

The University Senate of Michigan Technological University

Proposal 27-18 (Voting Units: Academic)

“Proposal for a Minor in Tissue & Stem Cell Engineering”

1. Date

March, 2018

2. Proposer Contact Information

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3. Introduction

The proposed minor in Tissue & Stem Cell Engineering offered through the Department of Biomedical Engineering in the College of Engineering, will offer Michigan Tech students the opportunity to learn tissue & stem cell engineering concepts and integrate them into their major field of study. The proposed minor will help to prepare students for careers in research & development, biological therapeutics, certain medical device sectors, and for entry into graduate study at the interface of life science and engineering, and for professional (e.g., medical, dental, PT, OT) careers.

4. Rationale

Biomedical engineering is a rapidly growing and evolving field. The need for engineers and scientists with knowledge of tissue and stem cell engineering is expected to continue to increase as developments in health care become more and more complicated and interdisciplinary, often requiring highly technical engineering solutions. Biological therapeutics and biological drug delivery are slowly accounting for larger and larger sectors of the therapeutics industry. The need to have a well trained workforce with the ability to integrate life sciences, engineering, and the practices of modern medicine is a pressing issue.

Therefore, there is a strong need to allow Michigan Tech students from all disciplines to learn the fundamental concepts of biomedical engineering in general, and tissue and stem cell engineering specifically, as they prepare for their professional careers. The broad nature of biomedical engineering across many scientific and engineering disciplines requires formal, structured education. The era of engineers ‘picking up some biology as they go’ is rapidly coming to a close. This approach has helped students wishing to enter the medical device industry in the past, but it is no longer sufficient in today’s rapidly changing medical environment. This is particularly true in the areas of regenerative medicine, tissue engineering and biological therapeutics. Non-engineers have played significant roles in these industry sectors in the past. However, as work progresses towards industrial scale-up of these technologies, engineers are playing a much more significant role. Engineers with a strong knowledge of

tissue & stem cell engineering will be in high demand as biologics play a bigger role in modern medicine. This minor will help prepare Michigan Tech students to fill this need.

The proposed minor consists of a series of courses that are designed to provide students with the necessary theoretical and practical knowledge to gain entry into the tissue & stem cell engineering field. The minor is structured in such a manner that it is accessible to a broad range of majors at Michigan Tech, however, it is most likely to attract students from Materials Science & Engineering, Chemical Engineering, General Engineering and Mechanical Engineering. Students from other majors such as Electrical Engineering may also find this minor useful. Science majors, particularly from chemistry, can also take advantage of the minor however, they will need to ensure that the proper pre-requisite math and engineering courses are met.

5. Details

I. Title of Minor

Tissue & Stem Cell Engineering

II. Catalog Description

The minor in Tissue & Stem Cell Engineering will provide students who are not Biomedical Engineering majors the opportunity to learn principles and practices of regenerative medicine, tissue engineering, and stem cell engineering. This minor is most suitable for students in one of the engineering majors, however non-engineering majors may participate in this minor provided the appropriate prerequisite courses are taken and passed.

Upon successful completion of the minor in Tissue & Stem Cell Engineering, students will be able to:

- a) broadly understand key concepts and principles of tissue & stem cell engineering
- b) develop the beginnings of an understanding of how the life sciences and other engineering disciplines can be integrated to solve problems in regenerative medicine
- c) apply biomedical engineering principles to the general area of their chosen majors
- d) contribute to solving complex biomedical engineering problems in industry, government, or academic settings

III. List of Courses

The minor in Tissue & Stem Cell Engineering requires the successful completion of 18 credits, including 9 credits of required courses and an additional 9 credits of electives. The required and elective courses are shown in Tables 1 and 2, respectively. Courses counting as minor credits cannot be double counted between minors.

Table 1. Required Courses (9 credits)

Required Courses: 9 credits	Credits
BE2700 Biomedical Signals & Systems	3
BE2400 Cellular & Molecular Biology I	3
BE4230 Stem Cell and Tissue Engineering (<i>prereq. BE2400, BE3350, BE3800</i>)	3

Table 2. Elective Courses (9 credits, minimum)

Elective Courses: 9 credits, minimum	Credits
BE3350 Human Biomechanics (<i>prereq. BE3300 or MEEM2110</i>)	3
BE3800 Biomaterials II (<i>prereq. BE2800 or MSE2100</i>)	3
BE3400 Laboratory Techniques for BME (<i>prereq BE2800 or MSE2100</i>)	2
BE4200 Cellular & Molecular Biology II (<i>prereq BE2400; Junior or Senior Standing required</i>)	3
BE4300 Polymeric Biomaterials (<i>prereq BE3800</i>)	3
BE4330 Biomimetic Materials (<i>prereq BE3350 and BE3800</i>)	3
BE4335 Smart Polymers (<i>prereq BE3350 and BE3800</i>)	3
BE4350 Cell Biomechanics & Mechanical Transduction (<i>prereq BE2400 and BE3350 and BE3800</i>)	3
BE4510 Cardiovascular Engineering (<i>BE2400; Junior or Senior Standing required</i>)	3
BE4800 Biomaterials Interfaces (<i>prereq BE3800</i>)	3
BE4850 Tissue Mechanics (<i>prereq BE3350</i>)	

*New courses may be added as faculty teach new BE elective courses

IV. Prerequisites not listed in the minor

The minor requires students to have taken CH1150, MA2160, ENG1102, and PH2100. To enroll in BE2700, students must have earned a “C” or better in CH1150, PH2100, and MA2160.

Anatomy and Physiology I & II, with laboratory sections (BL2010, BL2020, BL2011, BL2021, respectively) are required prerequisites for many upper-level BE courses. On an individual basis, these prerequisites may be waived with permission of the faculty member responsible for the course and the Department Chair.

6. Advising

The academic advisor for the Department of Biomedical Engineering, Mr. Mike LaBeau, will advise students who choose to enroll in this minor.

7. New Course Descriptions

No new courses associated with a minor in Tissue & Stem Cell Engineering are proposed.

8. Estimated Costs

No additional costs will be associated with this minor at this time. No additional library resources will be required either. All required and elective courses are currently being taught on a regular basis and there is existing capacity for additional enrollment of 10-15 students per year in terms of classroom seats.

If the minor proves to be popular and exceeds the enrollment capacity, the Department of Biomedical Engineering will explore options to increase the number of sections of key courses that are taught.

9. Library resources

No additional library resources are required to implement this minor.

10. Planned Implementation Date

Fall 2018