Co-Terminal Degree Proposal, Form 802 Attachment

Bachelor of Science in Biomedical Engineering
Master of Engineering Management

Undergraduate Program

Undergraduate Program Type: Bachelor of Science in Biomedical Engineering

Total Undergraduate Program Credit Hours (including shared credit): 131 hours (Cell and Tissue Engineering Track), 132 hours (Neural Engineering Track) 132 hours (Medical Imaging Track)

Program Description: IIT's undergraduate program in biomedical engineering (BME) facilitates the learning of biomedical engineering fundamentals. This foundation consists of a broad exposure to the biological and physical sciences, mathematics, and fundamental engineering content. In addition, students specialize in one of three BME areas: Cell and Tissue Engineering, Medical Imaging, or Neural Engineering. In all cases, students develop the skills necessary to succeed as professional biomedical engineers, and to thrive in graduate or professional school (e.g. medical, business, law).

Program Purpose: The co-terminal program between the BS in Biomedical Engineering and Master of Engineering Management (MEM) allows students interested in future careers in engineering management to enter the job force very competitively positioned to pursue management opportunities within engineering-based industries.

Program Benefits: The Master of Engineering Management degree was one of six new interdisciplinary engineering degrees approved for Fall 2017. These interdisciplinary degrees reflect contemporary shifts in engineering education and increase the attractiveness of IIT with potential graduate students. By offering these new interdisciplinary graduate degrees as co-terminal programs with our current undergraduate degrees, we are providing our current undergraduate engineering students a path to greater competitiveness while they retain undergraduate financial aid benefits. Furthermore, engineering transfer students often face significant course sequencing challenges within engineering curriculums. Some transfer students solve this problem by pursuing co-terminal programs, and some choose to leave IIT. This co-terminal program will increase the options available to transfer students and potentially improve retention.

Course requirements and sample curriculum: Course requirements and a sample curriculum are included in this document.

Competitive Programs: BS BME is a competitive degree offered by many institutions. However, most schools do not offer a co-terminal BS BME and engineering management.

Market Analysis: BS BME is a competitive degree offered by many institutions. The Master of Engineering Management is a new degree program (Fall 2017). Please refer to the market analysis for the MEM degree provided in the 2017 degree program application for further information.

Marketing and Advertising: Both degrees are currently marketed. The co-terminal degree will be included in current co-terminal degree marketing and additional marketing by the Armour College of Engineering.

Enrollment Estimates: Estimated enrollment in this co-terminal program is 2-6 new students/year.

Retention Estimates: It is anticipated that retention may be improved for transfer students as the co-terminal program allows more flexibility for scheduling each semester.

Economic Analysis: There are no additional costs for the co-terminal program. It is expected that this co-terminal program will draw from a group of students separate from those who pursue the other BME co-terminal programs (MAS Chemical Engineering and MAS Biomedical Imaging and Signals, administered by the ECE department). Therefore, it is expected that additional tuition revenue will be generated equivalent to 24 credits/student enrolled in the program.

Graduate Program

Graduate Program: Master of Engineering Management

Program Overview: The Master of Engineering Management degree program provides an accelerated pathway to management positions within engineering-based industries for new engineering graduates and practicing engineers. There are two tracks: Project Management (PM) and Product Design & Development (PDD).

Program Justification: The Armour College of Engineering is committed to be a lifelong educational partner with our community, from pre-college to professional advancement. The MEM degree program contributes to this commitment by enhancing the overall offerings within the Armour College of Engineering. It is anticipated that approximately 20 students will enroll in the MEM program Fall 2018. The BS BME/MEM co-terminal degree is anticipated to add 2-8 additional students. A detailed justification for the MEM program can be found in the 2017 MEM degree application.

Program Resources: The co-terminal program does not require additional resources. The MEM curriculum includes existing courses and a few new courses that will be developed and delivered by adjunct professors employed as engineering managers industry, with full-time faculty oversight.

Program description: A detailed list of courses required for each track in the co-terminal degree follows. Students should have a 3.0 GPA in order to be accepted into the co-terminal program. Students will be accepted into the program beginning Fall 2018.

Description of courses shared between Undergraduate and Graduate programs:

a) Shared required courses:

   UG: BME 433 (or BME 533) as GRAD: Engineering Elective

b) Shared elective courses:

   UG: BME elective (500-level) as GRAD: Engineering Elective

c) Course substitutions or exceptions:

   Students may substitute BME 433 with BME 533 to ensure no more than 12 UG credits are applied to the graduate degree.

Bachelor of Science in Biomedical Engineering/Master of Engineering Management

Required Courses	Credit Hours *UG*	*grad*	*total*
Biomedical Engineering Core Requirements BME 100, 310, 315, 330, 405, 419, 422, 420, **433**[c], 453	26	**3**	26
Cell and Tissue Track Requirements[a] *BME 301, 320, 335, 418, 424, 482, **BME electives**[c] (6 cr)* *CHE 202, MMAE 200, ECE 211, CHEM 235, BIOL 403*	*38*	***3***	*38*
Neural Engineering Track Requirements[a] *BME309, BME 325, BME438, BME443, BME445, **BME electives**[c] (9 cr)* *ECE 211, ECE 213, ECE 218, MATH 333, technical elective (3 cr)*	*39*	***3***	*39*
Medical Imaging Track Requirements[a] *BME309, BME 325, BME438, BME443, BME445, **BME electives**[c] (3 cr)* *CS201, ECE211, ECE 213, ECE 437, ECE 481, PHYS 224, MATH 333*	*39*	***3***	*39*
Master of Engineering Management Core Requirements EMGT 470, CAE 574/ENGR 574, CAE 575/ENGR 575, ENGR 510, ENGR 597, **Engineering electives**[c] (6 cr)	0	15	15
Project Management Specialization[c] *(select 9 cr)* *ENGR 520, ENGR 521, CAE 473/ENGR 573, CAE 421/ENGR 521, CAE 572/ENGR 572, MBA 523, INTM 511*	*0*	*9*	*9*
Product Design & Development Specialization[c] *(select 9 cr)* *ENGR 595, BUS 472, MMAE 589, CHE 506, IDN 597, ENGR/BME 502, MMAE 560, CAE 523*[d]	*0*	*9*	*9*
Science Requirements BIOL 115, BIOL 117, CHEM 124, CHEM 125, PHYS 123, PHYS 221	20	0	20
Mathematics & Computer Science Requirements MATH 151, MATH 152, MATH 251, MATH 252, CS 104	20	0	20
Humanities and Social Science Requirements	21	0	21
IPRO	6	0	6
Total (131-132 BME UG) + 30 (MEM) -6 (shared credits) = 155-156 (total)	131-132	30	155-156

[a]only one track is required for the BME UG program

[b]only one track is required for the MEM program

[c]shared courses between undergraduate and graduate curricula (6 cr)

BME elective selected from 500-level approved courses for MEM engineering elective (3 cr)

BME433 for MEM engineering elective; BME 533 may substitute for BME 433 (3 cr)

[d]CAE 523 is an elective for the Product Design & Development Specialization; however, BME 433/533 is an equivalent course and therefore BME students should select a different course

Sample Schedule: Cell and Tissue Track

Semester 1	Credits
BME 100 Introduction to the Profession	2
CHEM 124 Principles of Chemistry I	4
CS104 Intro to Programming for Engineers	2
MATH151 Calculus I	5
Hum/SS Elective	3
Total	**16**

Semester 2	Credits
CHEM 125 Principles of Chemistry II	4
MATH 152 Calculus II	5
PHYS 123 General Physics I	4
Hum/SS Elective	3
Total	**16**

Semester 3	Credits
CHE 202 Material & Energy Balances	3
ECE 211 Circuit Analysis I	3
MATH 252 Introduction to Differential Equations	4
MMAE 200 Introduction to Mechanics	3
Hum/SS Elective	3
Total	**16**

Semester 4	Credits
BIOL 115 Human Biology	3
BIOL 117 Experimental Biology	1
BME 315 Instrumentation Lab	2
MATH 251 Mutivariate and Vector Calculus	4
PHYS 221 Physics II: EM and Optics	4
Hum/SS Elective	3
Total	**17**

Semester 5	Credits
BME 330 Analysis of Biosignals and Systems	3
BME 405 Physiology Laboratory	2
BME 422 Mathematical Methods in BME	3
BME 453 Quantitative Physiology	3
CHEM 235/237 Organic Chemistry I	3/4
Hum/SS Elective	3
Total	**17/18**

Semester 6	Credits
BME 301 Biofluid Mechanics	3
BME 310 Biomaterials	3
BME 320 Biofluids Laboratory	1
BME 335 Thermodynamics of Living Systems	3
BIOL 403 Biochemistry	4
IPRO I	3
Total	**17**

Semester 7	
BME 418 Reaction Kinetics	3
BME 419 Intro to Design Concepts in BME	2
EMGT 470 Project Management	3
BME 482 Mass Transport for BME	3
ENGR 574 Economic Decision Analysis	3
Total	**14**

Semester 8	
BME 420 Design concepts in BME	3
BME 424 Quant. Aspects of Tissue Engineering	3
PM or PDD Elective	3
Senior Seminar	0
PM or PDD Elective	3
IPRO II	3
Total	**15**

Semester 9	
BME 433 Applications of Statistics	3
ENGR 575 Systems Analysis in Engineering	3
PM or PDD Elective	3
BME Elective	3
Hum/SS Elective	3
Total	**15**

Semester 10	
BME Elective	3
ENGR 510 Strategic Engineering Management	3
ENGR 597 Engineering Management Capstone	3
Hum/SS Elective	3
Total	**12**

Shared Credits (6 credit hours) : BME 433, BME Elective

Sample Schedule: Neural Engineering Track

Semester 1	Credits
BME 100 Introduction to the Profession	2
CHEM 124 Principles of Chemistry I	4
CS104 Intro to Programming for Engineers	2
MATH151 Calculus I	5
Hum/SS Elective	3
Total	**16**

Semester 2	Credits
CHEM 125 Principles of Chemistry II	4
MATH 152 Calculus II	5
PHYS 123 General Physics I	4
Hum/SS Elective	3
Total	**16**

Semester 3	Credits
PHYS 221 Physics II: EM and Optics	4
ECE 211 Circuit Analysis I	3
ECE 218 Digital Systems + Lab	4
MATH 252 Introduction to Differential Equations	4
Hum/SS Elective	3
Total	**18**

Semester 4	Credits
BIOL 115 Human Biology	3
BIOL 117 Experimental Biology	1
BME 315 Instrumentation Lab	2
ECE 213 Circuit Analysis II + Lab	4
MATH 251 Mutivariate and Vector Calculus	4
Hum/SS Elective	3
Total	**17**

Semester 5	Credits
BME 309 Imaging and Sensing	3
BME 330 Analysis of Biosignals and Systems	3
BME 405 Physiology Laboratory	2
BME 422 Mathematical Methods in BME	3
BME 453 Quantitative Physiology	3
Hum/SS Elective	3
Total	**17**

Semester 6	Credits
BME 310 Biomaterials	3
BME 325 Bioelectronics Lab	1
BME 443 Biomedical Instrumentation & Electronics	3
BME 445 Quantitative Neural Function	3
MATH 333 or CHEM 237	3/4
IPRO I	3
Total	**16/17**

Semester 7	
BME 419 Intro to Design Concepts in BME	2
Technical Elective or CHEM 239	3
EMGT 470 Project Management	3
BME Elective	3
ENGR 574 Economic Decision Analysis	3
Total	**14**

Semester 8	
BME 420 Design concepts in BME	3
BME 438 Neuroimaging	3
PM or PDD Elective	3
Senior Seminar	0
IPRO II	3
PM or PDD Elective	3
Total	**15**

Semester 9	
BME 433 Applications of Statistics	3
ENGR 575 Systems Analysis in Engineering	3
PM or PDD Elective	3
BME Elective	3
Hum/SS Elective	3
Total	**15**

Semester 10	
BME Elective	3
ENGR 510 Strategic Engineering Management	3
ENGR 597 Engineering Management Capstone	3
Hum/SS Elective	3
Total	**12**

Shared Credits (6 credit hours) : BME 433, BME Elective

Sample Schedule: Medical Imaging Track

Semester 1	Credits
BME 100 Introduction to the Profession	2
CHEM 124 Principles of Chemistry I	4
CS104 Intro to Programming for Engineers	2
MATH151 Calculus I	5
Hum/SS Elective	3
Total	**16**

Semester 2	Credits
CHEM 125 Principles of Chemistry II	4
MATH 152 Calculus II	5
PHYS 123 General Physics I	4
Hum/SS Elective	3
Total	**16**

Semester 3	Credits
PHYS 221 Physics II: EM and Optics	4
ECE 211 Circuit Analysis I	3
CS 201 Accelerated Intro to Computer Science	4
MATH 252 Introduction to Differential Equations	4
Hum/SS Elective	3
Total	**18**

Semester 4	Credits
BIOL 115 Human Biology	3
BIOL 117 Experimental Biology	1
BME 315 Instrumentation Lab	2
ECE 213 Circuit Analysis II + Lab	4
MATH 251 Mutivariate and Vector Calculus	4
Hum/SS Elective	3
Total	**17**

Semester 5	Credits
BME 309 Imaging and Sensing	3
BME 330 Analysis of Biosignals and Systems	3
BME 405 Physiology Laboratory	2
BME 422 Mathematical Methods in BME	3
BME 453 Quantitative Physiology	3
Hum/SS Elective	3
Total	**17**

Semester 6	Credits
BME 310 Biomaterials	3
BME 325 Bioelectronics Lab	1
BME 443 Biomedical Instrumentation & Electronics	3
BME 445 Quantitative Neural Function	3
MATH 333 or CHEM 237	3/4
IPRO I	3
Total	**16/17**

Semester 7	
BME 419 Intro to Design Concepts in BME	2
PHYS 224 or CHEM 239	3
EMGT 470 Project Management	3
ECE 437 Digital Signal Processing	3
ENGR 574 Economic Decision Analysis	3
Total	**14**

Semester 8	
BME 420 Design concepts in BME	3
BME 438 Neuroimaging	3
PM or PDD Elective	3
Senior Seminar	0
ECE 481 Image Processing	3
PM or PDD Elective	3
Total	**15**

Semester 9	
BME 433 Applications of Statistics	3
ENGR 575 Systems Analysis in Engineering	3
PM or PDD Elective	3
IPRO II	3
Hum/SS Elective	3
Total	**15**

Semester 10	
BME Elective	3
ENGR 510 Strategic Engineering Management	3
ENGR 597 Engineering Management Capstone	3
Hum/SS Elective	3
Total	**12**

Shared Credits (6 credit hours) : BME 433, BME Elective