March 27, 2015
No. 337

THE UNIVERSITY OF WISCONSIN-MILWAUKEE
College of Engineering and Applied Science

F A C U L T Y M E E T I N G

Friday, March 27, 2015 1:45 p.m. EMS E190

M I N U T E S

The meeting was called to order at 2:04 p.m. with Dean Brett Peters presiding. Thirty-nine faculty members were present:

EXCUSED: Professors Abu-Zahra, Amano, Campbell-Kyureghyan, Chen, Church, Cuzner, El-Hajjar, McRoy, Nasiri, Perez, Pillai, Qu, Reisel, Sobolev, Suzuki, Titi, L.Wang, W. Wang, Yuan, J. Zhao

ABSENT: Professors Cheng, Helwany, Li, Liu, Nambisan, Venugopalan, Y. Wang, Wornyoh, T. Zhao

I. ANNOUNCEMENTS

A. Faculty were encouraged to attend the Go Milwaukee event for prospective students in EMS after the meeting was over.

B. Prof. Petering made a short presentation on his understanding of the budget situation, and some suggestions for how cuts could be made to achieve financial savings.

II. INFORMAL REPORTS – See Attachment 1

III. AUTOMATIC CONSENT BUSINESS

A. Minutes of the February 27, 2015 meeting.

B. New Course and Course Changes – See Attachment 2

C. Electrical Engineering Curriculum Revisions – See Attachment 3

D. Materials Engineering Curriculum Revisions – See Attachment 4

IV. NEW BUSINESS

A. Request to Implement a B.S. in Biomedical Engineering – See Attachment 5 ***CEAS DOC NO. 234***

Prof. Misra moved to approve the B.S. in Biomedical Engineering program

The motion was seconded. Concerns over the resources needed for the program were

aired, as well as concerns over the impact of the program on existing programs. Other faculty voiced support for the program and its potential to increase enrollment in the college. In addition, several faculty mentioned that faculty are already working in the area, and are readily available to teach courses in the program.

The motion passed on a voice vote.

B. Biomedical Engineering Curricular Code – See Attachment 6

Prof. Misra moved to adopt the proposed Biomedical Engineering Curricular Code.

The motion was seconded and approved on a voice vote.

V. GENERAL GOOD AND WELFARE – None

VI. ADJOURNMENT

Meeting Adjourned at 2:40 p.m.

John R. Reisel, Secretary
CEAS Faculty

Sarah Albertson, Administrative Assistant

JRR
Attachments

ATTACHMENT 1

INFORMAL REPORTS

Office of Student Services – Todd Johnson

No Report

Career Services – Juli Pickering

No Report

Curriculum Committee – Prof. Tabatabai

No Report

Graduate Program Subcommittee – Prof. Li

No Report

Academic Planning Committee – Prof. Misra

No Report

Biomedical and Health Informatics – Prof. McRoy

No Report

Faculty Senate – Prof. Reisel

At its March meeting, the Faculty Senate passed four resolutions regarding the proposed budget cuts and conversion of the UW System into a Public Authority.

In addition, the University Committee is providing more frequent information regarding the budget situation and its other activities at http://UCNews.uwm.edu.

Graduate Faculty Committee – Prof. Campbell – Kyureghyan

UPDATES FROM THE GRADUATE FACULTY COMMITTEE

The UWM Graduate Faculty Committee (GFC) met on Feb 16th, 2015. A brief summary of the items of most interest to CEAS from the meeting is presented below. Full details can be found at: http://graduateschool.uwm.edu/faculty-staff/governance/graduate-faculty-committee

- Marija Gajdardziska-Josifovska reported:
  - ✓ Applications to the Graduate School (master's and doctoral categories) are up 2.2%
  - ✓ Programs are 16% behind on master's admissions and 40% behind on doctoral admissions, compared to last year. Budget uncertainties may be the cause of the lower admissions.
  - ✓ The Research Excellence Awards, Research Assistantships, Teaching Assistantships, and Program Assistantships will be continued for the next academic year at the current year's rates.
  - ✓ The award amounts for the Distinguished Graduate Student and Distinguished Dissertation fellowships will likely remain the same, but fewer awards might be given as a result of the proposed state budget cuts.
  - ✓ Since the January 2015 split into two divisions, the Graduate School has a deficit of $500,000 in salaries.
- The Graduate School is also investigating the following policies:
  - Certificate along the way to the master's
  - Master's along the way to the PhD
  - Double master's along the way to the PhD
- A draft of the certificate policy will go to the GCC. It has already been reviewed by the graduate program representatives.
- A draft of the English proficiency policy might be completed by the beginning of Fall 2015.
- Craig Guilbault was elected to be the next chair of the GFC

ATTACHMENT 2

NEW COURSE

MATLENG 491 SENIOR DESIGN PROJECTS II, 3 cr., U
Independent and team design projects under the direction of a faculty member. Written and oral engineering reports must be submitted on each design project undertaken.
Prereq: MatlEng 490(P).

COURSE CHANGES

ELECENG 354 DIGITAL LOGIC, 3 cr., U
Number systems and binary codes; Boolean Algebra and basic results; switching functions; minimization techniques; analysis and design of combinational and sequential logic circuits.
Prereq: CompSci 240(P) or 250(201)(P).

had been

ELECENG 354 DIGITAL LOGIC, 3 cr., U
Number systems and binary codes; Boolean Algebra and basic results; switching functions; minimization techniques; analysis and design of combinational and sequential logic circuits.
Prereq: CompSci 151(P) or 152(P) or 153(P) or 201(P) or 215(P).

ELECENG 367 INTRODUCTION TO MICROPROCESSORS, 4 cr., U
Fundamentals of microprocessors, including assembly language programming, hardware design, interfacing peripherals and programmable I/O devices, and social/ethical issues in engineering design and practice. Lab.
Prereq: CompSci 240(P) or 250(201)(P) & C or better in ElecEng 354(P).

had been

ELECENG 367 INTRODUCTION TO MICROPROCESSORS, 4 cr., U
Fundamentals of microprocessors, including assembly language programming, hardware design, interfacing peripherals and programmable I/O devices, and social/ethical issues in engineering design and practice. Lab.
Prereq: CompSci 151(P) or 152(P) or 153(P) or 201(P) & C or better in ElecEng 354(P).

ELECENG 436 INTRODUCTION TO MEDICAL INSTRUMENTATION, 3 cr., U/G
Biopotential signals and electrodes; Biopotential Amplifiers and Signal Processing; Sensors, Detectors, and Sources; Electrical Safety; Specifications; Error Analysis; Device Approval Process.
Prereq: jr st; ElecEng 305(P) or equiv.

had been

ELECENG 436 INTRODUCTION TO MEDICAL INSTRUMENTATION, 3 cr., U/G
Biopotential signals and electrodes; Biopotential Amplifiers and Signal Processing; Sensors, Detectors, and Sources; Electrical Safety; Specifications; Error Analysis; Device Approval Process.
Prereq: jr st; ElecEng 330(P) or equiv.

ELECENG 474 INTRODUCTION TO CONTROL SYSTEMS, 4 cr., U/G
Modeling of continuous systems; stability considerations, analysis and design of feedback control systems in time and frequency domains.
Prereq: jr st; ElecEng 310(P), CompSci 240(P), CivEng 202(P) or cons instr; or grad st.

had been

ELECENG 474(402) INTRODUCTION TO CONTROL SYSTEMS, 4 cr., U/G
Modeling of continuous systems; stability considerations, analysis and design of feedback control systems in time and frequency domains. Not open for cr to students w/cr in ElecEng 402.
Prereq: jr st; ElecEng 310(P), CivEng 202(P) or cons instr; or grad st.

MATLENG 490 SENIOR DESIGN PROJECTS I, 1 cr., U
Project identification and planning for senior design project; proposals, project management, ethics, professional responsibilities, use of standards and team procedures. Written and oral engineering reports and proposals. Intended for first semester seniors.
Prereq: sr st; MatlEng 411(C).

had been

MATLENG 490 SENIOR DESIGN PROJECTS, 4 cr., U
Independent and team design projects under the direction of a faculty member. Written engineering reports must be submitted on each design project undertaken.
Prereq: sr st; MatlEng 201(P); a 400-level Materials course except MatlEng 411.

MECHENG 360 MECHANICAL DESIGN I, 3 cr., U
Kinematic and dynamic analysis of machine members and design applications to linkages, cams, gears, machine balancing and mechanical systems subject to various constraints.
Prereq: MechEng 101(P),111(P); & Civ Eng 202(P).

had been

MECHENG 360 MECHANICAL DESIGN I, 3 cr., U
Kinematic and dynamic analysis of machine members and design applications to linkages, cams, gears, machine balancing and mechanical systems subject to various constraints.
Prereq: Ind Eng 101(P) or MechEng 111(P); CompSci 151(P) or 153(P) or 201(P); & Civ Eng 202(P).

MECHENG 370 COMPUTER AIDED ENGINEERING LABORATORY, 2 cr., U
Mechanical design and analysis using state of the art CADD, kinematics, and FEA computer tools.
Prereq: MechEng 101(P), 111(P);Civ Eng 202(P) & 303(P); & ElecEng 234(P).

had been

MECHENG 370 COMPUTER AIDED ENGINEERING LABORATORY, 2 cr., U
Mechanical design and analysis using state of the art CADD, kinematics, and FEA computer tools.
Prereq: MechEng 111(P) or MechEng 101(P) & Ind Eng 210(P); CompSci 151(P) or 153(P) or 201(P); Civ Eng 202(P) & 303(P); & ElecEng 234(P).

MECHENG 462 INTERMEDIATE DESIGN OF MACHINERY, 3 cr., U/G
Consideration of complicated loadings and combined stresses. Design against fatigue. Design and analysis of machine systems. Consideration of special topics in machine element design.
Prereq: jr st; MechEng 366(P).

had been

MECHENG 462 INTERMEDIATE DESIGN OF MACHINERY, 3 cr., U/G
Consideration of complicated loadings and combined stresses. Design against fatigue. Design and analysis of machine systems. Consideration of special topics in machine element design.
Prereq: jr st; MechEng 365(P).

ATTACHMENT 3

ELECTRICAL ENGINEERING CURRICULUM REVISIONS

The changes to the Electrical Engineering curriculum are highlighted on the following pages.

NEW

University of Wisconsin – Milwaukee

College of Engineering and Applied Science

ELECTRICAL ENGINEERING CURRICULUM

The typical number of credits required to complete the Bachelor of Science in Engineering with a major in Electrical Engineering is 126 credits. Students who need background preparation courses may need additional credits. See information below regarding placement examinations.

Engineering Core Courses (23 credits)		**Credits**	**Prerequisite**
ElecEng 101	Fundamentals of Electrical Engineering	3	Math 116(C), admis to College of Engineering & Applied Science
EAS 200	Professional Seminar	1	none
CompSci 240	Introduction to Engineering Programming	3	Math Placement Code of 40 or Math 116 (P)
Civ Eng 201	Statics	3	Math 232 (P)
Civ Eng 202	Dynamics	3	Civ Eng 201 (P), Math 233 (C)
MatlEng 201	Engineering Materials	4	Chem 105 (P) or 102 (P) or 117(P)
ElecEng 301	Electrical Circuits I	3	Physic 210 (C)
MechEng 301	Basic Engineering Thermodynamics	3	Math 233 (P), Physics 209 (P)

***Electrical Engineering Major (36 credits)**			
ElecEng 305	Electrical Circuits II	4	ElecEng 301 (P), ElecEng 234 (P)
ElecEng 310	Signals and Systems	3	ElecEng 305 (P)
ElecEng 330	Electronics I	4	ElecEng 305 (C)
ElecEng 335	Electronics II	4	ElecEng 330 (P), ElecEng 310 (C)
ElecEng 354	Digital Logic	3	CompSci 201 (P) or 240 (P) or 250 (P)
ElecEng 361	Electromagnetic Fields	3	Physics 210 (P), ElecEng 234 (P), grade C or better in Math 233
ElecEng 362	Electromechanical Energy Conversion	4	ElecEng 305 (P), ElecEng 361(P)
ElecEng 367	Introduction to Microprocessors	4	CompSci 240(P) or 250(201)(P) & C or better in ElecEng 354(P)
ElecEng 420	Random Signals and Systems	3	Jr St, ElecEng 310(P)
ElecEng 595	Capstone Design Project	4	Sr St, ElecEng 335 (P), ElecEng 367 (P)

****Mathematics (14 -16 credits)**		(16 credits typical: Math 231,232,233, ElecEng 234)
One of the following **Calculus** sequences must be completed:		
Math 231-232-233	12	Math placement score, or previous course with at least
Or Math 221- 222 (Honors)	10	"C" grade.
And ElecEng 234 (Analytical Methods in Engineering)	4	Math 232 (P) with at least "C" grade

****Chemistry (5 credits)**	
One of the following courses must be completed:	
Chem 102 or Chem 105	Chem 100 with "C" grade or Chemistry placement test

Physics (8 credits)	
Physics 209 – 210	Physics 209: Math 232 (C) Physics 210: Math 233 (C)

General Education Requirements

Distribution Requirements (15 credits)

Art	3	none
Humanities	3	none
Social Science	6	none
English 310 Writing, Speaking and Technoscience in the 21st Century	3	English competency

Cultural Diversity - One of the arts, humanities, or social science courses selected must also meet the UWM cultural diversity requirement.

Free Electives 2

Competency Requirements

***English Composition (0-6 credits)**

The English Composition requirement is satisfied by:

1. Earning a satisfactory score on the English placement test, **or**
2. Earning a grade of C or higher in English 102, **or**
3. Transferring with a grade of C or better in a course (3 credits or more) equivalent to English 102 or higher level expository writing course

Foreign Language (0-8 credits) (for new freshman starting fall 1999)

The foreign language requirement can be completed with one of these options:

1. Two years of a single foreign language in high school
2. Two semesters of a single foreign language in college
3. Demonstrate ability by examination

*** Advancement to Major:** 1. Complete a minimum of 24 credits required for major. (Excludes: general education, prerequisite and orientation courses). 2. Complete Math 232 (or 222) with "C" or better grade. 3. Complete EAS 200 Professional Seminar. 4. Complete the English composition requirement. 5. Obtain a 2.5 GPA in all courses in item 1. **The program may impose major status as a prerequisite for courses numbered 300 or above.**

** **Placement Examinations**: Students without previous college level credits in Math, Chemistry or English may be required to take placement exams. The results of these tests determine the appropriate course in which to register. Background prerequisite courses may be required in addition to the courses listed above.

Proposed Effective Fall 2015

NEW

Technical Electives--Electrical Engineering Major.

The electrical engineering program requires a total of 21 credits of technical electives, chosen as follows.

Group A Technical Electives: Select at least 15 credits. All non-required Electrical Engineering courses number 400-699 are Group A Technical Electives.

		Credits	Prerequisite
EAS 001	Co-op Work Period	3[1]	Prior cons co-op dir
EAS 497	Study Abroad	3[2]	Acceptance to Study Abroad Prog; cons CEAS assoc dean
ElecEng 410	Principles of Discrete Systems & Digital Signal Processing	3	Jr St, ElecEng 310(P)
ElecEng 421	Communication Systems	3	ElecEng 335(C))
ElecEng 436	Introduction of Medical Instrumentation	3	Jr St, ElecEng 330(P)
ElecEng 437	Introduction to Biomedical Imaging	3	Sr St, ElecEng 310(P)
ElecEng 451	Introduction to VLSI Design	3	Jr St, ElecEng 330(P), 354(P)
ElecEng 457	Digital Logic Laboratory	3	Jr St, ElecEng 330(P), 354(P)
ElecEng 458	Computer Architecture	3	Jr. St., ElecEng 354(P), CS 315(P) or EE 367(P)
CompSci 459	Fundamentals of Computer Graphics	3	Jr St, CompSci 217(P), CompSci 252(P)
ElecEng 461	Microwave Engineering	3	Jr St, ElecEng 361(P)
ElecEng 462	Antenna Theory	3	Jr St, ElecEng 361(P)
ElecEng 464	Fundamentals of Photonics	3	Jr St, ElecEng 361(P)
ElecEng 465	Broadband Optical Networks	3	Jr St, ElecEng 305(P), 361(P)
ElecEng 471	Electric Power Systems	3	Jr St, ElecEng 362(P)
ElecEng 474	Introduction to Control Systems	4	Jr St, ElecEng 310(P) or CivEng 202 or cons instr
ElecEng 482	Introduction to Nanoelectronics	3	Jr St, ElecEng 330(C), 361(C)
ElecEng 490	Special Topics	1-3	Jr St
CompSci 520	Computer Networks	3	Jr St, CompSci 315(P) or 458(P)or ElecEng 367(P)
CompSci 530	Computer Networks Laboratory	3	Jr St, CompSci 520(P)
ElecEng 541	Integrated Circuits and Systems	3	Jr St, ElecEng 330(P)
ElecEng 545	FPGA Embedded CPUs & Firmware Development	3	Jr St, ElecEng 367(P) & 457(P)
ElecEng 562	Telecommunication Circuits	3	Sr St, ElecEng 330(P)
ElecEng 565	Optical Communication	3	Sr St, ElecEng 361(P), 330(P) or 465(P)
ElecEng 572	Power Electronics	3	Sr St, ElecEng 335(C)
ElecEng 574	Intermediate Control Systems	3	Sr St, ElecEng 474(402)(P) or MechEng 474(P)
ElecEng 575	Analysis of Electric Machines and Motor Drives	3	Jr St, ElecEng 330 (P), 362 (P)
ElecEng 588	Fundamentals of Nanotechnology	3	Jr St, ElecEng 361(P)
ElecEng 599	Senior Thesis	3	Sr St, Cons Instr
ElecEng 699	Independent Study	1-3	Jr St, Cons Instr
Ind Eng 360	Engineering Economic Analysis	3	Jr St
Matl 481	Electronic Materials	3	Jr St, MatlEng 201(P)
MechEng 321	Basic Heat Transfer	4	Jr St, MechEng 301(P)
BusAdm 447	Entrepreneurship	3	Jr St, Bus Adm 350(P)

Group B Technical Electives: Choose no more than 6 credits from the following list.
Any Mathematics course 400-level or above, or Math 313, Math 321, or Math 322
Any Chemistry course 200-level or above, or Chem 104[3]
Any Physics course 300-level or above, or Phy 214, or Phy 215
Any Biology course 150-level or above
Any Atmospheric Sciences course 100-level or above
Any Computer Science course 200-level or above

[1]Students who earn **3 or more** credits of Co-op may use 3 of those credits as approved technical electives.
[2]Students who earn **3 or more** credits of Study Abroad may use 3 of those credits as approved technical electives.
[2]3Students who take Chem 102 and 104 (equaling a min. of 8 credits) may use up to **3** credits of Chem 104 as Group B technical electives.

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Web Site: www.ceas.uwm.edu

ATTACHMENT 4

MATERIALS ENGINEERING CURRICULUM REVISIONS

The proposed changes to the Materials Engineering curriculum are highlighted on the following pages.

Proposed

University of Wisconsin – Milwaukee

College of Engineering and Applied Science

MATERIALS ENGINEERING CURRICULUM

The minimum number of credits required to complete the Bachelor of Science in Engineering with a major in Materials Engineering is 124 credits. Students who need background preparation courses may need additional credits. See information below regarding placement examinations.

Engineering Core Courses (24 credits)		**Credits**	**Prerequisite**
EAS 100/MatlEng 150	Freshman Orientation **or** It's a Material World (recommended only)	1-3	none
EAS 200	Professional Seminar	1	none
Ind Eng 467	Introductory Statistics for Physical Sciences and Engineering Students	3	Jr St, Math 233
CompSci 240	Introduction to Engineering Programming	3	Math Placement Code of 40 or Math 116(P).
Civ Eng 201	Statics	3	Math 232
Civ Eng 202	Dynamics	3	Civ Eng 201, Math 233 (C)
Civ Eng 303	Strength of Materials	4	Civ Eng 201, Math 233 (C)
MatlEng 201	Engineering Materials	4	Chem 105 or 102 or 117
ElecEng 301	Electrical Circuits 1	3	Physic 210 (C)

Materials Engineering Major (28 credits)			
MatlEng 330	Materials and Processes in Manufacturing	3	MatlEng 201
MatlEng 402	Physical Metallurgy	3	Jr St, MatlEng 201
MatlEng 410	Mechanical Behavior of Materials	3	Jr St, MatlEng 201
MatlEng 411	Materials Laboratory	3	Sr St, MatlEng 201
MatlEng 442	Thermodynamics of Materials	3	Jr St, MatlEng 201
MatlEng 443	Transport Phenomena in Materials Processing	3	Jr St, MatlEng 442, ElecEng 234
MatlEng 452	Ceramic Materials	3	Jr St, MatlEng 201
MatlEng 453	Polymeric Materials	3	Jr St, MatlEng 201
MatlEng 490	Senior Design Projects - I	1	Sr St, MatlEng 411 (C)
MatlEng 491	Senior Design Projects - II	3	MatlEng 490

***Mathematics (14-16 credits)**		
One of the following **Calculus** sequences must be completed:		
Math 231-232-233	12	Math placement score, or previous course with at least "C" grade.
Or Math 221- 222 (Honors)	10	
And ElecEng 234 (Analytical Methods in Engineering)	4	Math 233

***Chemistry (5-10 credits)**		
One of the following sequences must be completed:		
Chem 105 (Suggested) or Chem 102 -104	5	Chem 100 with "C" grade or Chemistry placement test

Physics (10 credits)		
Physics 209 & 214 – 210 & 215	10	See Schedule of Classes

General Education Requirements

Distribution Requirements (15 credits)

Art	3	none
Humanities	6	one
Social Science	6	none

One of the arts, humanities, or social science courses selected must also meet the UWM cultural diversity requirement.
(Commun 103 Public Speaking or Commun 105 Business and Professional Communication are recommended as part of the distribution requirements)

Free Elective 2

Competency Requirements

***English Composition (0-6 credits)**

The English Composition requirement is satisfied by:

1. Earning a satisfactory score on the English placement test, or
2. Earning a grade of C or higher in English 102
3. Transferring a grade of C or better in a course (3 credits or more) equivalent to English 102 or higher level expository writing course

Foreign Language (0-8 credits) (for new freshman starting fall 1999)

The foreign language requirement can be completed with one of these options:

1. Two years of a single foreign language in high school
2. Two semesters of a single foreign language in college
3. Demonstrate ability by examination

***Placement Examinations**

Once admitted to UWM, most engineering students are required to take placement examinations in mathematics, English and chemistry. Students with previous college level credits in these areas may not be required to take placement exams. The placement exams are administered by the UWM Testing Center, Mellencamp Hall, room B28, (414) 229-4689. The results of these tests help students determine the appropriate course in which to register. Background prerequisite courses may be required in addition to the courses listed above. Possible Math placements for engineering students are Math 090-095-105-116-117-225-231-221. Possible English placements are English 090-095-101-102. Possible Chemistry placements are Chemistry 100, 102 or 105.

Technical Electives--Materials Engineering Major.

The materials engineering program requires a minimum of 24 credits of technical electives, chosen from the following lists. At least 18 of the credits of technical electives must be from Group A1 and A2 as outlined below.

Group A1 Technical Electives (Structure): Select at least 3 courses.

		Credits	Prerequisite
MatlEng 380	Engineering Basis for Materials Selection	3	MatlEng 201
MatlEng 465/ MechEng 465	Friction and Wear	3	Jr St, MatlEng 201
MatlEng 481	Electronic Materials	3	Jr St, MatlEng 201
MatlEng 483	Materials for Energy Systems	3	Jr St, MatlEng 201
MatlEng 485	Introduction to Biomaterials	3	Jr St, MatlEng 201
MatlEng 511	Advanced Materials Characterization	3	Jr St, MatlEng 201
MatlEng 461	Environmental Degradation of Materials	3	Jr St, MatlEng 201

Group A2 Technical Electives (Processing): Select at least 2 courses.

		Credits	Prerequisite
MatlEng 421	Metal Casting Engineering	3	Jr St, MatlEng 201
MatlEng 431	Welding Engineering	3	Jr St, MatlEng 201
MatlEng 460/ MechEng 460	Nanomaterials and Nanomanufacturing	3	Jr St, MatlEng 201
MatlEng 455	Engineering Composites	3	MatlEng 201
MatlEng 471	Heat Treatment of Materials	3	Jr St, MatlEng 201

Group B Technical Electives: Select no more than 6 credits

Chem 104	General Chemistry and Qualitative Analysis	3	Chem 102
Chem 223	Elementary Quantitative Analysis	4	Chem 104 or 118
Chem 341	Introductory Survey of Organic Chemistry	3	Chem 104 or 118
Civ Eng 401	Intermediate Strength of Materials	3	Jr St, CivEng 303
Civ Eng 502	Experimental Stress Analysis	3	Jr St, CivEng 303
EAS 001	Co-op Work Period	3[1]	none
English 206	Technical Writing	3	Soph St, Completion of Eng Comp
Ind Eng 111	Introduction to Engineering	3	Math 116 (C)
Ind Eng 112	Engineering Drawing & Computer Aided Design/Drafting	3	Math 116
Ind Eng 360	Engineering Economic Analysis	3	Jr St
MatlEng 699	Independent Study	3	Jr St, Cons Instr
Math 413	Introduction to Numerical Analysis	3	Jr St, Math 233(C), 234 (C)
MechEng 110	Engineering Fundamentals I	4	Math 231 (C)
MechEng 111	Engineering Fundamentals II	4	MechEng 110
MechEng 301	Basic Engineering Thermodynamics	3	Math 233, Physics 209
MechEng 320	Introduction to Fluid Mechanics	3	MechEng 301, ElecEng 234, Civ Eng 202

Other appropriate courses by permission of the department chair.

[1]Students who earn **3 or more** credits of Co-op may use 3 of those credits as approved technical electives.

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Department of Materials Engineering (414) 229-5181
Engineering & Mathematical Science Building (EMS) Room E1181

Web Site: www.ceas.uwm.edu

Current

University of Wisconsin – Milwaukee

College of Engineering and Applied Science

MATERIALS ENGINEERING CURRICULUM

The minimum number of credits required to complete the Bachelor of Science in Engineering with a major in Materials Engineering is 124 credits. Students who need background preparation courses may need additional credits. See information below regarding placement examinations.

Engineering Core Courses (24 credits)		**Credits**	**Prerequisite**
EAS 100/MatlEng 150	Freshman Orientation **or** It's a Material World (recommended only)	1-3	none
EAS 200	Professional Seminar	1	none
Ind Eng 467	Introductory Statistics for Physical Sciences and Engineering Students	3	Jr St, Math 233
CompSci 151/201	Intro. to Scientific Programming or Intro. Computer Programming	3	Math 105(P)
Civ Eng 201	Statics	3	Math 232
Civ Eng 202	Dynamics	3	Civ Eng 201, Math 233 (C)
Civ Eng 303	Strength of Materials	4	Civ Eng 201, Math 233 (C)
MatlEng 201	Engineering Materials	4	Chem 105 or 102 or 117
ElecEng 301	Electrical Circuits 1	3	Physic 210 (C)

Materials Engineering Major (28 credits)			
MatlEng 330	Materials and Processes in Manufacturing	3	MatlEng 201
MatlEng 490	Senior Design Projects	4	Sr St, MatlEng 201, 400-level Materials course except MatlEng 411
MatlEng 402	Physical Metallurgy	3	Jr St, MatlEng 201
MatlEng 410	Mechanical Behavior of Materials	3	Jr St, MatlEng 201
MatlEng 411	Materials Laboratory	3	Sr St, MatlEng 201
MatlEng 442	Thermodynamics of Materials	3	Jr St, MatlEng 201
MatlEng 443	Transport Phenomena in Materials Processing	3	Jr St, MatlEng 442, ElecEng 234
MatlEng 452	Ceramic Materials	3	Jr St, MatlEng 201
MatlEng 453	Polymeric Materials	3	Jr St, MatlEng 201

***Mathematics (14-16 credits)**			
One of the following **Calculus** sequences must be completed:			
Math 231-232-233		12	Math placement score, or previous course with at least "C" grade.
Or Math 221- 222 (Honors)		10	
And ElecEng 234 (Analytical Methods in Engineering)		4	Math 233

***Chemistry (5-10 credits)**			
One of the following sequences must be completed:			
Chem 105 (Suggested)	or Chem 102 -104	5	Chem 100 with "C" grade or Chemistry placement test

Physics (10 credits)			
Physics 209 & 214 – 210 & 215		10	See Schedule of Classes

General Education Requirements

Distribution Requirements (15 credits)

Art	3	none
Humanities	6	one
Social Science	6	none

One of the arts, humanities, or social science courses selected must also meet the UWM cultural diversity requirement.
(Commun 103 Public Speaking or Commun 105 Business and Professional Communication are recommended as part of the distribution requirements)

Free Elective 2

Competency Requirements

***English Composition (0-6 credits)**

The English Composition requirement is satisfied by:

1. Earning a satisfactory score on the English placement test, or
2. Earning a grade of C or higher in English 102
3. Transferring a grade of C or better in a course (3 credits or more) equivalent to English 102 or higher level expository writing course

Foreign Language (0-8 credits) (for new freshman starting fall 1999)

The foreign language requirement can be completed with one of these options:

1. Two years of a single foreign language in high school
2. Two semesters of a single foreign language in college
3. Demonstrate ability by examination

***Placement Examinations**

Once admitted to UWM, most engineering students are required to take placement examinations in mathematics, English and chemistry. Students with previous college level credits in these areas may not be required to take placement exams. The placement exams are administered by the UWM Testing Center, Mellencamp Hall, room B28, (414) 229-4689. The results of these tests help students determine the appropriate course in which to register. Background prerequisite courses may be required in addition to the courses listed above. Possible Math placements for engineering students are Math 090-095-105-116-117-225-231-221. Possible English placements are English 090-095-101-102. Possible Chemistry placements are Chemistry 100, 102 or 105.

Technical Electives--Materials Engineering Major.

The materials engineering program requires a minimum of 24 credits of technical electives, chosen from the following lists. At least 18 of the credits of technical electives must be from Group A1 and A2 as outlined below.

Group A1 Technical Electives (Structure): Select at least 3 courses.

		Credits	Prerequisite
MatlEng 380	Engineering Basis for Materials Selection	3	MatlEng 201
MatlEng 465/ MechEng 465	Friction and Wear	3	Jr St, MatlEng 201
MatlEng 481	Electronic Materials	3	Jr St, MatlEng 201
MatlEng 483	Materials for Energy Systems	3	Jr St, MatlEng 201
MatlEng 485	Introduction to Biomaterials	3	Jr St, MatlEng 201
MatlEng 511	Advanced Materials Characterization	3	Jr St, MatlEng 201
MatlEng 461	Environmental Degradation of Materials	3	Jr St, MatlEng 201

Group A2 Technical Electives (Processing): Select at least 2 courses.

		Credits	Prerequisite
MatlEng 421	Metal Casting Engineering	3	Jr St, MatlEng 201
MatlEng 431	Welding Engineering	3	Jr St, MatlEng 201
MatlEng 460/ MechEng 460	Nanomaterials and Nanomanufacturing	3	Jr St, MatlEng 201
MatlEng 455	Engineering Composites	3	MatlEng 201
MatlEng 471	Heat Treatment of Materials	3	Jr St, MatlEng 201

Group B Technical Electives: Select no more than 6 credits

Chem 104	General Chemistry and Qualitative Analysis	3	Chem 102
Chem 223	Elementary Quantitative Analysis	4	Chem 104 or 118
Chem 341	Introductory Survey of Organic Chemistry	3	Chem 104 or 118
Civ Eng 401	Intermediate Strength of Materials	3	Jr St, CivEng 303
Civ Eng 502	Experimental Stress Analysis	3	Jr St, CivEng 303
EAS 001	Co-op Work Period	3[1]	none
English 206	Technical Writing	3	Soph St, Completion of Eng Comp
Ind Eng 111	Introduction to Engineering	3	Math 116 (C)
Ind Eng 112	Engineering Drawing & Computer Aided Design/Drafting	3	Math 116
Ind Eng 360	Engineering Economic Analysis	3	Jr St
MatlEng 699	Independent Study	3	Jr St, Cons Instr
Math 413	Introduction to Numerical Analysis	3	Jr St, Math 233(C), 234 (C)
MechEng 110	Engineering Fundamentals I	4	Math 231 (C)
MechEng 111	Engineering Fundamentals II	4	MechEng 110
MechEng 301	Basic Engineering Thermodynamics	3	Math 233, Physics 209
MechEng 320	Introduction to Fluid Mechanics	3	MechEng 301, ElecEng 234, Civ Eng 202

Other appropriate courses by permission of the department chair.

[1]Students who earn **3 or more** credits of Co-op may use 3 of those credits as approved technical electives.

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University of Wisconsin – Milwaukee
P.O. Box 784
Milwaukee, WI 53201

Office of Student Services (414) 229-4667
Engineering & Mathematical Science Building (EMS) Room E386

Department of Materials Engineering (414) 229-5181
Engineering & Mathematical Science Building (EMS) Room E1181

Web Site: www.ceas.uwm.edu

Effective Spring 2014

ATTACHMENT 5

University of Wisconsin-Milwaukee
College of Engineering & Applied Science

Request for Authorization to Implement a Bachelor of Science in Biomedical Engineering

A. ABSTRACT:

The proposed Bachelor of Science (B.S.) in Biomedical Engineering will be offered by the Biomedical Engineering Program Department-like Body, within the College of Engineering & Applied Science. The program will require 120 credits of coursework that includes 16 credits of elective courses in a specialize track of the student's choice.

B. PROGRAM IDENTIFICATION:

Institution Name
University of Wisconsin-Milwaukee

Title of Proposed Program
Biomedical Engineering

Degree/major Designation
B.S. Engineering/Biomedical Engineering

Mode of Delivery
Primarily face-to-face classroom- and laboratory-based instruction

Single Institution or Collaboration
Single institution

Projected Enrollment by Year Five
250-300 students

Tuition Structure
Engineering undergraduate differential tuition

Department or Functional Equivalent
Biomedical Engineering Program Department-like Body

College, School or Functional Equivalent
College of Engineering & Applied Science

Proposed Date of Implementation
January 2, 2016

C. INTRODUCTION:

1. Why is the program being proposed? What is its relation to the institution's mission?

Biomedical engineering is a cross-disciplinary program that applies principles and methods from engineering, science, and technology to understand, define, and solve problems of life and medical sciences. Biomedical engineers design and manufacture devices and instrumentation, such as electrocardiography systems, electroencephalography, blood-flow monitoring, electrical stimulators for muscles and nerves, to assist medical specialists with diagnosis and treatment of patients. They design therapeutic and prosthetic devices to improve the quality of life. These include cochlear and visual prosthesis, prosthetic fingers, joints, and limbs. Biomedical engineers are also involved in development of artificial/bionic pancreas, heart, eyes, and other human organs.

Biomedical engineering is expected to play an important role in the economic development of Wisconsin and the region. The median annual pay in 2012 was $86,960 and, according to Forbes, biomedical engineering is ranked No. 1 in the major most worth tuition, time and effort, using a rubric of starting pay, median mid-career pay, growth in salary and wealth of job opportunities[1]. It has been ranked not only "one of the highest-paid engineering jobs," but also an immensely rewarding profession because "it is a career that gives back to society by helping improve world health."[2]

The mission statement of the University of Wisconsin-Milwaukee includes the development of high quality undergraduate programs appropriate to a major urban doctoral university, including developing and extending academic and professional opportunities for minority students. National trends indicate biomedical engineering is more attractive among under-represented groups. Since Southeast Wisconsin is home to a number of biomedical related industries, there are internship and job opportunities for the graduates. Furthermore, since it is a growing area, there is a strong possibility of entrepreneurship that will help with new economic development in the region.

2. How does it fit into the institution's overall strategic plan?

The proposed B.S. in Biomedical Engineering will complement the existing program array at UWM. Since the proposed program is of interdisciplinary nature, this will build upon several science and engineering courses already offered in our six ABET accredited B.S. degrees. The College of Engineering & Applied Science (CEAS) currently has over twelve faculty members with research and teaching interests in this area and offers a Master of Science in Engineering degree with Biomedical Engineering as one of the areas of concentration.

Further, the College leads a doctoral program in Biomedical and Health Informatics that is offered in collaboration with the following five units of the University and the Medical College of Wisconsin:

1. College of Health Sciences
2. College of Nursing
3. Lubar School of Business
4. School of Information Studies
5. Zilber School of Public Health

The proposed B.S. program will complement these graduate programs. Students in this program will have ample opportunities for research experience. Our partnership with the Medical College of Wisconsin will provide opportunities for hands-on experience to students. Also, biomedical engineering is one of the four areas of research concentrations with new investment by the College and therefore, such opportunities for students are expected to grow significantly.

3. Do current students need or want the program?

[1] http://whatisbiomedicalengineering.net/Factors-That-Affect-Biomedical-Engineering-Salaries.html
[2] http://money.cnn.com/pf/best-jobs/2012/snapshots/

Many students are aware of potential growth of biomedical engineering area. As a result, institutions with this program have exceptionally high enrollments. We have received enquiries from prospective students for quite some time about the availability of biomedical engineering program at UWM. Since our intent to plan was circulated, student requests for the date of availability of this program have been continuous, including many enquiries from students belonging to underrepresented groups. Some of the students have interests in engineering as well as in medicine and this program fits in their plans. Others find it appealing because of entrepreneurship or research interests.

4. Does market research indicate demand?

According to the U.S. Department of Labor, employment of biomedical engineers will grow 27 percent over the period of 2012 to 2022. This growth is at a much faster rate than the average for all occupations[3]. Since an aging population will need more medical care, demand for biomedical engineers is expected to continue to be strong. National trends show there will be a growing market for new and improved assistive devices for the aging population.

The proposed program has potential for an increased entrepreneurial activity in the region because of the availability of trained professionals in biomedical engineering.

5. How does the program represent emerging knowledge, or new directions in professions and disciplines?

It is a cross-disciplinary program that prepares students to apply basic science and engineering analysis and design techniques to the medical area. This requires basic understanding of the human body functions to design diagnostic and therapeutic devices. Thus, this brings a diverse group of professionals together than in turn benefits engineering designs as well. A number of biological phenomena have recently led to new engineering approaches. Against the backdrop of healthcare reform, an aging national populace[4], and innovations in medicine and engineering, biomedical engineering is emerging as a field of significant potential.

D. DESCRIPTION OF PROGRAM:

General Structure of the Program

Institutional Program Array
In keeping with its interdisciplinary nature, the program combines several disciplines of the College of Engineering & Applied Science, College of Letters and Sciences, College of Health Sciences, School of Nursing, and Zilber School of Public Health. The proposed program is designed on the basis of selected courses from engineering, biological sciences and other basic sciences. Only a few new courses will be needed for this program.

Other Programs in the University of Wisconsin System
Only University of Wisconsin-Madison currently offers this kind of program within the UW-System. The proposed program is not expected to significantly affect students' enrollment there. When fully implemented, we expect a total of about 300 students enrolling in this program.

Collaborative Nature of the Program
We have established strong relationships with the Medical College of Wisconsin as well as with GE Healthcare for research and graduate education in biomedical engineering. GE Healthcare has

[3] http://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm
[4] http://www.census.gov/prod/2014pubs/p25-1140.pdf

sponsored a Center for Computational Imaging at the College and a number of their engineers attend our classes for advanced degrees. Several senior engineers also teach as adjunct faculty at the College. Our newly built Innovation Campus is close to the Medical College of Wisconsin to facilitate collaborative activities. We have a strong support for the proposed program from the Medical College of Wisconsin that also sees it as a potential feeder into their graduate medical program.

Diversity
The mission statement of the University of Wisconsin-Milwaukee includes furthering academic and professional opportunities for women and minority students. National trends indicate that biomedical engineering is more attractive among the under-represented groups.

Student Learning Outcomes
Upon the completion of the program, a student will be able to:

a) Apply principles of engineering, biology, human physiology, basic science, mathematics (through differential equations), and statistics;
b) Solve biomedical engineering problems, including those associated with the interaction between living and non-living systems;
c) Analyze, model, design and realize biomedical engineering devices, systems, components, or processes; and making measurements on and interpreting data from living systems;
d) Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
e) Demonstrate an understanding of professional and ethical responsibility;
f) Demonstrate the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
g) Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Accreditation of engineering program requires a continuous assessment of the learning outcomes. Similar to existing engineering programs, this program will also be assessed in order to receive accreditation.

Programmatic Curriculum
Students will be required to take 120 credits to fulfill the requirements of the program. As indicated in the table below, this includes 26 credits in engineering core courses, 37 credits in the biomedical engineering major, up to 16 credits in mathematics, 10 credits in physics, and 15 in GER courses. Remaining 16 credits are assigned to several specialized tracks that students may select according to their interests. Some of these students may select a track in higher education while some other may select a broader spectrum and entrepreneurial emphasis. There will be more courses added to this group as the program expands.

Engineering core courses (26 credits)	BME 101 Fundamentals of Biomedical Engineering (3)* MechEng 101 Computational Tools for Engineers (2) EAS 200 Professional Seminar(1) CivEng 201 Statics (3)

	CivEng 202 Dynamics (3) MatlEng 201 Engineering Materials (4) ElecEng 301 Electrical Circuits I (3) MechEng 301 Basic Engineering Thermodynamic (3) ElecEng 305 Electrical Circuits II (4)
Biomedical Engineering Major (37 credits)	BioSci 202 Anatomy and Physiology I (4) BioSci 203 Anatomy and Physiology II (4) ElecEng 310 Signals and Systems (3) ElecEng 436 Introduction of Medical Instrumentation (3) MechEng 469 Introduction to Biomechanical Engineering (3) MechEng 474 Introduction to Control Systems (4) MechEng 479 Control and Design of Mechatronic Systems (3) MatEng 485 Introduction to Biomaterials (3) BME 495 Biomedical Instrumentation Lab/ Senior Lab (3)* BME 595 Capstone Design Project (4)* BioSci 465 Biostatistics OR IndEng 467 Introductory Statistics for Physical Science and Engineering Students (3)
Mathematics (14 - 16 credits)	One of the following Calculus sequences must be completed Math 231-232-233 (12) OR Math 221-222(Honors) (10), AND ElecEng 234 Analytical Methods in Engineering (4)
Physics (10 credits)	Physics 209 & 214 (Lab) Physics 210 & 215 (Lab)
GER courses (15 credits)	
Elective tracks (16 credits)	Students will select a track of their choice, such as (i) rehabilitation and bio-robotics, (ii) imaging, or

	(iii) general biomedical engineering and will be advised to enroll in courses from the list of electives. This list (and hence the tracks) is expected to grow as the faculty expands.

* Note: New course (CAR form) to follow

Electives (16)

EAS 001 Co-op Work Period
EAS 497 Study Abroad
CivEng 303 Strength of Materials
ElecEng 361 Electromagnetic Fields
ElecEng 410 Principles of Discrete Systems & Digital Signal Processing
ElecEng 437 Introduction to Biomedical Imaging
ElecEng 438 Bioanalytics and Biomedical Diagnostics
ElecEng 537 Fundamentals of Neuroimaging Technology
ElecEng 539 Introduction to Magnetic Resonance Imaging
IndEng 584 Biodynamics of Human Motion
IndEng 360 Engineering Economic Analysis
MechEng 320 Introduction to Fluid Mechanics
MechEng 370 Computer Aided Engineering Laboratory
BusAdm 447 Entrepreneurship
BioSci 354 Introduction to Neuroscience I
BioSci 355 Introduction to Neuroscience II
Psych 254 Physiological Psychology
Chem 102 General Chemistry
Chem 104 General Chemistry and Quantitative Analysis
Chem 343 Organic Chemistry
Chem 344 Organic Chemistry Laboratory
Chem 345 Organic Chemistry
CompSci 250 Introductory Computer Programming
Physics 305 Medical Physics
Physics 306 Introduction to Biophysics
BioSci 150 Foundations of Biological Sciences I
BioSci 152 Foundation of Biological Sciences II

Time to Degree

Students taking 15 credits per semester can finish the requirements in eight semesters. Students taking 12 credits per semester can finish the requirements in 10 semesters. Since engineering students are encouraged to co-op, this may add another year to their graduation time.

Program Review Process

Academic Planning and Curriculum Committee reviews all undergraduate programs at the University of Wisconsin-Milwaukee. The details may be found at the following site.

http://www4.uwm.edu/secu/faculty/standing/apcc/upload/UWM-Program-Review-Schedule-2030-3.pdf

Also, all existing engineering programs are accredited by ABET (Accreditation Board for Engineering and Technology). They have set eight criteria for such reviews: students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facility and institutional support. The requirements include monitoring of student progress in attaining 11 outcomes, documenting processes for assessing and evaluating the extent to which student outcomes are being attained, and using this evaluation for continuous improvement. Students, alumni, and employers are included in the assessment process. An industrial advisory committee is involved for each engineering program. The proposed program will also have these assessments in order to have ABET accreditation.

E. ***Institutional Commitment:*** attached separately.

ATTACHMENT 6

Department: Biomedical Engineering Department-like Body
Action: New

The University of Wisconsin - Milwaukee
CURRICULAR AREA APPROVAL FORM

School/College: Engineering & Applied Science, Date: 02/02/2015

I. ACTION REQUESTED: Effective date of action requested: Semester Fall 2015
APPROVE NEW CURRICULAR AREA

II. OLD CURRICULAR AREA
Old Curricular Area Title:
Old Curricular Area Abbreviation:

III. NEW CURRICULAR AREA
New Curricular Area Title: Biomedical Engineering
New Curricular Area Abbreviation: BME
UDDS Code: B19

IV. FOR NEW CODES, PROVIDE DESCRIPTION OF CURRICULAR AREA AND RELATIONSHIP TO ACADEMIC PROGRAMS:
The BME curricular code will be used for new courses developed for the B.S. in Biomedical Engineering housed within the College of Engineering & Applied Science.

V. REASON FOR CHANGE:
The newly approved B.S. in Biomedical Engineering will contain courses developed and offered by the new Biomedical Engineering Department-like Body. New courses developed for the BS in Biomedical Engineering will be assigned the BME designation to enhance program identity, and to minimize confusion from the student perspective.

VI. OTHER DEPARTMENTS AND CURRICULAR AREAS THAT MAY BE AFFECTED:
None

VII. APPROVAL:

Chair, School/College Curriculum Committee _____

Chair, Academic Program and Policy Committee _____

Chair, Graduate Course and Curriculum Committee _____

Dean, School/College: _____

Provost: _____

Comments: