... 3____ **MSE 581.03** (Mtrls Sci Lab III) ..... 2____ **MSE 595.03** (Jr. Seminar III)..... 1____ Tech Elect ..... 3____ GEC ..... 5____
4	MSE 6XY ..... 3____ MSE 6XY ..... 3____ MSE 695.01 (Sr Dsgn Project I) .... 1____ Tech Elect ..... 3____ GEC ..... 5____ **Graduation Application due 3 quarters before expected graduation date.**	MSE 6XY .....3____ MSE 6XY .....3____ MSE 6XY Lab .....1____ **MSE 600** (Mtrls Selc Perform I).....3____ MSE 695.02 (Sr Dsgn Project II)....1____ Tech Elect.....3____	MSE 6XY .....3____ MSE 6XY .....3____ **MSE 601** (Mtrls Selec Perform II).... 3____ MSE 695.03 (Sr Dsgn Project III)... 1____ GEC ..... 4____ Tech Elect ..... 3____

Courses printed in BOLD are Core MSE courses, and are taught one quarter per year. Please check on-line course offerings for availability of other courses. Note: 6XY courses in MSE will be determined by student choice of MSE Specialization.

GENERAL EDUCATION

English & Communication Skills (10)
English 110.xx (5)____
2nd Writing Course (5)____

Students must take 25 hours across **Social Sciences, Historical Study, and Arts & Humanities** with a minimum of 5 hours and maximum of 10 hours per category.

Historical Study (5-10)
_____(5)_____
_____( )_____

Arts & Humanities (5-10)
_____(5)_____
_____( )_____

Social Sciences (5-10)
_____(5)_____
_____( )_____

ETHICS (5 Hours)
(May overlap with a GEC category)
_____(5)_____

SOCIAL DIVERSITY
(May overlap with a GEC category)
_____( )_____

SPECIALIZATION COURSES

_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____
_____( )____

Must have 6 600-level non-core MSE courses, 1 600-level Lab, and 4 Technical Electives

Acceptance into the Materials Science and Engineering major requires a cumulative point-hour ratio (CPHR) and a secondary point-hour ratio (*SPHR*) of a minimum 2.0 upon completion of the following pre-major courses: *Chemistry 121; Physics 131; Math 151; MSE 205* (or their equivalents.) Students with a CPHR of 3.0 are assured of acceptance. Formal application is required. See MSE Undergraduate Advisor in WA 477 for details.

Scholarships: Returning and Transfer students should use the **College of Engineering Scholarship Application due MARCH 1 in the College Office.** Any MSE/pre-MSE student with a cumulative gpa of 3.0 is eligible.

The Ohio State University College of Engineering
General Education Curriculum (GEC) Courses

Revised August 1, 2008

ENGLISH & COMMUNICATION SKILLS (10 hrs)

A. First Course (5 hrs)
English 110.01, 110.02, 110.03

B. Second Course (5 hrs)
African-American and African Studies 367.02, 367.03, 367.04
Agricultural Communication 367
Arabic 367
Art Education 367.01, 367.02, 367.03
Communication 367
Comparative Studies 367.01, 367.02, 367.03, 367.04
Dance H367.01
Economics 367.01, 367.02
Engineering 367
English 367.01, 367.02, 367.03, 367.04, 367.05, 367.06, 367.07
German 367
Human Development and Family Science 367
Landscape Architecture 367
Linguistics 367.01, 367.02
Modern Greek 367
ENR 367
Nursing 367
Philosophy 367
Physics 367
Political Science 367.01
Psychology 367.01, 367.02
Slavic Languages and Literatures 367
Sociology H367.01, 367.02, H367.03
Spanish 367
Theater 367.01, 367.02, 367.03
Women's Studies 367.01, 367.02, 367.03, 367.04
Yiddish 367

C. Third Course (Major Department)
Aeronautical and Astronautical Engineering 510.01, 510.02 AND 510.03 (all three must be taken)
Aviation 530, 540, 550
Chemical & Biomolecular Engineering 521, 630, 760, 762, AND 764 (all five must be taken)
Civil Engineering 405, 406, 460, AND 619 (all four must be taken)
Computer Science & Engineering 560
Electrical & Computer Engineering 582
Engineering Physics – Physics 596
FAB Engineering 225, 695, 723, 724, AND 725 (all five must be taken)
Geodetic Science 625
Industrial and Systems Engineering 500, 608.01, AND 608.02 (all three must be taken)
Materials Science and Engineering 581.01, 581.02, 581.03, 695.01, AND 695.02, 695.03 (all six must be taken)
Mechanical Engineering 564, 570, AND 581 (all three must be taken)
Welding Engineering 690, 691, 692, AND MSE 581.02 (all four must be taken)

ETHICS (5 hrs selected from either Ethics Group I or II.)

A. Ethics Group I
Economics 348
Sociology 302, 464 (Counts as any Social Science Course)

B. Ethics Group II
Philosophy 131.01
Comparative Studies 272

Students must take 25 hours across Social Sciences, Historical Study, and Arts & Humanities with a minimum of 5 hours and maximum of 10 hours per category.

SOCIAL SCIENCES (5-10 hours, no more than one from a group)

A. Individuals and Groups
African-American & African Studies 201, 216
Animal Science 240
Anthropology 201, 202, 421.08
Communication 101, 200, 431
Economics 348
Edu P&L 411
Human Development and Family Science 360, 361, 364
International Studies 358
Linguistics 170, 270, 371, 372, 375
Political Science 201
Psychology 100[1], 367.01, 367.02, 371
Rural Sociology 378
Social Work 230
Sociology 210, 370, 380
Speech and Hearing Science 330, 350
Textiles and Clothing 372
Women's Studies 110

B. Organizations and Politics
Economics 201, 367.01, 367.02
Family Resource Management 243
Geography 450, 460, 843
International Studies 201, 230, 231, 235, 245, 250
Natural Resources 400
Political Science 100, 101, 165, 210, 245, 367.01
Rural Sociology 105
Sociology 101, 345, H367.01, H367.02, H367.03

C. Human, Natural, & Economic Resources
Agricultural, Environmental, and Development Economics 200, 280
Bus MHR 290
Economics 110, 200
Family Resource Management 340
Geography 200, 240, H410, 430
History 368
International Studies 210, 215, 240, 260
Political Science 145
Sociology 483, 466

HISTORICAL STUDY (5-10 hrs)

African-American & African Studies 121,122
Economics 515,516
Edu Psas 210, 211
Engineering 360.01, 360.02
History any History course (except 398 & 598). History 368 may be used to help fulfill either a History requirement or a Social Science requirement but not both.
Hist Art 201, 202
Philosophy H111, H112

ARTS & HUMANITIES (5-10 hrs, no more than one from a group)

A. Literature
African-American and African Studies 154, 251, 254, 271, 345, 367.02, 367.03, 367.04, 551
Arabic 371, 372
Chinese 251, 501, 502, 503, 504
Classics 101, 102, 222
Comparative Studies 100, 201, 202.01, 202.02, 203, 204, 205, H240, 273, 301, 306, 308, 314
English 201, 202, 220, 260, 261, 262, 275, 280, 281, 290, 291, 367.02, 367.03
French 150, 151, 152, 250
German 250, H263, 281, 292, 399
Hebrew 370, 372, 373, 374, 378
Italian 151, 152, 251
Japanese 251, 252
Korean 251
Modern Greek H250, 371
Near Eastern Languages & Cultures 271, 371, 372, 374
Persian 370, 371
Philosophy 215, 301, 302, 303, 304, 305, 306, 307
Russian 250, 251
Scandinavian 222, 513
Slavic 245
Spanish 320, 321, 520
Theatre 367.02
Turkish 371, 372
Women's Studies 215, 367.01, 367.02, 367.03, 367.04, 372
Yiddish 371, 399

B. Visual/Performing Arts
African-American and African Studies 288
Architecture 271[2]
Art 205, 206, 300.01, 300.02, 340, H455
Art Education 160, 252, 367.01
Comparative Studies 358
Dance 161, 200
East Asian Languages & Literatures 348
English 263, 269
Film Studies 270
History of Art 201, 202, 210, 211, 212, 213, 216, 260, 300, 301, 305, 315, 316, 340, 345, 350, 360, 505,519, 520, 525, 530, 578, 582
Italian 221
Korean 505
Landscape Architecture 201
Medieval & Renaissance Studies 219
Modern Greek 268
Music 250, 251, 252, 253, 288, 341, 342, 345.01, 347, 348, 349
Philosophy 240, H242
Physics H455
Russian 360
Scandinavian 520
Spanish 322, 330, 380
Theater 100, H101, 161, H230, 271, 280[2]
Women's Studies 230, 317

C. Cultures and Ideas
African-American and African Studies 303, 342, 485.01
Allied Medicine 307
Anthropology 241
Arabic 241, 367, 377
Art Educ 255
Arts and Sciences 500
Chinese 231, 232
Classics 224, 225, 226, 230, 240
Comparative Studies 234, 241, 242, 264, 270, 272, 274, 275, 305, 336, 339, 345, 367.01, 367.02, 367.03, 376, 377
Dance 357
East Asian Languages & Literatures 131, 341
English H167, 264, 270, 271, 278, 277, 364, 378
ENR 367
French 153
German 275, 299
Hebrew 216, 241, 376, 379
History 306, 330.01, 348
History of Art 306
Japanese 231
Jewish Studies 201
Korean 231
Landscape Architecture 387
Linguistics 201, 301, 303
Medieval and Renaissance Studies 210,211 212, 213, 214, 215, 216, 217, 218, 226, 240
Modern Greek 241
Near Eastern Languages and Cultures 241, 244, 311, 341, 344, 345, 351, 360, 370
Persian 241
Philosophy 101, 130, 131.01, 230, 270, 336
Portuguese 330
Romanian 235
Russian 135, 235
Slavic Languages and Literatures 130
Spanish 150, 151, 331
Turkish 241
Women's Studies 101
Yiddish 241, 387

DIVERSITY EXPERIENCE (Must take one "diversity experience" course which may be taken from any GEC category. Underlined courses in all categories meet "diversity experience" requirements.)

African-American & African Studies 230, 243
Art Educ 467
Biology 597
Comparative Studies 243
Econ 482, 485
Edu P&L 551, 552
Family Resource Management 302
Geography 400
History 325
Political Science 508
Psychology 375, 846
Social Work 300, 301
Sociology 306, 362, 435, 467, 608
Speech and Hearing 310
Women's Studies 370, 510, 520

FOREIGN LANGUAGE (Waived)

A. Completion through enrollment in a foreign language sequence through 104, or enrollment in a foreign language course with a prerequisite of 104 can be substituted for one GEC course requirement in the Arts and Humanities category, group C.

B. Completion of a foreign language minor can be substituted for two GEC courses, one in Social Sciences category, group A or B, and one in Arts & Humanities category, group A or C.

UNIVERSITY CAPSTONE (Waived – A Social Science 597 may be substituted for a 5 hr Social Science, group A, B, or C; A 5 hr Arts & Humanities 597 may be substituted for a 5 hr Arts & Humanities group B course.)

Social Sciences
Anthropology 597.01, 597.02, H597.03, 597.04
Evolution, Ecology, and Organismal Biology 597.02
Geography 597.01, 597.02
International Studies 597.01, 597.02
Political Science 597.01, 597.02
Sociology 597.01, 597.02

Arts & Humanities
Comparative Studies 597.01, 597.02
History 597

[1] Psychology 100 is not approved for social diversity when it comes in as a transfer credit.

[2] Note that this is a three credit hour course and by itself does not meet the minimum credit-hour requirement for the VPA section.

Underlined courses indicate "social diversity" GEC must include one "social diversity" course.

Attachment #3

DEPARTMENT OF
MATERIALS SCIENCE
AND ENGINEERING

Materials Science and Engineering
477 Watts Hall
2041 College Road
Columbus OH 43210
(614) 292-2553
mse@osu.edu

Undergraduate Core MSE Courses – Required

205 Introduction to Materials Science and Engineering
Structure, processing, properties, and applications of metals, ceramics, polymers, and composite materials.

281 Materials Processing Laboratory
Introductory lab course dealing with the appearance, handling, and characteristics of several important materials.

282 Materials Characterization
Microscopy, diffraction, and chemical analyses of metallic, ceramic, semiconducting, and polymeric materials.

341 Atomic Scale Structure of Materials
Crystal structures in metals, ceramics and other materials, point defects in crystals, structure determination by X-Ray diffraction.

342 Microstructure and Characterization of Materials
Introduction to dislocations, grain boundaries, surfaces and multiphase microstructures. Optical and electon microscopic characterization of microstructures.

361 Introduction to Mechanical Behavior of Materials
Macroscopic mechanical response of ceramics, metals, polymers and composite materials, with an introduction to the underlying microstructural processes during deformation.

371 Electronic Materials
Structure - properties relations and application of materials in electronics, magnetics and optics.

401 Materials Thermodynamics
First three laws of thermodynamics; phase equilibria; reaction equilibria; solution theory; phase diagrams.

525 Phase Diagrams
Phase diagrams of unary, binary and ternary materials systems; themodynamics and applications.

526 Transport and Kinetics
Transport of heat, mass and momentum and kinetics as applied to materials processing.

533 Modeling of Materials Processing Methods
Development and application of simple mathematical models of selected Solidification Processing methods, Solid State Processing methods, and Vapor Phase Processing methods.

543 Structural Transformations
Principles of structural transformations in materials. Thermodynamics and kinetics of nucleation, growth, precipitation, and martensitic reactions.

564 Mechanical Behavior and Material Microstructure
Course provides detailed understanding of how atomic-scale and micro-scale structure controls macroscopic mechanical behavior of ceramics, metals, polymers and composite materials.

581 (.01, .02, .03) Materials Science Laboratory
Laboratory experiments related to material properties and processes. Introduction to experimental techniques in materials science. Development technical writing skills.

595 (.02, .03) Junior Seminars
Seminars on Industrial Experience and on Graduate School by outside invited speakers.
Seminars and participation in senior design projects.

600 Materials Selection and Performance
Integration of structure, properties, processing, and performance principles to formulate and implement solutions to materials engineering problems.

601 Materials Selection and Performance II
Integration of structure, properties, processing and performance principles to formulate and implement solutions to materials engineering problems.

695 (.01, .02, .03) Senior Design Project
An in-depth design project to foster independent thinking and to develop problem solving skills.

- Analysis of design problem and formulation of approach to solve problem.
- Execution of design projects with written and oral reports.
- Completion of design projects with written and oral reports. May be taken as an honors course with permission of department.

Engineering 198A Explore Engineering
Lectures, field trips, and discussion of various materials related industries.

MSE Courses taken according to student's chosen Materials Specialization

602 Analysis of Die Casting Processes
Fundamental principles underlying the die casting process; integration of cast component design, process requirements and economics.

612 Structure and Defects of Crystalline Ceramics
Structure of ceramic crystals, point defects and non-stoichiometric structures.

614 Electrical, Optical and Magnetic Properties of Ceramic Materials
Ceramic conductors, sensors, varistors; dielectric materials; electro-optic ceramics, fiber optics and magnetic materials.

615 Chemical Processing of Ceramics
Chemical methods for making ceramic powders, the colloidal behavior of ceramic particulate suspensions and the multicomponent, multiphase equilibria found in thermomechanically processed ceramics.

616 Ceramic Forming Processes
Principles of ceramic forming processes and raw materials.

617 Thermal Processing of Ceramics
Ceramic drying and firing processes. Emphasis is on microstructure development: calcining, solid state sintering, liquid phase sintering, grain growth, hot pressing and reaction bonding.

618 Structure, Properties and Processing of Glass
Processing, structure and properties of glasses and basic glass manufacturing operations.

619 Ceramic Processing Laboratory
Processing and properties of ceramic materials.

642 Polymer Science and Engineering
Principles of polymer science and engineering and the important concepts that distinguish plastics from inorganic materials. Structure/property relationships that drive new applications.

643 Introduction to Physical Polymer Science
An introduction to the physical properties of polymeric materials, integrating polymeric structure with physical properties, and the application of these properties

Specializations in MSE

- Biomaterials
- Ceramic Materials
- Electronic Materials
- Metallurgy
- Materials Manufacturing
- Polymeric Materials
- Custom

Each specialization requires 6 600-level non-core MSE courses, 1 600-level MSE lab, and 4 technical elective courses.

644 Structure and Properties of Composite Materials
Structure and properties of polymer matrix, metal matrix, and ceramic matrix composites. Tailoring of properties by composite design.

645 Materials in Medicine I
The science and engineering of materials having medical applications.

646 Materials in Medicine II
How materials can be modified to meet the needs of specific medical applications.

649 Biomaterials Processing Lab
Processing and properties of biomaterials; forming processes used with biomaterials.

661 Ferrous Metallurgy
Physical metallurgy of plain carbon and alloy steels.

662 Corrosion
Principles of corrosion engineering; definitions, types of corrosive attack and methods of minimization and prevention.

663 Non-Ferrous Metallurgy
Physical metallurgy of important non-ferrous alloys; their properties and applications.

666 Deformation Processing
Continuum behavior of metals; analysis of common forming operations; slab calculations, ideal work methods, upper bound analysis, other numerical methods.

667 Casting and Powder Metallurgy
Near net shape manufacturing via solidification and powder metallurgy methods.

668 Process Metallurgy
Thermodynamics, reaction kinetics, and fluid, heat and mass transfer principles applied to metallurgical processes including their analysis and process design.

669 Metallic Materials Lab
Heat treatment, microstructure, phase transformations and mechanical properties of steels. Microstructure control for mechanical property optimization.

673 Electroceramics: Chemical Sensors, Thin-films and Nano-Structures
Principles of chemical sensing, catalysis, nano-materials/nano-structures and thin-films; includes laboratory group projects.

676 Processing Electronic Materials
Introduction to microfabrication with emphasis on processing, structure and stability of materials in microelectronics.

679 Electronics Materials Lab
Laboratory experience in microelectronics processing.

Attachment #4

Approved Feb. 2010

Department of Materials Science and Engineering

MSE - Specialization Options

- All MSE majors must complete a Specialization to graduate with the BS degree.
- All Specializations must be submitted and approved by the last day of the Winter Quarter of the MSE Junior Year.
- Each Specialization consists of at least 31 hours of graded credit.
- A statement of courses allowed as Technical Electives appears on the second page of this document and on the following webpage: http://www.matsceng.ohio-state.edu/depot/TechnicalElectivesReq.pdf

Biomaterials All of the following a-c:

a)

Biology 113 (5)	Energy Transf & Dev
Chem 231 (3) SP	Intr Organic Chem
EEOB 415 (4) W	Princ Anim Cell & Dev Bio
MSE 642 (3) A	Polymers Sci & Eng
MSE 662 (3) A	Metallic Corrosion
MSE 645 (3) W	Materials in Medicine I
MSE 646 (3) SP	Materials in Medicine II
MSE 644 (3) SP	Struc & Prop Composites
MSE 649 (1) W	Biomaterials Lab

b) One (1) non-core 600-level or higher MSE graded lecture courses.

c) One (1) Technical Elective course, totaling at least 3 credit hours

Ceramic Materials All of the following a-b:

a)

MSE 612 (3) A	Crystalline Struc
MSE 614 (3) A	Ceramic Properties
MSE 615 (3) A	Chem Proc of Cer
MSE 644 (3) SP	Struc & Prop Composites
MSE 673 (3) W	Electroceramics, Nano
MSE 618 (3) W	Proc of Glass
MSE 619 (1) W	Ceram Proc Lab

b) Four (4) Technical Electives courses, totaling at least 12 credit hours

Electronic Materials All of the following a-c:

a)

PHYS 517 (4) SU, A, SP	Intr Electron for Physicists
OR ECE 300 (3) and ECE 309 (1) A, WI, SP	Electrical Cir & Lab
MSE 614 (3) A	Ceramic Properties
MSE 673 (3) W	Electroceramics, Nano
MSE 676 (3) SP	Elect Mats Processing
MSE 679 (1) SP	Elect Mats Lab

b) Three (3) non-core 600-level or higher MSE graded lecture courses.

c) Three (3) Technical Electives courses, totaling at least 9 credit hours

Metallurgy – Metallic Materials
All of the following a-b

a)

MSE 661 (3) A	Ferrous Metallurgy
MSE 662 (3) A	Metallic Corrosion
MSE 663 (3) A	Non-Ferrous Met
MSE 666 (3) W	Deformation Proc
MSE 667 (3) SP	Casting & Powder Met
MSE 668 (3) SP	Process Metallurgy
MSE 669 (1) W	Metallic Mats Lab

b) Four (4) Technical Electives courses, totaling at least 12 credit hours

Materials Manufacturing All of the following a-c:

a) **Six courses** from:

MSE 602 (3) W	Analysis of Die Casting (even-numbered academic years)
MSE 616 (3) W	Ceramic Forming Proc
MSE 617 (3) SP	Thermal Proc of Cer
MSE 618 (3) W	Proc of Glass
MSE 642 (3) A	Struc & Prop of Solid Poly
MSE 661 (3) A	Ferrous Metallurgy
MSE 663 (3) A	Non-Ferrous Met
MSE 666 (3) W	Deformation Proc
MSE 667 (3) SP	Casting & Powder Met
MSE 668 (3) SP	Process Metallurgy
MSE 676 (3) SP	Elect Mats Processing

b) One (1) non-core 600-level MSE lab*
619, 649, 669, or 679 * Be aware of lab prerequisites.

c) Four (4) courses from:

Bus-FIN 420 (4)	Finance
Bus-MGT 430 (4)	Management
Bus–M&L 450 (4)	Marketing
ISE 650.01 (3) W	Intro Mfg Processes
ISE 650.03 (4) W	Mfg Proc & Simulation
ISE 750.01 (3) Qtr.varies	Intr Model of Mat Proc
ISE 652.01 (3) SP	Lab for Rapid Des Ptyp
WE 500 (3) A	Phys Prin in WE

d) Recommended: Econ 200 as a GEC

Polymeric Materials All of the following a-c:

a)

Chem 231 (3) SP	Intr Organic Chem
ISE 751.02 (3) Qtr.varies	Polymer Process Fundam
MSE 642 (3) A	Struc & Prop of Solid Poly
MSE 643 (3) W	Molcr Aspects Polym Prop
MSE 644 (3) SP	Struc & Prop Composites
MSE 649 (1) W	Biomaterials Lab

b) Three (3) non-core 600-level or higher MSE graded lecture courses

c) *Two (2) Technical Elective courses, totaling at least 6 credit hours
*Chem 252 and 253 may be used for Polymeric Materials technical electives (approved 10/22/09).

Custom Specialization All of the following a-f:

a) Six (6) non-core 600-level or higher MSE graded lecture courses
b) One (1) MSE 600-level lab (619, 649, 669, or 679)
c) Four (4) Technical Electives courses, totaling at least 12 credit hours
d) Written rationale for construction of the specialization
e) Signature of faculty advisor
f) Approval of Undergraduate Studies Committee

Quarters offered may change Updated 02/10

Year 1

	Fall			Spring	
	2	Intro. Engineering I		2	Intro. Engineering II
	4	Chem for Engineers		4	Organic Chem for Engineers
	3	GenEd Elective		5	Physics I (mechanics)
	1	Survey		5	Engineering Calculus II
	5	Engineering Calculus I			
Total	15		Total	16	

	Credits	%
"Non-technical" General Education:[2]	24	19%
Math & Basic Science:	32	25%
Engineering topics (incl. MSE):	71	56%
Total:	127	100%
MSE coursework	56	44%
MSE labs	7	6%

Year 2

	Fall			Spring	
	3	2010 Intro. to Engineering Materials		3	2241 Structure and Characterization
	5	Physics II (E&M)		3	2251 Thermodynamics of Materials
	4	Math (80% Diff Eq + 20% Lin Alg)		3	2321 Modeling and Simulation in MSE I
	3	GenEd Elective		2	2331 Structure & Chracterization Lab[1]
				3	GenEd Elective
				3	GenEd Elective
Total	15		Total	17	

Course number ABCD

A 2 = sophomore, 3 = junior, 4 = senior (not open to grad), 5 = senior/grad

B 0 = req'd lecture, offered each semester, 1 = req'd fall lecture, 2 = req'd spring lecture; 3 = req'd lab (co

C 1 = intro, 2 = computational lab, 3 = experimental lab, 4 = structural, 5 = chemical, 6 = mechanical, 7 =

D assigned number

Year 3

	Fall			Spring	
	3	3141 Transformation and Processing of Matls		3	3261 Mechanical Behavior of Materials
	3	3151 Transport Phenomena and Kinetics		3	3271 Electronic Properties
	2	3331 MSE Experimental Lab I[1]		2	3321 Modeling and Simulation in MSE II
	3	Technical Elective		2	3332 MSE Experimental Lab II[1]
	4	Statics & Strength of Materials		3	Technical Elective
	3	GenEd Elective		3	GenEd Elective
Total	18		Total	16	

Year 4

	Fall			Spring	
	3	4321 Modeling and Simulation in MSE III		3	4382 Design & Prof. Practice II
	2	4181 Materials Selection		3	5xxx MSE Elective
	3	4381 Design and Prof. Practice I		3	5xxx MSE Elective
	3	5xxx MSE Elective		3	GEC Elective
	3	5xxx MSE Elective		3	GEC Elective
	1	5x31 MSE Elective Lab			
Total	15		Total	15	

NOTES:

1 Credit hours for labs reflect a data analysis/experimental design component

2 "Non-technical" GEC's to include: 2 writing, 1 literature, 1 arts, 1 historical study, 2 social science, 1 culture & ideas (8 classes, 24 credits)

Attachment # 5

Materials Science and Engineering Curriculum Map: Courses to Program Outcomes

Course Number	a	b	c	d	e	f	g	h	i	j	k
MATSCEN 2010	***	**	**		**					*	**
MATSCEN 2193	***	**	**	*	**		*	*	*	*	**
MATSCEN 2194	***	**	**	***	**		**	*	*	*	**
MATSCEN 2241	***		*	*	***	*	*		*		**
MATSCEN 2251	***	*	***	*	**						***
MATSCEN 2321	***	***	**		***		**				***
MATSCEN 2331	***	***					**				***
MATSCEN 3141	**	*	*	***	***	*	*	**	*	**	***
MATSCEN 3151	***		***	*	***		*		*	**	***
MATSCEN 3189	***	**	**	**	*	*	**	**	**	*	***
MATSCEN 3261	***	**	**	**	**	*	*	*	*	*	***
MATSCEN 3271	***		***	*	***		*	*	*	**	***
MATSCEN 3321	***	**	**		**						***
MATSCEN 3331	***	***			**		***		*		***
MATSCEN 3332	***	***			**		***	*	*	*	***
MATSCEN 3611	**		***	*	***	**	*	*	*	*	***
MATSCEN 4181	***	***	***	*	***	*	*	*	**	**	**
MATSCEN 4189	**	**	**	**	**	*	*	*	*	*	***
MATSCEN 4193	***	**	**	*	**		*	*	*	*	**
MATSCEN 4194	***	**	**	***	**		**	*	*	*	**
MATSCEN 4321	***	***	***	***	**		**			*	***
MATSCEN 4381	***	**	**	***	***	*	***	*	*	**	**
MATSCEN 4382	**	***	**	***	***	*	**	*	*	**	***
MATSCEN 4891	**	*	*	*	**	*	***		*	*	**
MATSCEN 4892	**	*	*	*	**	*	***		*	*	**
MATSCEN 4998	***	***	***	*	***		*	*	*	*	***
MATSCEN 4999H	***	***	***	*	***		*	*	*	*	***
MATSCEN 5431	***	***	*	***	**	*	**	*			***
MATSCEN 5441	***		**	*	*						**
MATSCEN 5451	***		**		**	*	*	*		*	*
MATSCEN 5531	**	***	**		**		**				***

Attachment #6 cont.

Course Number	a	b	c	d	e	f	g	h	i	j	k
MATSCEN 5532	***	***		***			***				
MATSCEN 5541	***		*		**						
MATSCEN 5551	***	*	***	*	***	*	*	**	**	*	**
MATSCEN 5552	***	***	***	***	***						
MATSCEN 5571	***	**	***	*	**		*			*	**
MATSCEN 5572	***		***		***					*	
MATSCEN 5611	*		***	*	**	*	*	*	*	**	***
MATSCEN 5631	*	***	*	*	*		**	*	*	*	***
MATSCEN 5641	*		*	*	***	*	*	**	*	**	***
MATSCEN 5651	**	*	***	*	**	*	*	***	*	**	***
MATSCEN 5711	***	*	***	*	***	*	*	*	*	*	***
MATSCEN 5761	***	**	*		**		*		*	*	**
MATSCEN 5762	***	**	*	*	**					*	**
MATSCEN 5763	***	*	**	*	***	*	*		*	*	**
MATSCEN 5951	***	**	*		*		*	*	*		***
MATSCEN 5971	***		***	*	***		*	*	*	**	***
MECHENG 2040	***		*		***		*				*

MSE Proposed Transition Plan

Attachment # 7

Quarter Course #	Quar cr hrs	EqSemCrH	EqSemCrHr	Substitutes for #	Sem cr hrs	SemCrHr	Excess cr hrs
Chem 121	5	3.33	6.00	Chem	5	9	-3.00
Chem 125	4	2.67		Chem	4		
En Graph 167	4	2.67	2.67	MSE 2321	3	3	-0.33
Eng 100	1	0.67	0.67	Eng	1	1	-0.33
Eng 181	3	2.00		Eng	2		
Eng 183	3	2.00	4.67	Eng	2	4	0.67
Eng 198A	1	0.67					
English 110	5	3.33		English	3		
GEC	5	3.33		GenEd	3		
GEC	5	3.33		GenEd	3		
GEC	5	3.33	26.00	GenEd	3	24	2.00
GEC	5	3.33		GenEd	3		
GEC	5	3.33		GenEd	3		
GEC	5	3.33		GenEd	3		
GEC	4	2.67		GenEd	3		
ISE 410	4	2.67					
Math 151	5	3.33		Math	5		
Math 152	5	3.33	13.33			10	3.33
Math 153	5	3.33		Math	5		
Math 254	5	3.33					
Math 415	4	2.67	2.67	Math	4	4	-1.33
ME 410	4	2.67	5.33	ME	4	4	1.33
ME 420	4	2.67					
MSE 205	3	2.00	2.00	MSE 2010	3	3	-1.00
MSE 281	1	0.67	1.33			2	-0.67
MSE 282	1	0.67		MSE 2331	2		
MSE 341	3	2.00	4.00	MSE 2241	3	3	1.00
MSE 342	3	2.00					
MSE 371	3	2.00	2.00	MSE 3271	3	3	-1.00
MSE 401	4	2.67	4.67	MSE 2251	3	3	1.67
MSE 525	3	2.00					
MSE 526	3	2.00	4.00	MSE 3151	3	3	1.00
MSE 543	3	2.00					
MSE 533	3	2.00	2.00	MSE 3321	2	2	0.00
MSE 361	3	2.00	4.00			3	1.00
MSE 564	3	2.00		MSE 3261	3		
MSE 581.01	2	1.33		MSE 3331	2		
MSE 581.02	2	1.33	4.00	MSE 3332	2	4	0.00
MSE 581.03	2	1.33					
MSE 595.02	1	0.67					
MSE 595.03	1	0.67					
MSE 600	3	2.00	4.00	MSE 4181	2	5	-1.00
MSE 601	3	2.00		MSE 4321	3		
MSE 695.01	1	0.67		MSE 4381	3		
MSE 695.02	1	0.67	2.00	MSE 4382	3	6	-4.00
MSE 695.03	1	0.67					
Physics 131	5	3.33		Physics	5		
Physics 132	5	3.33	10.00	Physics	5	10	0.00
Physics 133	5	3.33					
		109.33	105.33		106	106	

Start as Freshman	First Qr as MSE major	Graduation Quarter	AU 09 Q	WI 10 Q	SP 10 Q	AU 10 Q	WI 11 Q	SP 11 Q	AU 11 Q	WI 12 Q	SP 12 Q	Student Summary	Bridge Courses (if any)
AU 12	SP 14 S	SP 16 S											
AU 11	SP 13 S	SP 15 S							Math 151(3.33) Chem 121(3.33) Engr 181(2) Engr 100.11(.67) = 9.33	Math 152(3.33) EnGraph 167(2.67) Phy 131(3.33) Engr 183(2) = 11.33	Math 153(3.33) Phy 132(3.33) English 110.xx(3.33) =10	Total = 30.66	
AU 10	AU 11 Q	SP 14 S				Math 151(3.33) Chem 121(3.33) Engr 181(2) Engr 100.11(.67) = 9.33	Math 152(3.33) EnGraph 167(2.67) Phy 131(3.33) Engr 183(2) = 11.33	Math 153(3.33) Phy 132(3.33) English 110.xx(3.33) MSE 205(2) = 12	Math 254(3.33) ISE 410(2.67) Phy 133(3.33) MSE 341(2) MSE 281(.67) = 12	ME 410(2.67) Chem 125(2.67) MSE 342(2) MSE 282(.67) GEC(3.33) = 11.34	Math 415(2.67) ME 420(2.67) MSE 401(2.67) Tech Elec (2) = 10	Total = 66	
AU 09	AU 10 Q	SP 13 S	Math 151(3.33) Chem 121(3.33) Engr 181(2) Engr 100.11(.67) = 9.33	Math 152(3.33) EnGraph 167(2.67) Phy 131(3.33) Engr 183(2) = 11.33	Math 153(3.33) Phy 132(3.33) English 110.xx(3.33) MSE 205(2) = 12	Math 254(3.33) ISE 410(2.67) Phy 133(3.33) MSE 341(2) MSE 281(.67) = 12	ME 410(2.67) Chem 125(2.67) MSE 342(2) MSE 282(.67) GEC(3.33) = 11.34	Math 415(2.67) ME 420(2.67) MSE 361(2) MSE 371(2) Eng 198A(.67) = 10	MSE 401(2.67) MSE 526(2) MSE 581.01(1.33) MSE 595.02(.67) GEC(3.33) = 10	MSE 525(2) MSE 564(2) MSE 581.02(1.67) GEC(3.33) GEC(2.67) = 11.67	MSE 533(2) MSE 543(2) MSE581.03(1.67) MSE 595.03(.67) Tech Elec(2) GEC(3.33) = 9.67	Total = 97.34	

Attachment #8: Spreadsheet showing our transition plan for students entering the university in AU 09Q, AU10Q, AU11Q, and AU12S (Pg 1 of 2)

	AU 12 S	SP 13 S	AU 13 S	SP 14 S	AU 14 S	SP 15 S	AU 15 S	SP 16 S	
AU 12	Intro Engg I (2) Chem for Engrs(4) GenEd (3) Survey (1) Calculus I (5) = 15	Intro Engg II (2) OrgChem for Engrs(4) Phy I (5) Calculus I (5) = 16	MSE 2010(3) Phy II (5) Math III (4) GenEd (3) = 15	MSE 2241(3) MSE 2251(3) MSE 2321(3) MSE 2331(2) GenEd (3) GenEd (3) = 17	MSE 3141(3) MSE 3151(3) MSE 3331(2) TechElec (3) Stat&St.ofMat (4) GenEd (3) = 18	MSE 3261(3) MSE 3271(3) MSE 3321(2) MSE 3332(2) TechElec (3) GenEd (3) = 16	MSE 4321(3) MSE 4181(2) MSE 4381(3) MSE 5xxx(3) MSE 5xxx(3) MSE 5x31(1) = 15	MSE 4382(3) MSE 5xxx(3) MSE 5xxx(3) GenEd (3) GenEd (3) = 15	**Graduation Semester** Total = 127
AU 11	MSE 2010(3) Phy II (5) Math III (4) GenEd (3) = 15	MSE 2241(3) MSE 2251(3) MSE 2321(3) MSE 2331(2) GenEd (3) GenEd (3) = 17	MSE 3141(3) MSE 3151(3) MSE 3331(2) TechElec (3) Stat&St.ofMat (4) GenEd (3) = 18	MSE 3261(3) MSE 3271(3) MSE 3321(2) MSE 3332(2) TechElec (3) GenEd (3) = 16	MSE 4321(3) MSE 4181(2) MSE 4381(3) MSE 5xxx(3) MSE 5xxx(3) MSE 5x31(1) = 15	MSE 4382(3) MSE 5xxx(3) MSE 5xxx(3) GenEd (3) GenEd (3) = 15	**Graduation Semester** Total = 126.67		
AU 10	MSE 3141(3) MSE 3151(3) MSE 3331(2) Stat&St.ofMat (4) GenEd (3) = 15	MSE 3261(3) MSE 3271(3) MSE 3321(2) MSE 3332(2) TechElec (3) GenEd (3) = 16	MSE 4321(3) MSE 4181(2) MSE 4381(3) MSE 5xxx(3) MSE 5xxx(3) MSE 5x31(1) = 15	MSE 4382(3) MSE 5xxx(3) MSE 5xxx(3) GenEd (3) GenEd (3) = 15	**Graduation Semester** Total = 127				
AU 09	MSE 4321(3) MSE 4181(2) MSE 4381(3) MSE 5xxx(3) MSE 5xxx(3) MSE 5x31(1) = 15	MSE 4382(3) MSE 5xxx(3) MSE 5xxx(3) GenEd (3) GenEd (3) = 15	**Graduation Semester** Total =127.34						

Attachment #8 (cont'd): Spreadsheet showing our transition plan for students entering the university in AU 09Q, AU10Q, AU11Q, and AU12S (Pg 2 of 2)

Appendix: External Advisory Committee report from October 2009 meeting

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Rudolph G. Buchheit
Professor and Chair, Materials Science and Engineering
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November 16, 2009

Dear Professor Buchheit:

The External Advisory Committee (EAC) of the Department of Materials Science and Engineering at The Ohio State University conducted its annual meeting on Thursday and Friday, October 22-23, 2009. This memo serves as our report to the department based on EAC's discussion at the meeting, supplemented by post-meeting communications from EAC members.

The EAC thought that beginning the meeting after an informal lunch with faculty members on Thursday was an outstanding idea versus the previous practice of conducting all the Committee's business on one day.

The EAC appreciated your review of the status of the Welding Engineering merger with MSE. The Committee understands that faculties of both departments have already voted to approve the merger, and that full University Board of Trustee approval is expected early next year. The EAC is in full agreement with the merger, and interested in adding members from the welding engineering community to the EAC. Furthermore, the EAC applauds your vision and leadership in conducting the merger negotiations on a win-win basis.

The discussion on the re-organization of the EAC went very well. There was full agreement to form four subcommittees, and all EAC members who were present volunteered to serve on at least one of the subcommittees. This change enables EAC members to provide further support to the department between meetings of the full committee, and to help prepare for the upcoming 2011 ABET accreditation assessment.

- Industrial Relations—cultivate MSE-Industry relations for mutual benefit. Chair: Rowdy Joseph
- Undergraduate Programs—review and assess the undergraduate program. Chair: Henry Cialone
- Graduate and Research Programs—review and assess the graduate program and research activities. Chair: Sri Sriram
- Capital Campaign—assist in relationship building with friends of the department and alumni, and assist in setting development priorities. Chair: John Marra

Every EAC member will be expected to participate in one or more of the subcommittees. The membership of the EAC will also be expanded from 17 current members to 25; this will allow alumni members of the

Welding Engineering to be added to the committee, one or two MSE academics from outside of OSU, and principals from companies that hire graduates. The Committee also agreed to schedule a 1-day meeting in the spring to review activities by the subcommittees in addition to making the regularly scheduled fall meeting a day and half on the Thursday and Friday before Homecoming. Note: it was subsequently decided to set the spring meeting date for Friday, April 23, 2010. Professor Buchheit extended the possibility of helping defray travel costs for EAC members if that would make the difference between attending in person or not.

It was announced that the term of membership to the EAC was 3 years, which can be indefinitely renewed based on mutual interest.

The EAC then considered a proposal by Professor Buchheit for members to evaluate Senior Design Projects. He mentioned that Virginia Tech instituted a similar procedure a few years ago, and that the benefits of the review included:

- Elevating awareness of what constitutes "design" in the field of materials science and engineering for faculty and students
- Keeping project scopes realistic but challenging
- Elevating the significance of the Senior Design Project by making it an externally evaluated exercise

The committee unanimously agreed to Professor Buchheit's proposal; every EAC member will be contacted to evaluate 1-2 Senior Design Projects beginning 2010.

The EAC was impressed at the progress made during the last year in planning the transition of the academic calendar from quarters to semesters, which is scheduled to occur beginning with the autumn term in 2012. However, the Engineering curricula must be ready by March 2010 for review by the university. A MSE faculty committee has benchmarked the MSE curriculum at 7 leading universities to help guide the selection of MSE core courses. A proposal for MSE undergraduate extended design sequence was presented and discussed, as well as a proposed list of MSE elective courses. Long-standing student interest in offering core courses more often than once per year was discussed, as well as taking advantage of distance learning successfully utilized by Welding Engineering.

The Committee appreciated Professor Buchheit summary of the role that the EAC could play in the important autumn 2011 ABET accreditation visit that will focus on continual improvement. EAC members were in full agreement to assist the department in getting ready for this visit, including possibly meeting with program evaluators during their on-site visit.

At the end of the first day, several members attended the Emeritus Dinner at the OSU Golf Course. This event was well attended by current and emeritus faculty and their spouses. It provided an excellent informal opportunity for EAC members to catch-up with faculty.

The strategic review of the department beginning the second day was enlightening. It demonstrated real progress from 2008 and the challenge presented by the merger with Welding Engineering. The increase in undergraduate and graduate enrollment was impressive; when combined with the addition of students from Welding Engineering, the OSU MSE program may become the largest in the US. The targets presented of increasing graduate enrollment to 180 and undergraduate enrollment to 300, while increasing tenure track faculty from 33 to 35, is wholeheartedly endorse by the EAC. With the anticipated retirement of up to 9 current MSE faculty by 2015, the department has an opportunity to implement a strategic vision of focusing on core strengths, which includes support to industry within Ohio.

Friday afternoon was devoted entirely to meetings with undergraduate and graduate students, with an EAC-only wrap-up session at the end. In a departure from the past freewheeling discussions, the EAC posed the same 5 questions to the students:

- What most attracted you to the MSE Department?
- What two things do you like about the MSE Department?
- What two things do you dislike about the MSE Department?
- Who is the Department Chairman?
- What would you suggest the External Advisory Council do to make your educational experience better?

What most attracted you to the MSE Department?

- Undergraduate students
    - Multiple students highlighted Megan Daniels' advice and MSE advocacy. In particular, she is recognized for doing an excellent job in conveying the value of MS&E to students. Aside: In light of these comments, the EAC was pleased to see that Megan was recognized in the Fall 2009 Watts News with an Above and Beyond Award.
    - Attendance at an ASM Materials Camp and MSE Day for High School seniors made a significant impact on many of the undergraduate students. In a marked change from the past, more than half of them came into the engineering program interested in specializing in materials.
    - The MSE presentations as part of the freshman engineering survey class also were very effective in generating interest in materials. Several students meeting with EAC originally were interested in chemistry, chemical engineering, and mechanical engineering but changed their majors after learning more about materials.
    - Consistent with the past, the students highlighted the friendliness, open door policy, and accessibility of the faculty and staff as a tremendous positive.
        - As the merger with Welding Engineering progresses and the department increases in size, the EAC encourages the department to maintain this culture of friendliness and openness with the students.
    - Several students expressed the importance of the department's applications orientation, opportunity for internships, and ties to industry as key factors in majoring in MSE.
- Graduate students
    - Students highlighted the lack of parochialism among faculty members and their willingness to share information as very positive factors in their selection of OSU's MSE department; those from other universities in particular were vocal in this regard.
    - Consistent with the undergraduate students, the open door policy by the facility was mentioned in quite positive terms.
    - Small class size, but with critical mass
    - Variety of the type of materials covered in the department
    - National ranking and reputation of the department
    - Financial aid opportunity

What two things do you like about the MSE Department?

- Undergraduate students
    - Friendliness of the faculty and staff
    - Class size

- Good professor-student relationships; Accessibility of the professors
- Opportunities to do research
- Opportunity to be paid to assist research projects
- Well-rounded program

- Graduate students
  - Theoretical & application focus of the programs
  - Accessibility to state-of-the-art instruments and equipment
  - Collaboration with other departments
  - Access to experts within the department
  - Accessibility of the advisors, the entire faculty, and the staff
  - Diversity of opportunities
  - World class equipment
  - Kudos to Mark Cooper for deftly handling many administrative tasks

What two things do you dislike about the MSE Department?

- Undergraduate students
  - Some professors reading PowerPoint slides versus using them as a teaching aide
  - Some make teaching appear as a chore, not a priority
  - Laboratories leave much to be desired
    - This has been a consistent story for several years, leaving the appearance it is a low priority
    - Often the instructors do not explain the purpose behind the experiment
    - Often there appears to be a lack of preparation of the equipment
    - Long delays in the feedback on Lab Reports
    - TA's not always engaged
    - Lack of consistency in report writing expectations
- Graduate students
  - Lack of recognition and marketing the excellence of the department...Appears that the Department does not pursue aggressive marketing
  - Lack of optical microscopes, in marked contrast to electron microscopes
  - Non-MSE background course poorly taught
  - No trial period or rotation opportunity before selecting an advisor
  - Decrepit buildings are not consistent with the reputation of the department
  - Lack of technician for the high bay is a long standing problem
  - No flexibility in scheduling of 700 and 800 courses...only offered once every 2 years
  - Difficulty in obtaining acceptance of equivalent to core courses that were taught outside the department

Who is the Department Chairman?

- Undergraduate students
  - Everyone knows Rudy
  - Rudy got great kudos...All agree he is a great ambassador for the MSE department

The more visibility Rudy gets, the better it is for all involved

- Graduate students
    - Same comments as undergraduates

What would you suggest the External Advisory Council do to make your educational experience better?

- Undergraduate students
    - Help expose students to industry and specialization sooner than junior year
    - Encourage earlier emphasis on design and technical writing
    - Help with understanding the benefits of professional society membership
    - Support more than only one session per year for required courses…avoid a 5th year
    - Provide ability to take specialization courses earlier and offer even if initial enrollment is not high…building interest in welding engineering, ceramics, electronic materials, bio materials
- Graduate students
    - Support increase in the number of sessions for certain courses
    - Some only offered every 2 years…Add flexibility in the 700-800 level courses
    - Help get the word out about how good the department really is
        - Support more Public Relations activities such as more write-ups in the OSU Engineering publication
    - Help the department to not be so humble!

In synopsizing these student comments, several key themes stand out:

- The students overwhelmingly are pleased with their interactions with the faculty and staff. Their experiences within the department in this regard met the expectations they had when they committed to the department. The culture of "friendliness" made a deep impression.
- The department's outreach activities with high school students and entering freshman have had a dramatic effect in raising awareness of the MSE career field for undergraduates.
- No concerns were expressed about the pending integration with welding engineering…on the contrary, most students looked on it as a positive since there is an interest in learning more about welding.
- The students, both graduate and undergraduate, like the range of courses offered (only exception was the comment that no graduate courses are available in bio-materials). But they dislike the lack of frequency in the course offerings. The EAC does not believe that this issue is being addressed in the revamping of the curricula to semesters. This is due to the fact that the department is currently short of faculty, and possibly classroom space as the enrollment has increased.
    - A suggestion: would it be possible to offer key courses "off-cycle" using a course that was recorded and presenting it digitally as is done for remote students in welding engineering?
- Undergraduate laboratories still are not being fully exploited to reinforce knowledge of MSE fundamentals, nor practice writing clear technical reports.
- Students were gratified to see their faculty engaged and well-respected at national technical meetings. This re-affirmed their understanding of the prominence of the department.
- The poor state of the physical facilities is in marked contrast to the state-of-the-art research instrumentation.
- There is great interest by undergraduates in learning more about MSE careers in industry, government laboratories, and academia before the senior year.

- The current department chair, Professor Buchheit, is widely known and respected by the students.

The EAC appreciates its access to the faculty and students, and the openness with which our questions are addressed. We look forward to increasing our involvement with the department, helping the department to achieve its goals.

On behalf of the entire External Advisory Committee,

Robert E. Schafrik, PhD, PE
EAC Chair

Vincent Russo, PhD
Vice Chair

Cc: EAC members (via e-mail)

Comments from the MSE External Advisory Committee

Letter dated: August 17, 2010

Aviation

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August 17, 2010

Dear Professor Buchheit:

The undergraduate curriculum in Materials Science and Engineering (MSE) was presented to the MSE External Advisory Committee (EAC) at our Annual Fall meeting in October 2009. The EAC was impressed with the thoroughness of the planning for conversion to a semester-based curriculum. The committee recognized that this revision included a substantial update to the present curriculum consistent with changes in the discipline and in faculty expertise that has occurred over the past ten years. The revised curriculum we reviewed included: novel approaches to the laboratory experience and importantly, integration of computational methods and approaches; an extended design sequence; and a list of MSE elective courses. The Committee was gratified that the updated curriculum was thoroughly benchmarked against programs at peer institutions. Also, long-standing student interest the department offering high demand core courses more frequently than once per year was discussed, as well as the department taking advantage of distance learning successfully employed by Welding Engineering.

The EAC was in general agreement that the new curriculum would properly prepare materials scientists and engineers for professional practice, and for further graduate or professional studies. As committee co-chairs, we have now reviewed the final draft of the MSE proposal and find that it substantially reflects the curriculum that was presented in October 2009. The MSE EAC looks forward to the implementation of this new curriculum and the opportunity to help adapt this curriculum if needed when it is implemented in 2012.

Sincerely Yours,

Robert E. Schafrik & Vincent J. Russo
Co-chairmen, External Advisory Committee