Agendum
Oakland University
Board of Trustees Formal Session
February 7, 2025

MASTER OF SCIENCE DEGREE IN BIOENGINEERING
A Recommendation

1. **Division and Department:** Academic Affairs, School of Engineering and Computer Science and College of Arts and Sciences, Department of Bioengineering.

2. **Introduction:** Oakland University proposes a new Master of Science (MS) degree in Bioengineering. The new program builds on the academic and research strengths of the School of Engineering and Computer Science and the College of Arts and Sciences. The program is designed to synergistically pair advanced coursework in both biological sciences and engineering in order to prepare students for the quickly evolving bioengineering needs both in research and industry. The proposed curriculum is rich in interdisciplinary coursework from life sciences, mathematics, physics, mechanical engineering, electrical engineering, and computer science, representing the truly interdisciplinary nature of bioengineering. In addition, this program will support the strategic growth of the Department of Bioengineering at Oakland University, increasing the research profile of the university and increasing both graduate and undergraduate research opportunities.

3. **Previous Board Action:** None.

4. **Budget Implications:** The primary source of funding for the program will be graduate tuition. The program is expected to generate a net income for the University in its second year of operation, with a deficit in the third and fourth years that come with hiring a new faculty member. By the fifth year of operation, net income is projected to return and sustain through the program duration. Sustained salary expenses include one full-time faculty member, one administrative professional, three part-time instructors, and four graduate assistants. Operating expenses include marketing and library expenses for this new program. The proforma budget is included as Attachment B.

5. **Educational Implications:** The proposed program will introduce seven new courses related to advanced bioengineering topics. One of these seven courses will serve as a foundation course for the program. The remaining six courses will serve as advanced electives spanning medical imaging to biomechanics. To support the increase in offered courses, the offering frequency of advanced courses will be adjusted based on course enrollment.

6. Personnel Implications: To manage the anticipated teaching and administrative load arising from the introduction of the seven new courses, the program will necessitate the hiring of: (1) a full-time faculty member starting from the third year of program operation, (2) three part-time instructors per year, and (3) one 0.5 FTE administrative professional. Additionally, the annual hiring of four graduate assistants will be essential to recruit talented graduate students and support undergraduate courses.

7. University Reviews/Approvals: The proposed program has been reviewed by the College of Arts and Sciences Graduate Committee on Instruction, the School of Engineering and Computer Science Faculty Assembly, the Graduate Council, the Oakland University Senate, and the Executive Vice President for Academic Affairs and Provost.

8. Recommendation:

WHEREAS, the MS in Bioengineering degree program is consistent with the objectives contained in Oakland University's Institutional Priorities; and

WHEREAS, the MS in Bioengineering degree program will build on the academic and research strengths of the School of Engineering and Computer Science and the College of Arts and Sciences and provide new educational and community engagement opportunities; now, therefore, be it

RESOLVED, that the Board of Trustees authorizes the School of Engineering and Computer Science and the College of Arts and Sciences to offer the MS in Bioengineering; and, be it further

RESOLVED, that the Executive Vice President for Academic Affairs and Provost will complete annual reviews of the MS in Bioengineering degree program to evaluate academic quality and fiscal viability to determine whether the program should continue.

9. Attachments:

A. Proposal for the MS in Bioengineering degree program.
B. Proforma budget for the MS in Bioengineering degree program.

Submitted to the President
on 1/28/25, 2025 by

Kevin J. Corcoran, PH.D.
Interim Executive Vice President
for Academic Affairs and Provost

Recommended on 1/30, 2025
to the Board for Approval by

Ora Hirsch Pescovitz, M.D.
President

Reviewed by

Joshua D. Merchant, Ph.D.
Chief of Staff and
Secretary to the Board of Trustees

Oakland University

GRADUATE COUNCIL

Policy updated 2016-17

NEW DEGREE PROGRAM –GUIDELINES AND PROCEDURES

The Senior Vice President for Academic Affairs and Provost encourages proposals for new degree programs since continuing program development is vital to the university. This process may take up to two years – timing of the proposal submission is crucial. The timeline presented in this document is a **general guide** for new program development.

However, to meet this timeline it is crucial to have a well-reasoned and documented proposal. It is the purpose of these guidelines to help academic units develop good proposals and to elucidate the approval process.

The new degree proposal is a detailed description of the new program as outlined below. While writing the proposal, it is important to remember that it is the principal document used in the approval process for the program. Therefore, it must be written so that it is suitable and sufficient for two different audiences: 1) various faculty and administrative bodies within the university, and 2) a consultant, usually an expert in the field.

Any questions regarding the preparation of the proposal should be referred to the Graduate School.

THE PROPOSAL

Cover Memo

All proposals must be accompanied with a **signed cover memo** from the Dean stating that the proposal has received the appropriate school/college and department/school approvals, and that implementation of the proposal is recommended. **All proposals should be submitted in a word document to gradcouncil@oakland.edu**

Title Page

Abstract

One-page summary of the proposal

Table of Contents

The Table of Contents should show all headings and subheadings in these Guidelines and Procedures, along with page numbers in the Proposal where the information is found. If some information is better located in another location, e.g., an additional appendix or

supplemental binder, be sure to record according to this outline where the information is located.

Body of Proposal

Cover Memo

REQUESTED Effective Term/Year Fall 2024
Proposed Title of the Graduate Degree program Master of Science in Bioengineering
Department Department of Bioengineering
School/College School of Engineering and Computer Science & College of Arts and Sciences
The delivery method for the Graduate Degree program is **x face to face (100%)** ☐ **fully online (100%)** ☐ **primarily online (75%)**

I, Dean Chamra certify that the Master of Science in Bioengineering has been reviewed by the appropriate school/college and department committees and that implementation of the proposed degree program is recommended.

Louay Chamra — 11/17/2023 — Louay Chamra

Dean of College/School (signature) | Date | Dean of College/School (print)

I, Dean Carey certify that the Master of Science in Bioengineering has been reviewed by the appropriate school/college and department committees and that implementation of the proposed degree program is recommended.

11/20/2023 Elaine Carey

Dean of College/School (signature) | Date | Dean of College/School (print)

Bradley A Randall 1/8/2024

DECISION OF GRADUATE COUNCIL | Date

approved by Graduate Council

Title Page

Degree Program Title: Master of Science in Bioengineering

Degree: Master of Science

Name of Degree Program Coordinator: TBD

Requested Implementation Term: Fall 2025

School or College Governance

Department of Bioengineering

Date Submitted: 10/17/2023 Date Approved: 10/17/2023

CAS Graduate Committee on Instruction

Date Submitted: 11/6/2023 Date Approved: 11/10/2023

SECS Assembly

Date Submitted: 10/31/2023 Date Approved: 11/9/2023

University Governance

Graduate Council

Date Submitted: 11/20/2023 Date Approved: 01/08/2024

Senate

Date Submitted: 02/27/2024 Date Approved: 01/16/2025

Board of Trustees

Date Submitted Date Approved

Presidents Council

Date Submitted Date Approved

One Page Abstract

The Department of Bioengineering proposes a new Master of Science program in Bioengineering (BE). The program is designed to synergistically pair advanced course work in both biological sciences and engineering in order to prepare students for the quickly evolving bioengineering needs both in research and industry. The Bioengineering graduate committee has proposed this program, which will be offered by the Department of Bioengineering at Oakland University. Similar to the undergraduate program, it will be co-governed between the School of Engineering and Computer Science (SECS) and the College of Arts and Sciences (CAS).

Students will engage in extensive and interdisciplinary coursework with several options to tailor coursework to career goals. A foundation will be established in life science through a course in quantitative physiology and in mathematics through a choice of advanced offerings in the departments of mathematics, electrical and computer engineering, or mechanical engineering. The variety of mathematical core courses enables students to tailor their mathematical foundation to their future career. Students will be given the opportunity to select a depth area including: (1) biomedical imaging and signal processing, (2) bioinformatics and genome engineering, and (3) molecular and tissue engineering. Within this depth area, student can choose between a research track or a professional track, further tailoring their degree to their career goals. Finally, a diverse and interdisciplinary set of electives round out the program.

The proposed curriculum is rich in coursework from both life sciences, mathematics, physics, mechanical engineering, electrical engineering, and computer science, representing the truly interdisciplinary nature of bioengineering. In addition to cross-listing existing flagship bioengineering courses, additional courses are proposed to further develop and grow the program through strategic hiring of new faculty in areas such as quantitative physiology, neural engineering, and biomechanics.

Graduates of this program will be in demand by educational and research institutions, government agencies, hospitals, health technology companies, and technology companies investing in healthcare. This proposal has been discussed in detail with the bioengineering industry advisory board, who provided valuable insight into current market trends and improved the curriculum to include needed coursework that will make graduates of the program stand out amongst those from peer institutions. Finally, this proposal will support the strategic growth of the Department of Bioengineering at Oakland University, increasing the research profile of the university and increasing opportunities for both graduate and undergraduate research opportunities.

Table of Contents

D Detailed New Course Descriptions or Syllabi
E Proforma Budget
F Library Budget Report
G Graduate Assessment Plan
H Support Letters
I Survey Data

The Proposal

I. Rationale

a. How the program will help promote the role and mission of the university

The Master of Science program in Bioengineering will serve scientists and engineers in Michigan, consistent with the University mission to have an impact on our state through research and scholarship. The establishment of this graduate program is also relevant to Goals 2 and 3 of the Oakland University 2025 Strategic plan. In order to build this graduate program, the number of tenure-track faculty engaged in bioengineering research will increase (Goal 2.3), which will translate to increased opportunities for undergraduate students to participate in bioengineering research (Goal 2.5). Additionally, this program will facilitate graduate students access to experiential learning activities related to bioengineering (Goal 3.1), and expand connections with our bioengineering alumni (Goal 3.5).

b. Need for the program – unique or distinctive aspects

There is current and growing demand for individuals trained in advanced bio- and biomedical engineering evidenced by the growth statistics both nationally and locally. As shown in Figure 1, the Bureau of Labor Statistics estimates that "employment of bioengineers and biomedical engineers is projected to grow 10 percent from 2021 to 2031, faster than the average for all occupations." In Michigan, specifically, the projected long-term occupational projections for 2030 predict biomedical engineers to increase by 10%, according to the projections managing partnership (PMP). According to MichBio, Michigan is the 14th largest bioscience state, the 10th largest medical device state, with over 39,000 bioscience jobs and over $28 Billion in economic impact. The TEConomy Bio 2022 report found that Michigan has a specialized concentration of jobs in the medical device and equipment subsector. Michigan ranks in the top 10 for the number of medical device technology business locations in the US. In fact, the same report specifically states "The high-quality jobs generated across Michigan's bio-industry pay more than 64 percent above the overall private sector wage average in the state reflecting the prominent value-adding activities and skilled workforce deployed across scientific research and development, manufacturing, sales, distribution, and other key roles." Indicating and further justifying the

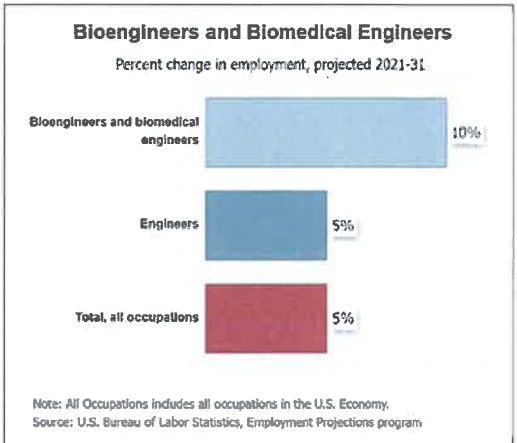


Figure 1. Expected increase in jobs for bio- and biomedical engineers according to the US Bureau of Labor Statistics.

creation of workforce development programs in bioengineering specifically at OU. Given the unique expertise available at OU in both basic science research and engineering, we are uniquely suited to start a Master in Bioengineering and enable our students to seek these important jobs.

c. List the goals and objectives of the program

The Master of Science program in Bioengineering is designed for students who are interested in acquiring advanced knowledge and skills in the emerging areas of Bioengineering. The graduate curriculum will focus on significant coursework in three key areas including: 1) biomedical imaging and signal processing, 2) bioinformatics and genome engineering, and 3) molecular and tissue engineering.

By the end of the program, students will be able to

1. Explain and evaluate key and emerging technologies in bioengineering
2. Apply principles of bioengineering to real-world problems
3. Analyze the unique ethical and societal implications of biotechnology
4. Investigate current state-of-the-art biotechnology and identify new ways to tackle the growing bioengineering needs of society

d. Comparison to other similar programs –State/Regional/National

As the need for bioengineers to tackle societal problems continues to grow, universities around the country have continued to build programs for advanced studies in Bioengineering and Biomedical Engineering. Table 1 lists a few MS programs in closely related disciplines, including seven from the state of Michigan. The proposed program at OU will be unique in its close relationship with the Department of Biological Sciences, resulting in students trained to be highly skilled in both life sciences and engineering. In addition, the proposed program offers a unique on-ramp for students with either life science or more traditional engineering backgrounds to bridge into biology, training interdisciplinary engineers.

Table 1. *Summary of comparable local and national bio/biomedical engineering Masters degree programs.*

University	Degree	Credits/Units	Concentrations	Options
University of Michigan Dearborn	MSE Bioengineering	30 total (6 core, 18 elective, 6 cognate electives)	N/A	thesis or non-thesis
Lawrence Technological University	MS Biomedical Engineering	unclear	N/A	design project or thesis
Western Michigan University	MS Medical Engineering	unclear	N/A	(no longer taking students)

University of Michigan	Meng Advanced Medical Product Engineering & Development	27 total (12 core, 2 RCR, 3 statistics, 10 electives)	N/A	none
	MS/MSE Biomedical Engineering	30 total	Bioelectrics and Neural Engineering Biomaterials and Regenerative Medicine Biomedical Imaging and Ultrasonics Biotechnology and Systems Biology Biomechanics and Biotransport	optional thesis
Michigan State University	MS Biosystems Engineering	30 total	N/A	thesis or project
Grand Valley State University	MSE Biomedical Engineering	33 total (6 professional, 21 emphasis, 6 culminating experience)	Biomechanical Stream Bioelectrical Stream	thesis or project
Wayne State University	MS Biomedical Engineering	30 total (9 core, 12 track, elective+thesis)	Biomedical imaging track Biomedical instrumentation track Computational systems biology track Injury biomechanics track Interdisciplinary BME track Tissue engineering track	thesis or non-thesis
Stanford University	MS Bioengineering	unclear	Biomedical Computation Regenerative Medicine/Tissue Engineering Molecular and Cell Bioengineering Biomedical Imaging Biomedical Devices	non-thesis
University of Illinois Urbana-Champaign	MS Bioengineering	32 total (21 core, 7 elective, 4 research)		thesis
	MS Bioengineering	40 total (21 core, 19 elective)		non-thesis
	M.Eng. Bioengineering	32 total	Bioinstrumentation General Bioengineering	project
	MS Biomedical Image Computing	36 total	N/A	project
University of Maryland	M.Eng. Bioengineering	30 total (12 core, 18 elective)	N/A	non-thesis

II. Academic Unit

a. How the goals of the unit are served by the program

The Master of Science program in Bioengineering will primarily serve scientists and engineers in Southeast Michigan. This graduate program will serve the goals of SECS and CAS by providing high-quality graduate programs of instruction in bioengineering. The department's long-term goals are to integrate training in biological sciences and engineering to support this interdisciplinary field.

b. How existing staff will support the proposed program

The proposed MS in Bioengineering program will be housed in the Bioengineering department. A Graduate Program Committee formed from a minimum of three primary faculty and/ or affiliated faculty will oversee the graduate programs, with an elected chair also serving as a program coordinator.

The current faculty will continue to teach courses at the undergraduate and graduate level, developing new material or supplemental course activities for graduate students. Furthermore, they will mentor graduate students and work to find and advise thesis projects.

The Graduate Program Coordinator will be responsible for graduate student recruitment, onboarding of new graduate students, and monitoring graduate student progress via established benchmarks (plan of study, forming a thesis committee, thesis proposal and the final thesis presentation).

The BE Graduate Program Committee will be charged with assisting the Graduate Program Coordinator in evaluating applications for admission to the program, and administration of the program. Administration of the program would include preliminary evaluation of proposed graduate level courses, program changes, and program policy.

c. Faculty qualifications — current scholarly activity of the faculty in the proposed program **Appendix A**

The BE faculty are categorized as either primary- or affiliate- members based on several criteria of their hiring and significant contribution to the Department both in teaching and mentoring students. The participating members must have tenure track appointments or appointments as special instructor eligible for job security in their home department belonging to either SECS or CAS. The primary- faculty are recruited directly into the program or appointed by the Deans at the administrative level in consultations with BE faculty. The faculty who seeks appointment at the affiliate status must provide evidence of their potential significance to the department in the form of an upper-level or graduate course proposal that satisfies the requirement for at least one of the BE approved professional tracks. The proposed course should not bear redundancy but rather complement the existing courses in the curriculum. The proposed course will require initial

review and approval by the BE UAC/GAC. The courses approved by BE UAC/GAC will subsequently require approval from both SECS UGCC and Assembly before the formal appointment as an affiliate appointment. The affiliate faculty are required to maintain their contribution to BE by continued participation in teaching curriculum and in service. The appointment of the affiliate faculty who do not participate in the curriculum for more than 5 years in a row will be terminated pending the review and approval from both BE UAC/GAC and BE Steering Committee.

The Bioengineering (BE) department currently has 11 tenured and tenure-track faculty, and 1 special instructor. The breakdown by faculty rank is as follows:

3 full professors
7 associate professors
1 assistant professors
1 special instructor

The 12 faculty members are from 3 different home departments. Seven faculty members (Craig, Battistuzzi, Blumer-Schuette, Lal, Madlambayan, Villa-Diaz, Westrick) are from the Biology department. Four faculty members (Dean, Hanna, Li, Wiacek) are from the Electrical and Computer Engineering department. One faculty member (Siadat) is from the Computer Science and Engineering department. All of the tenured and tenure-track faculty hold earned doctorates in their fields and maintain active research activities. In terms of professional registration and license, Craig holds UK Personal License for Animal Research and International Certification in Forensic Science. Madlambayan completed the EIT examination. Wiacek serves on the Bioeffects Committee of the American Institute of Ultrasound in Medicine. Hanna has a high level of industrial consulting activities, while a few other faculty members maintain some level of industrial consulting.

Please refer to **Appendix A** for faculty vitaes.

d. Current Resources and how will the new program impact existing resources

The Department of Bioengineering is a new and growing department. In order to sustain our current success, it is necessary to grow the program to include graduate degree offerings and recruit additional faculty. By cross-listing our senior undergraduate courses, the new program will enable increased enrollment in these courses to ensure they do not get canceled. This will help current undergraduate students to follow a track-specific option, which is currently difficult with the limited BE resources. Therefore, the new program will help the BE department to have its own resources and become a sustainable department.

In addition, benefiting the current program, the new MS program will help to recruit new faculty, provide more advanced course offerings for our undergraduate and graduate students, and increase the research profile of our department.

To ensure sufficient coverage of courses and optimize faculty workload, we created an example course schedule projected over the next five years, shown in Table 2. The current agreement on faculty load for the BE department is determined as follows: (1) all affiliate faculty teach a minimum of 1 course per year and (2) all joint appointed faculty teach 50% of their course load with BE. In addition to the graduate courses as part of this proposal, we include 3 core undergraduate BE courses as these contribute to department faculty workload.

***Table 2**. Example workload schedule for the Department of Bioengineering*

Course Number	Course Name	Offering	Year 1		Year 2		Year 3		Year 4		Year 5	
			Fall	Winter	Fall	Winter	Fall	Winter	Fall	Winter	Fall	Winter
BE 5000	Principles of Bioengineering	Fall	**PT**		**PT**		**New**		**New**		**New**	
BE 4100 / 5100	Biomedical Signal Processing	Winter		Li		**PT**		Li		**PT**		Li
BE 4110 / 5110	Medical Imaging	Fall	Wiacek		Wiacek		Wiacek		Wiacek		Wiacek	
BE 4120 / 5120	Medical Image Analysis	Winter		Siadat		Siadat		Siadat		Siadat		Siadat
BE 5130	Ultrasound and Photoacoustic Imaging	Fall (every other)				Wiacek				Wiacek		
BE 5140	Artificial Intelligence in Medicine	Winter		Wiacek		**PT**		Wiacek		**PT**		Wiacek
BE 5150	Medical Sensing and Design	Fall	Dean		Li		Dean		Li		Dean	
BE 5600	Introduction to Neural Engineering	Winter (every other)		**PT**				**PT**				**PT**
BE 4200 / 5200	Genetic and Genomic Engineering	Winter		Westrick		Battistuzzi		Westrick		Battistuzzi		Westrick
BE 4300 / 5300	Bioprocess Engineering	Winter		Madlambayan		Madlambayan		Madlambayan		Madlambayan		Madlambayan
BE 4400 / 5400	Tissue Engineering	Fall	Villa-Diaz		Villa-Diaz		Villa-Diaz		Villa-Diaz		Villa-Diaz	
BE 5500	Musculoskeletal Biomechanics	Winter				**PT**		**PT**		**PT**		**PT**
BE 3150	Bioinstrumentation	Fall	**PT**		Dean		**PT**		Dean		**PT**	
BE 3899	Introduction to Engineering Biology	Fall	Hanna		Hanna		Hanna		Hanna		Hanna	
BE 4999	Research Project/Capstone Design	Winter		Lal		Lal		Lal		Lal		Lal

As evidenced by this schedule, with the inclusion of part-time faculty and the hiring of one full-time faculty in Year 3, we have sufficient resources to run the MS program. This example schedule ensures courses are offered at minimum every other year.

III. Program Plan

a. Admission Requirements

Admission terms and application deadlines
Before an applicant's file can be reviewed for full program admission, all application documents must be received in Oakland University Graduate School by the semester deadlines listed below. Incomplete applications will not be sent to departments for admission review.

- February 15 (early) April 15 (regular) and July 15 (late) for fall semester
- October 1 (early) and November 15 (regular) for winter semester
- March 1 (regular) for summer semester
- International applicants: https://catalog.oakland.edu/content.php?catoid=56&navoid=11890#Admission_terms_and_application_deadlines

Application requirements
To be considered for graduate admission, applicants must submit all Graduate Application Requirements and additional department requirements by the published application deadlines:

1. Graduate Application Requirements: https://catalog.oakland.edu/content.php?catoid=56&navoid=11816#graduate_application_requirements
2. Additional department application requirements
    - Requirements for recommendations: Two recommendation forms must be from faculty members of the undergraduate major department or professionals in the field who can evaluate the scholarly achievement and potential of the applicant. These recommendations form an important part of the admission credentials.
    - Bachelor's degree in bioengineering or biomedical engineering. Applicants from other disciplines will be considered after successfully completing appropriate prerequisite courses.
    - Admission to a master's program is selective; applicants should have an undergraduate GPA of 3.0 on a 4.0 scale or better for regular admission.
    - If the applicant's undergraduate GPA is between 2.7 and 3.0 on a 4.0 scale, admission with limited standing may be offered.

- Applicants from institutions with which Oakland University has an articulation agreement containing alternative admission criteria will be admitted according to the criteria in that agreement.

Admission review and assessment
Admission to graduate school at Oakland University is selective. In making admission recommendations to Oakland University Graduate School, each department assesses the potential of applicants for success in the program by examining their undergraduate records, goal statement, letters of recommendation, prerequisite courses and any other admission requirements established by the academic department.

b. Degree requirements.

To fulfill the requirements for a Master of Science in bioengineering degree, a student must:

- Complete at least 32 credits of graduate-level work, of which at least 24 credits must be in approved courses offered by the School of Engineering and Computer Science and/or the College of Arts and Sciences (CAS).
- Earn a cumulative GPA of at least 3.0 in courses applied toward the degree.

The 32 credits of graduate-level work will consist of 8 credits of core courses introducing mathematical and biological foundations of bioengineering, 16 credits of depth course work, and 8 credits of elective courses. Students have two options to complete their depth coursework:

1. **Professional Track**. This track requires coursework only, which may include an independent study (BE 5970).
2. **Research Track**. This track requires a research thesis under the supervision of a faculty advisor. The scope of the research topic for the thesis should be defined in such a way that a full-time student could complete the requirements for a master's degree in 24 months or 6 semesters following the completion of course work by regularly scheduling graduate research credits. Completion of a Master's Thesis requires 8 credits of BE 6998. Up to 16 credits of BE 6998 may be included with approval from the thesis committee.

Additional details can be found in **Appendix B**.

c. Curriculum Overview

A typical Plan of Study for students enrolled full-time in the program is outlined in **Appendix C**. The course descriptions for all new courses in the program are included in **Appendix D**.

Course requirements (32 credits)

a. Core (8 credits)
   - Life Science Core - select one of the following:
     - BE 5000 – Principles of Bioengineering (4) (new course)

- Mathematics Core - select one of the following:
  - APM 5441 – Mathematical Analysis for Engineers I (4)
  - APM 5442 – Mathematical Analysis for Engineers II (4)
  - ECE 5404 – Signal and Linear Systems Analysis (4)
  - ME 5400 – Numerical Methods for Mechanical Engineering (4)
  - ECE 5206 – Random Signals and Processes (4)

b. Depth areas (16 credits)
- Research Track: students must complete a master's thesis (8-16 credits) and complete the remaining credits from the depth areas below (0-8 credits). 8 credits total of BE 6998 are required for a Master's thesis. Up to 16 credits of BE 6998 may be included with approval from the thesis committee.
  - BE 6998 – Master's Thesis Research (1 to 8)
- Professional Track: students must choose 16 credits from the list below. It is recommended, but not required, that students select at least 3 courses from the same area to establish a depth of knowledge.

1. Biomedical Imaging and Signal Processing
   - *BE 5100 – Biomedical Signal Processing (4)
   - *BE 5110 – Medical Imaging (4)
   - *BE 5120 – Medical Image Analysis (4)
   - BE 5130 – Ultrasound and Photoacoustic Imaging (4) (new course)
   - BE 5140 – Artificial Intelligence in Medicine (4) (new course)
   - BE 5150 – Medical Sensing and Design (4) (new course)
   - BE 5600 – Introduction to Neural Engineering (4) (new course)
   - ECE 5206 – Random Signals and Processes (4)
   - *CSI 5550 – Visual Computing (4)
   - CSI 6550 – Advanced Visual Computing (4)
   - ECE 5140 – Instrumentation and Measurements (4)
   - PHY 5450 – Physics of NMR and MRI (4)

2. Bioinformatics and Genome Engineering
   - *BE 5200 – Genetic and Genomic Engineering (4)
   - BE 5140 – Artificial Intelligence in Medicine (4) (new course)
   - *BIO 5388 – Design and Analysis of Biological Experiments (4)
   - *BIO 5400 – Advanced Genetics (4)
   - *BIO 5412 – Functional Genomics and Bioinformatics (4)
   - STA 5005 – Statistical Analyses in Big Data Applications (4)
   - *CSI 5450 – Database Systems I (4)
   - *CSI 5780 – Bioinformatics (4)
   - *CSI 5170 – Machine Learning (4) or ME 6700 – Machine Learning Processes (4)

3. Molecular and Tissue Engineering

- *BE 5300 – Bioprocess Engineering (4)
- *BE 5400 – Tissue Engineering (4)
- BIO 5256 – Advanced Topics in Cellular Biochemistry and Metabolism (4)
- *BIO 5388 – Design and Analysis of Biological Experiments (4)
- *BIO 5550 – Microbial Biotechnology (4)
- *ME 5210 – Analysis and Design of Mechanical Structures (4)

c. Electives (8 credits)

- Any graduate courses listed above under various depth areas. (4-8)
- BE 5900 – Special Topics (4)
- BE 5500 – Musculoskeletal Biomechanics (4) (new course)
- *CSI 5460 – Information Security (4)
- *CSI 5480 – Information Security Practices (4)
- *ECE 5500 – Robotic Systems and Control (4)
- *ECE 5551 - Human Robot Interaction (4)
- *ISE 5441 – Human Factors Engineering (4)
- *ISE 5485 – Statistical Quality Analysis (4)
- ISE 5540 – Occupational Biomechanics (4)
- ISE 5574 – Healthcare Informatics (4)
- ME 5515 – Computational Fluid Dynamics (4)
- ME 5XXX – Biofluid Mechanics (4) (new course)
- *ME 5600 – Materials Properties and Processes (4)
- *ME 5610 – Polymeric Materials (4)
- PHY 5250 – Radiation Biophysics (4)
- ** BE 5970 – Independent Study (2 to 4)
- ** BE 6995 – Bioengineering Research Seminar (2)
- ** BE 6996 – Graduate Engineering Project (1 to 4)

Courses with asterisks (*, **, ***)

* These courses are cross-listed as advanced undergraduate and graduate courses. If completed as a 4000-level course or equivalent as part of baccalaureate degree, the course may be used to offset graduate program requirements. However, credit will not then be awarded and must be earned by completion of an approved substitute course.

** At most 4 credits of BE 5970, BE 6995, and BE 6996 can be used toward the degree.

d. Academic Progress – Probation – Dismissal

To stay in good academic standing, students must not allow their cumulative grade point averages (GPA) to drop below 3.0. The program follows the official Academic Policies and Procedures. (See university website for details.)

Inactive student status: At Oakland University, a matriculated graduate student is a student who has been previously admitted to and has enrolled in a graduate program. The Graduate

School classifies inactive, matriculated students into two categories: one category permits readmission to a graduate program, and the other category requires reapplication before an inactive student can re-enroll in a course. The periods of inactivity used to classify inactive students into the appropriate category are defined as follows:

Readmission: Students who have not enrolled for six or more consecutive semesters are permitted to submit a Request for Graduate Readmission form. Each request is evaluated in terms of the time limit established for completing degree requirements, performance in previous coursework, and progress made toward the degree. Students will not be readmitted to programs that have been suspended or discontinued. The catalog current at the time a student is readmitted will govern program requirements, policies and procedures.

Reapplication: Students who have not enrolled for seven consecutive years are considered inactive and their graduate student files are destroyed. These students are considered new applicants and must submit a new Application for Admission to Graduate Study and new supporting documents as specified in both the General Admission Requirements and the Program Admission Requirements.

e. Academic direction and oversight for the program

The proposed MS in BE program will be hosted by the BE department. One program director will be responsible for administering the program and they will be supported by the BE department chair. As part of the budget we are also requesting funds for 50% time of an administrative professional who will dedicate approximately 50% of their time to the BE graduate program.

f. Interdisciplinary programs

Academic home: The Master of Science in BE program will be administered in the Department of Bioengineering and co-governed by the School of Engineering and Computer Science (SECS) and College of Arts and Sciences (CAS). A program committee will be designated to oversee the degree program. The role of the program committee is to administer program policies, curricula changes and petition approvals. The Chair of the Department of Bioengineering will determine the members of the program committee and select a program director.

Other participating academic units: School of Engineering and Computer Science (SECS): Department of Electrical and Computer Engineering, Department of Industrial and Systems Engineering, Department of Mechanical Engineering, and Department of Computer Science and Engineering. College of Arts and Sciences (CAS): Department of Biological Sciences, Department of Physics

g. Accreditation

Not applicable.

h. Prepare a brief description of the program

The Master of Science in Bioengineering program presents students with extensive and interdisciplinary coursework with several options to tailor coursework to career goals. The proposed curriculum is rich in coursework from both life sciences, mathematics, physics, mechanical engineering, electrical engineering, and computer science, representing the truly interdisciplinary nature of bioengineering. Students will be given the opportunity to select a depth area for their coursework including: (1) biomedical imaging and signal processing, (2) bioinformatics and genome engineering, and (3) molecular and tissue engineering. Within this depth area, student can choose between a research track or a professional track, further tailoring their degree to their career goals.

i. Source of Students

- Graduates of the BE undergraduate program of the BE department;
- Graduates of other SECS undergraduate programs (e.g., ECE, ME, CS) who have interest in the biological or medical applications of their engineering discipline
- Graduates of life science undergraduate programs at OU (e.g., biology, chemistry, physics) who have interest in the applied engineering aspects of their scientific discipline
- Graduates or current students at OUWB who are interested in medical devices or engineering solutions to identified problems in medicine
- Graduates of other higher education institutions in Michigan and around the country/world
- General public who are interested in data science and satisfy the admission requirement of the program

j. Recruitment Plan

The BE department, in collaboration with university marketing, will create a brochure describing the program and distribute it through several channels including: 1) SECS newsletter and network of established executives and collaborators, 2) the BE industry advisory board, 3) LinkedIn and other professional social networking sites, 4) the CAS and SECS undergraduate advising offices, and 5) university chapters of national organizations (e.g., NSBE, EMBS, SWE, SHPE, WIC). In addition, the BE faculty will schedule informational seminars within OU and at local companies to explain the program and its benefits to students' careers. Finally, a website will be created to advertise the program to prospective students.

k. Planned Program Enrollment

We anticipate the initial success of our program to be driven by students currently enrolled and interested in our BS in Bioengineering program. Therefore, we worked with OU Undergraduate Admissions to understand the incoming pipeline of BS students to predict enrollment of our BS program who will be candidates for the MS program in the future. Based on the College Board prospect data, shown in the table below, there are 292 prospective students interested in Bioengineering for Fall 2024 and 135 in Fall 2025. We also show these data for biomedical sciences, to demonstrate interest in biomedical-related topics. While these data are still being acquired and analyzed by admissions, they show promise for a strong pipeline of students interested in bioengineering and biomedical-related topics.

***Table 3**: College Board prospect data indicating strong interest for bioengineering and biomedical-related topics.*

	Fall 2024	Fall 2025
Bioengineering	292	135
Biomedical Sciences	515	298
Total	**807**	**433**

To understand realistic enrollment expectations for a MS program, we used the historical enrollment data of the Bioengineering/Biomedical Engineering Master programs in neighboring universities. From 2018 to 2022, the average yearly enrollment was 34 at Michigan State University, 11 at Michigan Technological University, and 23 at Cleveland State University. Therefore, the average yearly enrollment over the three universities is 23. This enrollment includes two cohorts, bringing the average new students per year to 12.

To verify these numbers in the context of OU, we compare to programs within OU with interdisciplinary content comparable to bioengineering (Table 4) and to the yearly enrollment of the BE undergraduate program (Table 5):

***Table 4**. Historical enrollment of OU programs with interdisciplinary content*

Dept.	Major	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
ISE	Systems Engineering	27	22	8	8	13
	ISE	19	14	13	12	8
	Engineering Management	127	120	124	104	95
CSE	CS	73	62	60	82	87
	Cybersecurity	31	28	16	19	23
	Software Engineering	25	26	19	12	19
ECE	ECE	106	88	72	72	65
	Mechatronics / Mechatronic Systems Engineering	52	65	59	48	51
	Embedded Systems	28	27	36	32	33
ME	Mechanical Engineering	156	130	96	77	59
Biology	Biology	21	31	35	32	34
	Biomedical Sciences	11	8	5	6	3

Excluding the four largest programs (i.e., engineering management, ME, ECE, and CS), the average enrollment for these programs over 5 years is 24. This enrollment includes two cohorts, bringing the average new students per year to 12.

Table 5. *Historical enrollment of the BS in Bioengineering program at OU*

	Fall 2019	Fall 2020	Fall 2021	Fall 2022	Fall 2023
Freshmen	17	19	20	17	12
Sophomore	19	13	11	16	12
Junior	19	24	14	10	22
Senior	20	29	28	23	21

Therefore, the average yearly enrollment is 17 for the BE undergraduate program.

Paired with the strong College Board pipeline data in bioengineering, we project the enrollment of our proposed MS in Bioengineering combining the enrollment numbers shown above (Tables 4 & 5). We assume a 5-year growth trend beginning with 14 students and expecting 10% growth each year. The following table shows the expected number of new students and total program enrollment. After year 5, the projection places the program comparable to other flagship Masters programs in SECS/CAS at OU (range: 34 - 95 in 2023).

Table 6. *Projected enrollment of the proposed MS in Bioengineering program.*

	Year 1	Year 2	Year 3	Year 4	Year 5
New students	14	15	17	19	21
Total enrollment	14	29	32	36	40

l. Advising students

Students will be assigned to a faculty mentor upon admission into the program. This Graduate advisor in conjunction with the graduate administrative coordinator will monitor the Plan of Study and assist with course scheduling.

m. Retention Plan

Student retention is one of the key components to a successful program. Therefore, significant emphasis will be placed on student retention. To accomplish this, we will focus on the following key areas:

- Mentoring: students will be assigned a faculty mentor upon admission to the program. Informal mentoring will take place through key student organizations such as EMBS.

- Networking: the BE department will organize seminars that enable students to hear about and meet top researchers in their fields and industry. Students will be invited to these seminars through the BE e-Space. Furthermore, students will be encouraged to participate in national professional organizations such as EMBS and BMES.
- Professional Development: in addition to seminars and in collaboration with SECS career services, we will ensure opportunities and internships are available, particularly those close to graduation
- Feedback: in addition to the established university course surveys and identified program assessments, we will solicit feedback from the current graduate students to assess their level of engagement with the program. Furthermore, we will continue to solicit feedback from current undergraduate students to determine their likelihood of joining the program.

n. Provide list of businesses that would likely employ graduates of the program

- Educational institutions: All universities, medical schools, high schools, middle schools, and elementary schools
- Government agencies: NIH, NSF, NASA
- Hospitals and healthcare: Corewell Health, Henry Ford Health, St. Joseph Mercy Hospital, Michigan Medicine, Blue Cross Blue Shield of Michigan
- Health technology companies: Philips, Siemens Healthineers, GE HealthCare, Butterfly Network, Stryker, Delphinus Medical Technologies
- Tech companies investing in healthcare: Google, Apple, Microsoft, Meta

IV. Off Campus or Distance Delivered Programs

Not applicable.

V. Needs and Costs of the Program

A. New Resources Needed for the Program

- Faculty positions:
  - One (1) new *full-time faculty* hired in year 3.
    - Targeted hiring of faculty will focus in strategic areas of program growth including biomechanics, neural engineering, and quantitative physiology. It is expected that this faculty will be hired in CAS.
    - This faculty will not only support the graduate program, but also help to boost and grow the undergraduate program in bioengineering.
    - Resources will be required to support the research agenda of this faculty including lab space, research assistants, and start-up funds.

        - Faculty Startup Funding is budgeted as part of this program proposal distributed into Years 3-5 with a total reaching $380k. We expect this faculty to be hired in CAS, therefore we approximate the startup funding based on recent biology and chemistry startup packages offered in CAS (range: $280-$360k). Projected inflation is expected to be approximately 2%/year between now and 2028 when this faculty would be hired. Therefore, a startup package of $350k today would be equivalent to approximately $380k in 2028. This startup package will be negotiated between the perspective faculty and the department chair, dean, and provost.
        - The Faculty Startup Package will include one MS graduate assistant and one PhD graduate assistant. The MS graduate assistant is included in this proposal as the fourth MS graduate assistant in Years 3-5. At the time of writing this proposal, the BE department does not have a PhD program; therefore, one graduate assistant at the PhD level will be supported by the Department of Biological Sciences as discussed with current department chair, Gerard Madlambayan.
    - Funds to support *part-time faculty* are required to support the needs of the growing program. Three part-time instructors are requested in Year 1 to support the courses required for the first cohort. In Year 2, a fourth part time instructor is required do the increase in students after the start of the second cohort. In Year 3, we plan to hire a new full-time faculty member, and therefore the number of part-time faculty is reduced back to three.
- Library holdings: see library report.
- Graduate assistants: 4 total – tied to program growth and faculty hiring.
    - Two graduate assistants are included in Year 1, three in Year 2, and four in Years 3-5. The fourth GA included in Years 3-5 will be part of the start up package for the new faculty hired in Year 3.
    - These positions are critical to recruit talented MS students to the program and ensure they have funding for high-level research
    - On average we plan to run 4-5 undergraduate courses per semester (many with lab components) which would significantly benefit from a teaching assistant
- Space: this program will use existing teaching space, but the program will require research lab space for the new faculty expected to be hired in CAS. Fabia Battistuzzi (Associate Dean, CAS) has been in touch with Amy Banes-Berceli regarding this need in the plans for Dodge Hall renovations.
- Equipment: none projected directly as part of this program
- Administrative support: As part of this proposal, we are requesting 0.5 FTE for an Administrative Professional in the BE department who will provide support for this program. Salary is estimated using Band M, consistent with other program coordinators. This individual will handle dissemination of recruitment materials, application processing, program logistics, and overall management of the graduate program.

- Marketing resources: Funds are requested to support marketing of the new program through a paid digital and social media marketing campaign. Specifically, $25,000 are requested in year 1 to support the initial program launch. We expect the program will have initial recruitment success from current OU undergraduate students in year 1, which will help with initial program launch. In year 2, we request $20,000 to compete with reactions from Wayne State University and other local universities with similar programs. For the remaining years, we request $5,000 to support ongoing marketing expenses. Expenses may include for example: print brochures, recruitment events at OU and offsite, and advertisements in local publications, billboards, and on social media.

B. Source of New Resources

The cost of the program will be covered by an increase in tuition revenue based on expected growth. See **Appendix E** for a detailed budget.

C. 5-Year Budget and Revenue from Program **Appendix E**

See **Appendix E**.

D. Library – Include library assessment report **Appendix F**

See **Appendix F**.

E. Classroom, Laboratory, Space needs

No additional teaching resources are included as part of this proposal. We will use existing bioengineering teaching and administrative space. However, research lab space will be required for the new faculty as part of this proposal. Fabia Battistuzzi (Associate Dean, CAS) has been in touch with Amy Banes-Berceli regarding this need.

F. Equipment Needs

No additional equipment is included as part of this proposal. We will use existing bioengineering teaching equipment. Research equipment may be required by the individual hired faculty.

V. Program Assessment Plan

As this is the first graduate program proposed in the Department of Bioengineering, assessment procedures will follow those of MS programs established in SECS and CAS. A comprehensive description of these assessment procedures can be found in **Appendix G**.

The assessment plan for graduate level BE courses for the MS in Bioengineering (including the core courses) will be coordinated by the BE department and will use both direct and indirect assessment to evaluate how well students are achieving the core outcomes of each individual course. Electives from other departments (BIO, CSE, ECE, ISE, ME) will be assessed using those department's established procedures.

Direct assessments will include an anonymized assessment of student coursework to be sampled at random from the core courses. Selected student work will be cumulative and synthetic to each course, such as final projects, and BE program faculty will develop quality rubrics to assess the outcomes of each course and the level of achievement by current students. Direct assessments will occur annually.

Indirect assessments of the program and new core courses will include standard institutional metrics, including (but not limited to) enrollment data, completion and persistence rates, and student surveys (current students and alumni). The program will also conduct student interviews (group and individual) to understand student perceptions of program and course operation.

Annual assessments of the program will be conducted for the first four years to continually improve the admissions rubric and to identify curricular gaps and employment trends, as well as program strengths and weaknesses. Table 7 shows a provisional timeline for program assessment. A comprehensive program review will be conducted at the close of the program's fifth year.

Table 7. A provisional timeline for program assessment

Assessment Plan	Timeline	AY 25/26			AY 26/27			AY 27/28			AY 28/29			AY 29/30		
		F	W	Su	F	W	Su	F	W	Su	F	W	Su	F	W	Su
Current Student Survey	Annual			x			x			x			x			x
Alumni Surveys	Annual after 1st cohort graduates								x			x			x	
Program Data	Annual			x			x			x			x			x
Student Coursework	Annual			x			x			x			x			x

Graduate students who complete this MS degree will be able to:

- Goal 1: Explain and evaluate key and emerging technologies in bioengineering
- Goal 2: Apply principles of bioengineering to real-world problems
- Goal 3: Analyze the unique ethical and societal implications of biotechnology
- Goal 4: Investigate current state-of-the-art biotechnology and identify new ways to tackle the growing bioengineering needs of society

Program assessment will be coordinated by BE. Two of the program goals above will be chosen to assess two required courses (core and depth area) for two consecutive years. Assessment plans for succeeding years will be developed during the second year of the program and we will follow the university's program assessment and review procedure.

VII. Appendices

a. Abbreviated Faculty Vitae
b. Degree Requirements
c. Typical Student Plan of Study – Full-Time Schedule
d. Detailed New Course Descriptions or Syllabi
e. Proforma Budget
f. Library Budget Report
g. Graduate Assessment Plan
h. Support Letters
i. Survey Data

Oakland University
Graduate Council

APPENDIX A
Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Alycen Wiacek **Title:** Assistant Professor **School:** SECS	**Office:** EC 432	**Office Phone** 248-370-2694 **Office Email** awiacek@oakland.edu
Degrees – School – Year PhD, Johns Hopkins University, 2022 MSE, Johns Hopkins University, 2019 MS, Oakland University, 2015 BS, Wayne State University, 2014	**Research Interest** Medical imaging, ultrasound imaging, photoacoustic imaging, breast imaging, image-guided surgery, clinical translation, signal processing, artificial intelligence, deep learning, machine learning.	

Grants Awarded

1. "ERI: Development of a Wireless 3D Breast Ultrasound Imaging System for Low-Resource Settings". $200,000, Sponsored by: National Science Foundation (NSF), 2024-2026.
2. "Quantitative Ultrasound and Photoacoustic Imaging of Thrombosis". $10,000, Sponsored by: National Aeronautics and Space Administration (NASA), under the Michigan Space Grant Consortium (MSGC), 2023-2024.

Most Recent Publications (limit to 6)

1. **A. Wiacek**, E. Oluyemi, K. Myers, E. Ambinder, and M. A. L. Bell, "Coherence metrics for reader-independent differentiation of cystic from solid breast masses in ultrasound images," Ultrasound in Medicine & Biology, vol. 49, no. 1, pp. 256–268, 2023.
2. **A. Wiacek**, K. C. Wang, H. Wu, and M. A. L. Bell, "Photoacoustic-guided laparoscopic and open hysterectomy procedures demonstrated with human cadavers," IEEE Transactions on Medical Imaging, vol. 40, no. 12, pp. 3279–3292, 2021.
3. D. Hyun, **A. Wiacek**, S. Goudarzi, S. Rothlubbers, A. Asif, K. Eickel, Y. C. Eldar, J. Huang, M. Mischi, H. Rivaz, D. Sinden, R. J. van Sloun, H. Strohm, and M. A. L. Bell, "Deep Learning for Ultrasound Image Formation: CUBDL Evaluation Framework & Open Datasets," IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, vol. 68, no. 12, pp. 3466–3483, 2021.
4. **A. Wiacek** and M. A. L. Bell, "Photoacoustic-guided surgery from head to toe," Biomedical Optics Express, vol. 12, no. 4, pp. 2079–2117, 2021, [Invited Review]
5. J. Huang, **A. Wiacek**, K. M. Kempski, T. Palmer, J. Izzi, S. Beck, and M. A. L. Bell, "Empirical assessment of laser safety for photoacoustic-guided liver surgeries," Biomedical Optics Express, vol. 12, no. 3, pp. 1205–1216, 2021.
6. **A. Wiacek**, E. González, and M. A. L. Bell, "CohereNet: A deep learning architecture for ultrasound spatial correlation estimation and coherence-based beamforming," IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, vol. 67, no. 12, pp. 2574–2583, 2020

Graduate Courses Taught (relevant to new degree	**Prospective Graduate Courses (relevant to new degree)**
ECE 5220 - Digital Signal Processing	BE 5110 – Medical Imaging BE 5130 – Ultrasound and Photoacoustic Imaging BE 5140 – Artificial Intelligence in Medicine

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

<table>
<tr><td>Faculty Name: Jia Li

Title: Professor

School: SECS</td><td>Office:
EC 422</td><td>Office Phone
248-370-2661

Office Email
li4@oakland.edu</td></tr>
<tr><td>Degrees – School – Year
PhD, University of Michigan – Ann Arbor, 2002
MS, University of Michigan – Ann Arbor, 1998
BS, Peking University, 1996</td><td colspan="2">Research Interest
Statistical Signal Processing with applications in biomedical imaging and communications. The current and past projects include image segmentation, reconstruction and registration of different imaging modalities, UWB channel modeling and capacity evaluation, and intra-vehicle wireless sensor network.</td></tr>
<tr><td colspan="3">Grants Awarded</td></tr>
<tr><td colspan="3">Most Recent Publications (limit to 6)
1. J. Liu, H. Mu, A. Vakil, R. Ewing, X. Shen, E. Blasch, J. Li, "Human Occupancy Detection via Passive Cognitive Radio," submitted to Sensors, 2020.
2. A. Litvinenko, V. Lurchuk, P. Sethi, S. Louis, V. Tiberkevich, J. Li, A. Jenkins, R. Ferreira, B. Dieny, A. Slavin, U. Ebels, "Ultra-fast sweep-tuned spectrum analyzer with temporal resolution based on a spin-torque nano-oscillator," Nano Letters, 2020 (in press).
3. A. Vakil, J. Liu, P. Zulch, E. Blasch, R. Ewing, J. Li, "A Survey of Multimodal Sensor Fusion for Passive RF and EO Information Integration," IEEE Trans. on Aerospace and Electronic Systems, 2020 (in press).
4. P. Artemchuk, O. Sulymenko, S. Louis, J. Li, R. Khymyn, E. Bankowski, T. Meitzler, V. Tyberkevych, A. Slavin, O. Prokopenko, "Terahertz frequency spectrum analysis with a nanoscale antiferromagnetic tunnel junction," Journal of Applied Physics, vol. 127, 063905, 2020.
5. Y. Chen, X. Jing, J. Mu, J. Li, "An Improved Covariance Spectrum Sensing Algorithm Establish on AD Test," in: Signal and Information Processing, Networking and Computers, Lecture Notes in Electrical Engineering, vol. 494, pp. 16-22, Springer, 2019.
6. S. Louis, O. Sulymenko, V. Tiberkevich, J. Li, D. Aloi, O. Prokopenko, I. Krivorotov, E. Bankowski, T. Meitzler, A. Slavin, "Ultra-fast Wide Band Spectrum Analyzer based on a Rapidly Tuned Spin-torque Nano-oscillator," Applied Physics Letters, vol. 113, no. 11, 112401, 2018.</td></tr>
<tr><td>Graduate Courses Taught (relevant to new degree)

ECE 5206 – Random Signals and Processes</td><td colspan="2">Prospective Graduate Courses (relevant to new degree)

BE 5100 – Biomedical Signal Processing
BE 5150 – Medical Sensing and Design</td></tr>
</table>

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Randal Westrick **Title:** Associate Professor **School:** CAS	**Office:** 305 DH	**Office Phone** (248) 370-3577 **Office Email** rjwestrick@oakland.edu
Degrees – School – Year PhD, Oakland University, 2009 MS, University of Michigan, 2004 BS, Michigan State University, 1993	**Research Interest** Genetics of cardiovascular disease; understanding and preventing the development of pathologic intravascular blood clot formation (also known as thrombosis).	

Grants Awarded

1. National Institutes of Health NIH R15: Identification of the genetic regulators of Plasminogen Activator Inhibitor-1. Grant number: 1R15HL133907
2. American Heart Association Innovative Research Grant: Mouse ENU mutagenesis screen for atherothrombosis modifier genes. Grant Number: 17IRG33460238
3. National Institutes of Health NIH R01: Thrombosuppressive mechanisms of an ARP2 mutant discovered through a mouse ENU mutagenesis screen. Grant number: 1R01HL135035
4. National Institutes of Health NIH R01: Characterization of an isoform specific anticoagulant function of TFPI-alpha. Grant number: R01HL068835
5. AHA-OU Summer Undergraduate Research Program. Grant Number: 19UFEL34450138

Most Recent Publications (limit to 6)

1. Siebert AE...,Westrick RJ, Madlambayan GJ, Lal SK. Evolutionary Conservation and Essential Function of Human and Maize RNA Binding Motif Protein 48 (RBM48) in U12-Type Intron Splicing. BioRxiv, bioRxiv 2020.07.18.209528; doi: https://doi.org/10.1101/2020.07.18.209528
2. Maroney SA, Westrick RJ..., and Mast AE. Inhibition of factor V dependent procoagulant activity by tissue factor pathway inhibitor is required for cerebrovascular development in mice. Blood 2020 Jul 31; blood.2020006054. doi: 10.1182/blood.2020006054. Online ahead of print.
3. Westrick RJ, Røjkjær L, Yang AY, Siebert AE, Ginsburg D. Deficiency of Plasminogen Activator Inhibitor-2 (PAI2) Results in Accelerated Tumor Growth. Journal Thrombosis and Haemostasis. 2020 Aug 11. doi: 10.1111/jth.15054. Online ahead of print.
4. Schulman S..., Westrick RJ..., Furie B. A coagulation defect arising from heterozygous premature termination of tissue factor. Journal of Clinical Investigation. 2020 Jul14;133780. Doi: 10.1172/JCI133780
5. Shaya SA, Westrick RJ and Gross PL. Thrombus Stability Explains The Factor V Leiden Paradox: A Mouse Model. Blood Advances 2019 Nov 12;3(21):3375-3378. doi: 10.1182/bloodadvances.2019031112.
6. Brake MA..., Westrick RJ. "Assessing blood clotting and coagulation factors in mice". Current Protocols in Mouse Biology. 2019 Mar 15:e61. doi: 10.1002/cpmo.61.

Graduate Courses Taught (relevant to new degree	**Prospective Graduate Courses (relevant to new degree)**
BIO 5400 – Advanced Genetics	

Oakland University
Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

<table>
<tr><td>Faculty Name: Sara Blumer-Schuette

Title: Associate Professor

School: CAS</td><td>Office:
331 MSC</td><td>Office Phone
248-370-3168

Office Email
blumerschuette@oakland.edu</td></tr>
<tr><td colspan="2">Degrees – School – Year
PhD, Michigan State University, 2006
MS, Michigan Technological University, 2002
BS, Michigan Technological University, 2000</td><td>Research Interest
microbial physiology and genomics of non-model microorganisms living at the extremes of life, unraveling mechanisms used by extremophilic microbes to interact with substrates that they require as an energy source, anaerobic and aerobic microbiology, functional genomics, microbial genetics and biochemistry</td></tr>
<tr><td colspan="3">Grants Awarded</td></tr>
<tr><td colspan="3">Most Recent Publications (limit to 6)
1. M. A. M. Khan, V. J. Hauk, M. Ibrahim, T. R. Raffel, and S. E. Blumer-Schuette, "Caldicellulosiruptor bescii Adheres to Polysaccharides via a Type IV Pilin-Dependent Mechanism," Appl. Environ. Microbiol., vol. 86, no. 9, pp. e00200-20, Apr. 2020.
2. S. E. Blumer-Schuette, "Insights into Thermophilic Plant Biomass Hydrolysis from Caldicellulosiruptor Systems Biology," Microorganisms, vol. 8, no. 3, Art. no. 3, Mar. 2020.
3. Mendoza and S. E. Blumer-Schuette, "Complete Genome Sequence of Caldicellulosiruptor changbaiensis CBS-Z, an Extremely Thermophilic, Cellulolytic Bacterium Isolated from a Hot Spring in China," Microbiol Resour Announc, vol. 8, no. 9, pp. e00021-19, Feb. 2019.
4. L. L. Lee et al., "Comparative Biochemical and Structural Analysis of Novel Cellulose Binding Proteins (Tāpirins) from Extremely Thermophilic Caldicellulosiruptor Species," Appl. Environ.
5. M. A. M. Khan, C. Mendoza, V. J. Hauk, and S. E. Blumer-Schuette, "Genomic and physiological analyses reveal that extremely thermophilic Caldicellulosiruptor changbaiensis deploys uncommon cellulose attachment mechanisms," J Ind Microbiol Biotechnol, vol. 46, no. 9–10, pp. 1251–1263, Aug. 2019.
6. L. L. Lee et al., "Genus-Wide Assessment of Lignocellulose Utilization in the Extremely Thermophilic Genus Caldicellulosiruptor by Genomic, Pangenomic, and Metagenomic Analyses," Appl. Environ. Microbiol., vol. 84, no. 9, pp. e02694-17, May 2018.</td></tr>
<tr><td colspan="2">Graduate Courses Taught (relevant to new degree)

BIO 5550 – Microbial Biotechnology</td><td>Prospective Graduate Courses (relevant to new degree)</td></tr>
</table>

Oakland University
Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Brian Dean **Title:** Associate Professor **School:** SECS	**Office:**	**Office Phone** (248) 370-2822 **Office Email** bkdean@oakland.edu
Degrees – School – Year PhD, University of Wyoming, 2012 MS, University of Wyoming, 2008 BS, University of Wyoming, 2006	**Research Interest** Sensors, signal conditioning and signal processing, biomimicry, electric motors, embedded systems	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Dean, B.K. and Llamocca, D., "Introduction to Analog and Digital Circuits," Kendell Hunt Publishing, Textbook and Lab Manual, 2019. ISBN 978-1524986056. 2. Agrawal, S; Dean B.K., "Edge Detection Algorithm for Musca-Domestica Inspired Vision System," IEEE Sensors Journal, vol 19, issue 22, pp. 10591-10599, Nov. 2019. 3. Agrawal, S and Dean B.K., "Digitization of Biomimetic Vision Sensor based on the Common Housefly (Musca Domestica), Proc. of Bioinspiration, Biomimetic, and Bioreplication IX, vol. 109650R, March 2019. 4. Agrawal, S and Dean B.K., "Multiple Cartridges Improve Edge Detection Algorithm for Fly Inspired Vision System," Proc. of IEEE Sensors 2018, Oct. 2018. 5. Adabonyan, A.N; Llamocca, D.; and Dean, B.K., "Fly-Inspired Edge Detection: Architecture and Reconfigurable Embedded Implementation," 61st IEEE International Midwest Symposium on Circuits and Systems, August 2018. 6. Dean, B.K.; Rawashdeh, O.A., "An Interdisciplinary Undergraduate Research Program in Electrical and Computer Engineering – Lessons Learned through 6 Years of Program Operations," American Society for Engineering Education Annual Conference & Exposition (ASSE Annual), April 2017.		
Graduate Courses Taught (relevant to new degree ECE 5140 – Instrumentation and Measurements	**Prospective Graduate Courses (relevant to new degree)** BE 5150 – Medical Sensing and Design	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Gerard Madlambayan **Title:** Professor **School:** CAS	**Office:** 325 DH	**Office Phone** (248) 370-3585 **Office Email** madlamba@oakland.edu
Degrees – School – Year PhD, University of Toronto, 2004 MEng, University of Michigan, 1997 BS, Rose-Hulman Institute of Technology, 1993	**Research Interest** Tumor microenvironment, cancer biology, the roles of different stem and progenitor cell populations in cancer initiation, progression and relapse.	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Li, X., Y. Su, G. Madlambayan, H. Edwards, L. Polin, J. Kushner, S.H. Dzinic, K. White, J. Ma, T. Knight, G. Wang, Y. Wang, J. Yang, J.W. Taub, H. Lin and Y. Ge. (2020). Antileukemic activity and mechanism of action of the novel PI3K and histone deacetylase dual inhibitor CUDC-907 in acute myeloid leukemia. Haematologica 105: Epub ahead of print. DOI: 10.3324/haematol.2018.201343. 2. Li,X. Y. Su, K. Hege*, G. Madlambayan, H. Edwards, T. Knight, L. Polin, J. Kushner, S.H. Dzinic, KI White, J, Yang, R. Miller*, G. Wang, L. Zhao, Y. Wang, H. Lin, J. W. Taub and Y. Ge. (2020). The HDAC and PI3K dual inhibitor CUDC-907 synergistically enhances the antileukemic activity of venetoclax in preclinical models of acute myeloid leukemia. Haematologica epub ahead of print. DOI: 10.3324/haematol.2019.233445. 3. Vijay, V., R. Miller*, G.S. Vue*, M.B. Pezeshkian*, M. Maywood, A.M Ast, L.M. Drusbosky, Y. Pompeu, A.D. Salgado, S.D. Lipten, T. Geddes, A.M Blenc, Y. Ge, D.A Ostrov, C.R. Cogle and G. J. Madlambayan. (2019). Interleukin-8 blockade prevents activated endothelial cell mediated proliferation and chemoresistance of acute myeloid leukemia. Leukemia Research 84:106180. DOI: 10.1016/j.leukres.2019.106180. 4. Bigoni-Ordóñez, G.D., D. Czarnowski*, T. Parsons*, G.J. Madlambayan and L.G. Villa-Diaz. (2018). Integrin α6 (CD49f), the microenvironment and cancer stem cells. Current Stem Cell Research & Therapy 14(5): 428-436. DOI: 10.2174/1574888X13666181002151330. 5. Kane*, J.L., S.A. Krueger, A. Hanna, T.R. Raffel, G.D. Wilson, G.J. Madlambayan and B. Marples. (2016). Effect of irradiation on tumor microenvironment and bone marrow cell migration in a preclinical tumor model. International Journal of Radiation Oncology Biology Physics 96: 170-178. DOI: 10.1016/j.ijrobp.2016.04.028. 6. Qi, W., W. Zhang, H. Edwards, R. Chu, G.J. Madlambayan, J.W. Taub, Z. Wang, Y. Wang, C. Li, H. Lin and Y. Ge. (2015). Synergistic anti-leukemic interactions between panobinostat and MK-1775 in acute myeloid leukemia ex vivo. Cancel Biology & Therapy 16: 1784-1793. DOI: 10.1080/15384047.2015.1095406.		
Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)** BE 5300 Bioprocess Engineering	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Fabia Battistuzzi **Title:** Associate Professor and Associate Dean **School:** CAS	**Office:** 340 DH	**Office Phone** (248) 370-3593 **Office Email** battistu@oakland.edu
Degrees – School – Year PhD, Pennsylvania State University, 2007 BS, Universita' Roma Tree, 2001	**Research Interest** bioinformatics	
Grants Awarded		
Most Recent Publications (limit to 6) 1. C. Powell, F. U. Battistuzzi, "Quantifying the error of secondary versus distant-primary calibrations in a simulated environment", Frontiers in Genetics, vol. 11, p. 252, 2020 2. F. Sitto and F.U. Battistuzzi, "Estimating pangenomes with Roary", Molecular Biology and Evolution, msz284, 2019 3. A.A. Superson, D. Phelan, A. Dekovich, F.U. Battistuzzi, "Using taxon resampling to identify species with contrasting phylogenetic signals: an empirical example in Terrabacteria", Bioinformatics, btz121, 2019 4. F.U. Battistuzzi, Q. Tao, L. Jones, K. Tamura, S. Kumar, "RelTime relaxes the strict molecular clock throughout the phylogeny", Genome Biology and Evolution vol. 10, pp. 1631-1636, 2018 5. S. Chaudhry, N. Lwin, D. Phelan, A.A. Escalante, F.U. Battistuzzi, "Comparative analysis of low complexity regions in Plasmodia", Scientific Reports, vol. 8, p. 335, 2018 6. J. Marin, F.U. Battistuzzi, A.C. Brown, B. Hedges, "The timetree of prokaryotes: new insights into their evolution and speciation", Molecular Biology and Evolution, vol. 34, pp. 437-446, 2017		
Graduate Courses Taught (relevant to new degree) BIO 5412 – Functional Genomics and Bioinformatics	**Prospective Graduate Courses (relevant to new degree)** BE 5200 – Genetic and Genomic Engineering	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Shailesh Lal **Title:** Professor & Chair **School:** CAS	**Office:** 346 DH	**Office Phone** (248) 370-2875 **Office Email** lal@oakland.edu
Degrees – School – Year PhD, University of Nebraska, 1993 MS, University of Baroda, 1987 BS, University of Delhi, 1985	**Research Interest** genomics, genetics and bioinformatics to study fundamental processes that impact gene expression in plants from a genome-wide perspective	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Amy E. Siebert, Jacob Corll**, J. Paige Gronevelt**, Laurel Levine*, Linzi M. Hobbs, Catalina Kenney*, Ruth Davenport, A. Mark Settles, W. Brad Barbazuk, Randal J. Westrick, Gerard J. Madlambayan, and Shailesh Lal(2020)Genetic analysis of human RNA binding motif protein 48 (RBM48) reveals an essential role in U12-type intron splicing 2. Fang Bai, Jacob Corll** , Donya N. Shodja** , Ruth Davenport, Guanqiao Feng, Janaki Mudunkothgea, Christian J. Brigolin**, Federico Martin, Gertraud Spielbauer, Chi-Wah Tseung, Amy E. Siebert**, W. Brad Barbazuk, Shailesh Lal, and A. Mark Settles(2019)RNA binding motif protein48 is required for U12 splicing and maize endosperm differentiation Plant Cell 3. Lynch BT**, Patrick TL*, Moreno JJ*, Siebert AE**, Klusman KM*, Shodja DN**, Hannah CL, and SK Lal(2015) Differential pre-mRNA splicing alters the transcript diversity of helitrons between the maize inbred lines.G3:Genes|Genome|Genetics 4. Rauch HB**, Patrick TL*, Klusman KM*, Battistuzzi FU, Mei W, Brendel VP, and SK Lal (2013) Discovery and expression analysis of alternative splicing events conserved among plant SR proteins. Mol. Biol. Evol. 5. Barbaglia AM**, Klusman KM*, Higgins J*, Hannah, Shaw J, and SK Lal (2012) Gene capture by Helitron transposons reshuffles the maize transcriptome. Genetics 190(3) 965-975. Issue Highlights: Genetics (2012) 190:NP 6. Lal SK, M Oetjens**, and LC Hannah (2009) Helitrons: Enigmatic abductors and mobilizers of host genome sequences. Plant Science 176:181-186.		
Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)** BE 5200 Genetic and Genomic Engineering	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Darrin M. Hanna **Title:** Professor **School:** SECS	**Office:** 436 EC	**Office Phone** (248) 370-2170 **Office Email** dmhanna@oakland.edu
Degrees – School – Year PhD, Oakland University, 2003 MS, Oakland University, 2000 BS, Oakland University, 1999	**Research Interest** embedded systems, embedded artificial intelligence, cyberphysical security systems, nanoimaging	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Jason Gorski and Darrin Hanna, "The FPOA: A Medium-grained Reconfigurable Architecture for High-Level Synthesis," accepted for publication in ACM Transactions on Reconfigurable Technology and Systems, 2019. 2. Bryant Jones and Darrin Hanna, "Automatic cache partitioning method for high-level synthesis," Microprocessors and Microsystems - Embedded Hardware Design, 67, 71-81, 2019. 3. Darrin Hanna, Michael Lohrer, David Stern, Alexander Postlmayr, Adam Kollin, Shuo Wang, and Gang-yu Liu, "An online Algorithm for Detecting Anomalies using Fuzzy Clustering," Proceedings of the International Conference on Artificial Intelligence, in Las Vegas, NV, July 30 – August 2, 2018. 4. Michael F. Lohrer, Darrin M. Hanna, Yang Liu, Kang-Hsin Wang, Fu-Tong Liu, Ted A. Laurence, Gang-Yu Liu, "Applying Pattern Recognition to High-Resolution Images to Determine Cellular Signaling Status", IEEE Transactions on Nanobioscience, 2017 September, 16(6):438-446. DOI: 10.1109/TNB.2017.2717871.		
Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)**	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Luis Gerardo Villa-Diaz **Title:** Associate Professor **School:** CAS	**Office:** 305 MSC	**Office Phone** (248) 370-2576 **Office Email** luisvilladiaz@oakland.edu
Degrees – School – Year PhD, Kobe University, 2004 MApS, Lincoln University, 1999 DVM, Universidad Veracruzana, 1995	**Research Interest** Stem cell biology	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Qiryaqoz, Z., Timilsina, S., Czarnowski, D, Krebsbach, P.H., Villa-Diaz, L.G. Identification of biomarkers indicative of functional skeletal stem cells. Orthodontics & Craniofacial Research 2019 2 (Suppl. 1):192-198. DOI:10.111/ocr.12260 2. Ramotowski, C,. Qu, X., Villa-Diaz, L.G. Progress in the use of iPSCs for traumatic spinal cord injuries in animal populations: Meta-analysis and review. Stem Cell Translational Medicine 2019. DOI:10.1002/sctm.18-0225. 3. Topal T., Kim, B.C., Villa-Diaz, L.G., Deng, C., Takayama, S., Krebsbach, P.H. Rapid translocation of pluripotency-related transcription factors by external uniaxial forces. Integrative Biology. 2019, 11:41-52. PMID: 30809641. 4. Chen, W., Han, S., Qian, W., Weng, S., Yang, H., Sun, Y., Villa-Diaz, L.G., Krebsbach, P.H., Fu, J. Nanotopography Regulates Motor Neuron Differentiation of Human Pluripotent Stem Cells. Nanoscale 2018, 10: 35563565. PMID: 29410983. 5. Villa-Diaz, L.G., Kim, J.K., Laperle, A. Palecek, S.P., Krebsbach, P.H. Inhibition of Focal adhesion kinase signaling by integrin □6□1 supports human pluripotent stem cell self-renewal. Stem Cells 2016, 34:1753-1764. PMID: 26930028. 6. Qian, X., Kim, J.K. Tong, W., Villa-Diaz, L.G., Krebsbach, P.H. DPPA5 promotes pluripotency and reprogramming by regulating NANOG turnover. Stem Cells 2016, 34:588-600. PMID: 26661329.		
Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)** BE 5400 – Tissue Engineering	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Mohammad-Reza Siadat **Title:** Associate Professor **School:** SECS	**Office:** 540 EC	**Office Phone** (248) 370-2230 **Office Email** siadat@oakland.edu
Degrees – School – Year PhD, Wayne State University, 2005 MS, University of Tehran, 1997 BS, Sharif University of Technology, 1994	**Research Interest** medical computing, Bayes methods, Big Data, data analysis, data mining, data warehouses, demography, geriatrics, health care, medical image processing, parallel processing, probability, query processing, risk analysis, rough set theory, statistical analysis, statistical testing, biomedical MRI, brain, cancer, patient diagnosis, uncertainty handling, belief networks, bioinformatics, decision making	
Grants Awarded		
Most Recent Publications (limit to 6) 7. S. Arslanturk, M. Siadat, T. Ogunyemi, K. Killinger and A. Diokno, "Effect of Missing Data Imputation on Prediction of Urinary Incontinence," 2019 International Conference on Data Mining Workshops (ICDMW), Beijing, China, 2019, pp. 918-924, doi: 10.1109/ICDMW.2019.00134. 8. Sims, D., Siadat, M-R. "Frequency-based similarity detection of structures in human brain," Proc. SPIE 10138, Medical Imaging 2017: Imaging Informatics for Healthcare, Research, and Applications, 1013804 (March 13, 2017); doi:10.1117/12.2247085. 9. Istephan, S., Siadat, M-R. "Unstructured medical image query using big data – An epilepsy case study," Journal of Biomedical Informatics, Vol. 59, pp. 218–226, 2016. 10. Arslanturk, S., Siadat, M-R., Ogunyemi, T., Killinger, K., Diokno, A. "Analysis of Incomplete and Inconsistent Clinical Survey Data," Journal of Knowledge and Information Systems, Vol. 46, Issue 3, pp 731-750, 2016.		
Graduate Courses Taught (relevant to new degree) CSI 5550 – Visual Computing CSI 6550 – Advanced Visual Computing	**Prospective Graduate Courses (relevant to new degree)**	

Oakland University

Graduate Council

Abbreviated Faculty Vitae

Please include information relevant to the proposed program

Faculty Name: Mary Craig **Title:** Special Lecturer **School:** CAS	**Office:** 323 MSC	**Office Phone** (248) 370-3566 **Office Email** mecraig@oakland.edu
Degrees – School – Year PGCE, University of Sheffield, 2006 PG Dip, University of Sheffield, 2003 BS, Michigan State University, 1989	**Research Interest** Human anatomy	
Grants Awarded		
Most Recent Publications (limit to 6) 1. Craig, M.E. Human Anatomy: A Core Concepts Approach Lecture Workbook, Great River Technologies ISBN 978-1-68075-097-5, 2015 2. Craig, M.E. Human Anatomy A Core Concepts Approach Lab Access Card, Great River Technologies ISBN: 978-168075-1055.		
Graduate Courses Taught (relevant to new degree)	**Prospective Graduate Courses (relevant to new degree)**	

Oakland University
Graduate Council

APPENDIX B

Degree Requirements

PREPARATORY COURSES – undergraduate courses

Course	Title	Credits	Prerequisites	
MTH 1555	Calculus II	4	MTH 1554	
MTH 2554	Multivariable Calculus	4	MTH 1555	
APM 2555	Introduction to Differential Equations with Matrix Algebra	4	MTH 1555	
BIO 1200	Biology I	4		
BIO 2600	Human Physiology	4	BIO 1200	
BE 3899	Introduction to Engineering Biology	4		

CORE COURSES

Course	Title	Credits	Prerequisites	New (x)	% Distance
Life Science Core - select one of the following:					
BE 5000	Principles of Bioengineering	4		x	
Mathematics Core - select one of the following:					
APM 5441	Mathematical Analysis for Engineers I	4			
APM 5442	Mathematical Analysis for Engineers II	4	APM 5441		
ECE 5404	Signal and Linear Systems Analysis	4			
ECE 5206	Random Signals and Processes	4			
ME 5400	Numerical Methods for Mechanical Engineering	4			

DEPTH AREAS

Research Track: students must complete a master's thesis (8-16 credits) and complete the remaining credits from the list below (0-8 credits)

Professional Track: students must choose 16 credits from the list below. It is recommended, but not required, that students select at least 3 courses from the same area to establish a depth of knowledge.

Course	Title	Credits	Prerequisites	New (x)	% Distance
Biomedical Imaging and signal processing					
BE 5100	Biomedical Signal Processing*	4		x	
BE 5110	Medical Imaging*	4		x	
BE 5120	Medical Image Analysis*	4		x	
BE 5130	Ultrasound and Photoacoustic Imaging	4	BE 5110	x	
BE 5140	Artificial Intelligence in Medicine	4		x	
BE 5150	Medical Sensing and Design	4		x	
BE 5600	Introduction to Neural Engineering	4		x	
ECE 5206	Random Signals and Processes	4			

CSI 5550	Visual Computing*	4			
CSI 6550	Advanced Visual Computing	4			
ECE 5140	Instrumentation and Measurements	4			
PHY 5450	Physics of NMR and MRI	4			
Bioinformatics and genome engineering					
BE 5200	Genetic and Genomic Engineering *	4		x	
BE 5140	Artificial Intelligence in Medicine	4		x	
BIO 5388	Design and Analysis of Biological Experiments*	4			
BIO 5400	Advanced Genetics*	4			
BIO 5412	Functional Genomics and Bioinformatics*	4			
STA 5005	Statistical Analyses in Big Data Applications	4			
CSI 5450	Database Systems I*	4	CSE 3450, CSE 5005, CSE 5006, and CSE 5007		
CSI 5780	Bioinformatics*	4			
CSI 5170	Machine Learning* --OR--	4	CSE 5006 and CSE 5007		
ME 6700	Machine Learning Processes	4			
Molecular and tissue engineering					
BE 5300	Bioprocess Engineering*	4		x	
BE 5400	Tissue Engineering*	4		x	
BIO 5256	Advanced Topics in Cellular Biochemistry and Metabolism	4			
BIO 5388	Design and Analysis of Biological Experiments*	4			
BIO 5550	Microbial Biotechnology*	4			
ME 5210	Analysis and Design of Mechanical Structures*	4			

RECOMMENDED ELECTIVE COURSES
Students may choose any 8 credits either from the list below or any of the graduate courses listed in the depth areas above.

Course	Title	Credits	Prerequisites	New (x)	% Distance
	Any graduate course listed in the depth areas above	4			
BE 5900	Special Topics	4		x	
BE 5500	Musculoskeletal Biomechanics	4		x	
CSI 5460	Information Security*	4			
CSI 5480	Information Security Practices*	4			
ECE 5500	Robotic Systems and Control*	4			
ECE 5551	Human Robot Interaction*	4			
ISE 5441	Human Factors Engineering*	4			
ISE 5485	Statistical Quality Analysis*	4	Student must have completed a course in probability.		

ISE 5540	Occupational Biomechanics	4			
ISE 5574	Healthcare Informatics	4			
ME 5515	Computational Fluid Dynamics	4	ME 5400 or equivalent		
ME 5XXX	Biofluid Mechanics	4		x	
ME 5600	Materials Properties and Processes*	4			
ME 5610	Polymeric Materials*	4			
PHY 5250	Radiation Biophysics	4			
BE 5970	Independent Study	1 to 4		x	
BE 6995	Bioengineering Research Seminar	2		x	
BE 6996	Graduate Engineering Project	1 to 4		x	

EXIT COURSES – thesis, dissertation, internship
Research Track: students must complete a master's thesis for a minimum of 8 credits. This course can be taken more than once for a maximum of 16 credits.

Course	Title	Credits	Prerequisites	New (x)	% Distance
BE 6998	Masters Thesis	1 to 8		x	

Note: as proposed, the program consists of 25 cross-listed courses and 25 stand-alone graduate courses, meeting the 50% graduate course rule.

Oakland University

Graduate Council

APPENDIX C

Typical Plan of Study – Full-Time Schedule

Student Schedule - Research Track, Bioinformatics and Genome Engineering Depth Area		
Fall I APM 5441 - Mathematical Analysis for Engineers I BIO 5412 - Functional Genomics and Bioinformatics	**Winter I** BIO 5620 - Advanced Human Physiology BE 5200 - Genetic and Genomic Engineering	**Summer I**
Fall II STA 5005 - Statistical Analyses in Big Data Applications BE 6998 - Master's Thesis Research	**Winter II** CSI 5780 - Bioinformatics BE 6998 - Master's Thesis Research	**Summer II**
Student Schedule - Professional Track, Biomedical Imaging and Signal Processing Depth Area		
Fall I ECE 5404 - Signal and Linear Systems Analysis BE 5100 - Biomedical Signal Processing	**Winter I** BE 5110 - Medical Imaging ECE 5140 - Instrumentation and Measurements	**Summer I**
Fall II CSI 5550 - Visual Computing BIO 5620 - Advanced Human Physiology	**Winter II** PHY 5250 - Radiation Biophysics ISE 5574 - Healthcare Informatics	**Summer II**

APPENDIX D

Provide Detailed New Course Descriptions or Syllabi

BE 5100 - Biomedical Signal Processing (4 credits) - Modification of undergraduate syllabus
This course introduces fundamental aspects of practical signal processing, modeling, and analysis techniques for biomedical signals, using specific applications to demonstrate these principles. This course is cross listed with an undergraduate course.

BE 5110 - Medical Imaging (4 credits) - Modification of undergraduate syllabus
Physics and engineering principles associated with x-ray, computer tomography, nuclear, ultrasound, and magnetic resonance, including human visualization and perception of image data. Cross-listed with BE 4110. Students enrolled in BE 5110 will be expected to complete a final project applying their knowledge of medical imaging to the understanding of an advanced topic of their choosing. This course is cross listed with an undergraduate course.

BE 5120 - Medical Image Analysis (4 credits) - Modification of undergraduate syllabus
This course introduces how to extract, model, and analyze information from medical imaging data and utilize applications to help diagnosis, treatment planning and prognosis. Medical Image Analysis includes topics in medical image segmentation, registration and multimodality fusion, feature extraction, statistical modeling and anomaly detection though shape and texture analysis with applications in MRI, CT, DTI, PET, SPECT, fMRI, etc. This course will provide students with a multidisciplinary background in current state-of-the-art in medical image analysis. This course is cross listed with an undergraduate course.

BE 5200 - Genetic and Genomic Engineering (4 credits) - Modification of undergraduate syllabus
This course will cover the latest advances in genomic and genetic research tools for the manipulation of genes and genomes. Students will review the principles of genetics, genomic and molecular biology as they pertain to genomic and genetic engineering. Students will use this introductory knowledge as the basis for learning to navigate genomic databases and manipulate Next Generation Sequencing (NGS) whole genome sequencing date. They will also learn the latest genome editing techniques for introduction of unique mutations/variants. The engineering of therapeutic molecules such as proteins and aptamers will also be covered. The ethical implications of genomic and genetic engineering will be discussed. This course is cross listed with an undergraduate course.

BE 5300 - Bioprocess Engineering (4 credits) - Modification of undergraduate syllabus
This course will cover material related to the application of biological, biochemical, and engineering fundamentals in the area of bioprocess engineering. Students will review aspects related to molecular biology, cell biology, genetic engineering, biochemistry and microbiology as then pertain to bioprocess engineering concepts. Advanced topics will include bioprocessing kinetics (enzymes, cell growth, substrate utilization, and product formation); bioenergetics; quantification of metabolism; bioreactor design and selection; bioprocess scale-up; product recovery, biosafety and good manufacturing practices; and the role of bioprocess engineering in medicine. This course is cross listed with an undergraduate course.

BE 5400 - Tissue Engineering (4 credits) - Modification of undergraduate syllabus
In this class, students will learn physical laws governing cellular homeostasis including the role of microenvironment on cell life, death, and differentiation and how to control cellular function and genetic programs by adhesion to substrates. Focus will be placed on the interaction between cell shape, substrate, mechanics, receptor mediated adhesion and applied force with mechanical and chemical signal transduction pathways. This course is cross listed with an undergraduate course.

BE 5000 – Principles of Bioengineering (4 credits)
Basic principles of human physiology presented from the engineering perspective. Systems covered include the cardiovascular, neuromuscular, respiratory, renal and endocrine systems at the organ, tissue and cellular levels. Bodily functions, their regulation and control discussed in quantitative terms and illustrated by mathematical models where feasible.

BE 5130 – Ultrasound and Photoacoustic Imaging (4 credits)
Physics, mathematical, and engineering principles of ultrasound, quantitative ultrasound, elastography, and optoacoustic/photoacoustic imaging. Emphasis will be placed on beamforming and image analysis including signal processing, machine learning, and deep learning approaches and clinical applications. The course will culminate with a project applying image analysis techniques to ultrasound and photoacoustic imaging.
Prerequisite: BE 5110

BE 5140 – Artificial Intelligence in Medicine (4 credits)
This course will cover the theory and application of artificial intelligence as applied to medicine including both machine learning and deep learning algorithms. Applications will focus on electronic health records, time series analysis of physiological data, patient outcome prediction, and medical image analysis. Projects will be used to demonstrate key course concepts.

BE 5150 – Medical Sensing and Design (4 credits)
Survey of the design of modern medical instrumentation including highly
technical specialized instruments, mobile, and low-cost instruments. Analysis will include the physical, electrical, mechanical, and biological foundations for the theory of operation for each instrument studied. Regulatory policy on the design, testing, and maintenance of medical devices will be introduced.

BE 5500 – Musculoskeletal Biomechanics (4 credits)
Application of engineering mechanics to the musculoskeletal system including the kinematics and dynamics of spatial multiple degree-of-freedom human motion. Hands-on projects will include the use of Matlab for movement analysis.

BE 5600 – Introduction to Neural Engineering (4 credits)
Survey of topics in neural engineering including neural bioelectrical measurements and sensors, EEG signal processing, brain-computer interfaces, implantable and transcranial neuromodulation, peripheral neural interfacing, neuroimaging, neural modelling, and neural circuits and system identification.

BE 5900 - Special Topics (1 to 4 credits)
Study of special topics in bioengineering. May be taken more than once. May not exceed a maximum of 8 credits.

BE 5970 - Independent Study (1 to 4 credits)
Independent study in a special area of bioengineering. Topic must be approved prior to registration. May be taken more than once. May not exceed a maximum of 8 credits.

BE 6995 - Bioengineering Research Seminar (2 credits)
Current topics in bioengineering delivered through seminars by invited speakers, faculty, or graduate students. May be taken twice.

BE 6996 - Graduate Engineering Project (1 to 4 credits)
Independent work on an advanced project in bioengineering. Topic must be approved prior to registration. May be taken more than once. May not exceed a maximum of 4 credits.

BE 6998 - Master's Thesis Research (1 to 8 credits)
Directed research leading to a master's thesis. Topic must be approved prior to registration. May be taken more than once. May not exceed a maximum of 16 credits.

ME 5XXX – Biofluid Mechanics (4 credits)
Physics, mathematical, and engineering principles of fluids as they apply to medical and biological systems. Emphasis will be placed on the physics and mathematics underpinning intermediate to advanced fluid mechanics. Students will study applications including pulsatile blood flow in vessels, mucus transport from coughing, biomicrofluidics, inspiratory flow in tracheobronchial trees, biological applications to porous media, among others.

Oakland University
Graduate Council

APPENDIX E
Proforma Budget

SBRC Proforma Template		Bioengineering, MS				FY2025
Most Likely Scenario						
		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		14	15	17	19	21
1st Year Cohort Revenue		$ 204,960	$ 219,600	$ 248,880	$ 278,160	$ 307,440
2nd Year Cohort Revenue		$ -	$ 204,960	$ 219,600	$ 248,880	$ 278,160
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$ 204,960	$ 424,560	$ 468,480	$ 527,040	$ 585,600
Less: Avg Financial Aid (30%)						
Net Tuition Revenue		**$ 204,960**	**$ 424,560**	**$ 468,480**	**$ 527,040**	**$ 585,600**
Expenses						
Salaries						
Faculty Salaries	6101			$ 105,000	$ 109,200	$ 113,568
Visiting Faculty	6101					
Administrative Professionals	6201	$ 25,779	$ 25,779	$ 25,779	$ 25,779	$ 25,779
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$ 30,000	$ 40,000	$ 30,000	$ 30,000	$ 30,000
Graduate Assistant	6311	$ 21,370	$ 32,055	$ 42,740	$ 42,740	$ 42,740
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 77,149**	**$ 97,834**	**$ 203,519**	**$ 207,719**	**$ 212,087**
Fringe Benefits	6701	$ 12,944	$ 13,744	$ 57,884	$ 59,681	$ 61,551
Total Compensation		**$ 90,093**	**$ 111,578**	**$ 261,403**	**$ 267,400**	**$ 273,638**
Operating Expenses						
Supplies and Services	7101	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Graduate Tuition	7101	29,280.00	43,920.00	58,560.00	58,560.00	58,560.00
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 20,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 9,894	$ 9,398	$ 10,339	$ 11,372	$ 12,510
Faculty Startup Funding		$ -	$ -	$ 180,000	$ 120,000	$ 80,000
Total Operating Expenses		$ 68,174	$ 77,318	$ 257,899	$ 198,932	$ 160,070
Total Expenses		**$ 158,267**	**$ 188,896**	**$ 519,302**	**$ 466,332**	**$ 433,708**
University Overhead		$ 42,000	$ 87,000	$ 96,000	$ 108,000	$ 120,000
Net Income (Loss)		**$ 4,693**	**$ 148,664**	**$ (146,822)**	**$ (47,292)**	**$ 31,892**

1The tuition calculations do not account for any attrition of students.

SBRC Proforma Template		Bioengineering, MS				FY2025
Best-Case Scenario						
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Est. New Students to Program		20	22	24	26	29
1st Year Cohort Revenue		$ 292,800	$ 322,080	$ 351,360	$ 380,640	$ 424,560
2nd Year Cohort Revenue		$ -	$ 292,800	$ 322,080	$ 351,360	$ 380,640
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$ 292,800	$ 614,880	$ 673,440	$ 732,000	$ 805,200
Less: Avg Financial Aid (30%)						
Net Tuition Revenue		**$ 292,800**	**$ 614,880**	**$ 673,440**	**$ 732,000**	**$ 805,200**
Expenses						
Salaries						
Faculty Salaries	6101			$ 105,000	$ 109,200	$ 113,568
Visiting Faculty	6101					
Administrative Professionals	6201	$ 25,779	$ 25,779	$ 25,779	$ 25,779	$ 25,779
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$ 30,000	$ 40,000	$ 30,000	$ 30,000	$ 30,000
Graduate Assistant	6311	$ 21,370	$ 32,055	$ 42,740	$ 42,740	$ 42,740
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 77,149**	**$ 97,834**	**$ 203,519**	**$ 207,719**	**$ 212,087**
Fringe Benefits	6701	$ 12,944	$ 13,744	$ 57,884	$ 59,681	$ 61,551
Total Compensation		**$ 90,093**	**$ 111,578**	**$ 261,403**	**$ 267,400**	**$ 273,638**
Operating Expenses						
Supplies and Services	7101	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Graduate Tuition	7101	$ 29,280	$ 43,920	$ 58,560	$ 58,560	$ 58,560
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 20,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 9,894	$ 9,398	$ 10,339	$ 11,372	$ 12,510
Faculty Startup Funding		$ -	$ -	$ 180,000	$ 120,000	$ 80,000
Total Operating Expenses		$ 68,174	$ 77,318	$ 257,899	$ 198,932	$ 160,070
Total Expenses		**$ 158,267**	**$ 188,896**	**$ 519,302**	**$ 466,332**	**$ 433,708**
University Overhead		$ 60,000	$ 126,000	$ 138,000	$ 150,000	$ 165,000
Net Income (Loss)		**$ 74,533**	**$ 299,984**	**$ 16,138**	**$ 115,668**	**$ 206,492**
1The tuition calculations do not account for any attrition of students.						

SBRC Proforma Template		Bioengineering, MS				FY2025
Worst-Case Scenario						
		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		8	9	10	11	12
1st Year Cohort Revenue		$ 117,120	$ 131,760	$ 146,400	$ 161,040	$ 175,680
2nd Year Cohort Revenue		$ -	$ 117,120	$ 131,760	$ 146,400	$ 161,040
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$ 117,120	$ 248,880	$ 278,160	$ 307,440	$ 336,720
Less: Avg Financial Aid (30%)						
Net Tuition Revenue		**$ 117,120**	**$ 248,880**	**$ 278,160**	**$ 307,440**	**$ 336,720**
Expenses						
Salaries						
Faculty Salaries	6101			$ 105,000	$ 109,200	$ 113,568
Visiting Faculty	6101					
Administrative Professionals	6201	$ 25,779	$ 25,779	$ 25,779	$ 25,779	$ 25,779
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$ 30,000	$ 40,000	$ 30,000	$ 30,000	$ 30,000
Graduate Assistant	6311	$ 21,370	$ 32,055	$ 42,740	$ 42,740	$ 42,740
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 77,149**	**$ 97,834**	**$ 203,519**	**$ 207,719**	**$ 212,087**
Fringe Benefits	6701	$ 12,944	$ 13,744	$ 57,884	$ 59,681	$ 61,551
Total Compensation		**$ 90,093**	**$ 111,578**	**$ 261,403**	**$ 267,400**	**$ 273,638**
Operating Expenses						
Supplies and Services	7101	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Graduate Tuition	7101	$ 29,280	$ 43,920	$ 58,560	$ 58,560	$ 58,560
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 20,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 9,894	$ 9,398	$ 10,339	$ 11,372	$ 12,510
Faculty Startup Funding		$ -	$ -	$ 180,000	$ 120,000	$ 80,000
Total Operating Expenses		$ 68,174	$ 77,318	$ 257,899	$ 198,932	$ 160,070
Total Expenses		**$ 158,267**	**$ 188,896**	**$ 519,302**	**$ 466,332**	**$ 433,708**
University Overhead		$ 24,000	$ 51,000	$ 57,000	$ 63,000	$ 69,000
Net Income (Loss)		**$ (65,147)**	**$ 8,984**	**$ (298,142)**	**$ (221,892)**	**$ (165,988)**
1The tuition calculations do not account for any attrition of students.						

APPENDIX F
Library Budget Report

OAKLAND UNIVERSITY
Libraries

October 9, 2023

To: Alycen Wiacek, Assistant Professor, Department of Electrical and Computer Engineering / Department of Bioengineering, School of Engineering and Computer Science (SECS)

From: Helen Levenson, Associate Professor and Collection Development Librarian, University Libraries

James E. Van Loon, Assistant Professor and Liaison Librarian to SECS, University Libraries

Re: Library collection evaluation for proposed M.S. program in Bioengineering

In developing this collection evaluation, we reviewed the draft proposal for the master's program in bioengineering, as well as title lists of core journals and resources in the field. Overall, the library is well-positioned to support the proposed program; only a few resources appropriate for graduate use should be added to strengthen the collection in subject areas relevant to the new program. Below is a brief description of the resources currently available, those that should be acquired, and a five-year cost estimate in support of this proposed program.

Journals and Conference Proceedings

Currently, the library subscribes to the IEEE Library, which includes all journals, proceedings and standards produced by the IEEE in the subject areas of image/signal processing and bioinformatics. The library also maintains online access to all Association of Computing Machinery (ACM) journals, magazines, transactions, and conference proceedings through the ACM Digital Library. The ACM and IEEE digital libraries, along with the library's current subscription to the Springer publisher package, provide full-text access to most of the journal and proceedings literature. The library subscribes to a selection of journals of the American Chemical Society (ACS) in subject areas including applied material science and nanomaterials. Interlibrary loan also provides quick access to articles published in other relevant journals. Based on our review of the major journals (Appendix A) and major proceedings and series (Appendix B) in this subject area, we conclude that the library's current holdings of journals and proceedings would provide strong support for the new MS program with the addition of one journal recommended below.

One journal not currently subscribed to (Acta Biomaterialia, Elsevier) has been identified in Appendix A for acquisition, and funding for subscription to this journal has been requested in Appendix C. This journal publishes articles on a range of topics relevant to the proposed MS program and is subscribed to by all the targeted peer institutions; as such it represents a key

resource to which immediate online access will be a benefit for students and faculty of the proposed MS program.

Indexes

To access the journal and conference literature in bioengineering, the University Libraries maintain subscriptions to a number of online indexes. The most important of these are Scopus (an Elsevier product), which indexes journals and conferences across all subjects; SciFinder-n, an American Chemical Society (ACS) database which indexes scholarly and patent literature in biomaterials and tissue engineering; and Science Citation Index (available online through the Web of Science platform), which indexes journals from 1980 to present in applied science and medical technology. The library also provides access to the ProQuest Technology Collection which covers materials science, engineering, and technology. Other important resources include the ACM Digital Library and IEEE Xplor, both of which index journals and conferences published by their respective societies. No additional indexes are needed to support the proposed program adequately.

Monographs and Reference Sources

The library purchases the complete collection of Springer eBooks each year, which includes the essential book series Lecture Notes in Computer Science (and its subseries in Bioinformatics) and other book and book series, totaling more than 29,000 volumes. Beyond the Springer eBook collection, the library purchases only a minimal number of books related to bioengineering and related aspects (such as tissue engineering or molecular modeling). Table 1 shows the library's holdings (total, and recently acquired) in the Library of Congress subject classifications most relevant to bioengineering and highlights the gaps in the collection relevant to the new program.

To ensure that the libraries' monographic collection adequately supports the new proposed master's degree program, we recommend the purchase of approximately (10) ebooks in the initial year and (5) ebooks per year thereafter across the subject areas highlighted in Table 1; these materials would be selected at a level appropriate for graduate use.

Table 1: Monographic titles held by OU in subjects relevant to the proposed M.S. in Bioengineering

LC class	Subject	Books (all formats)	
		Number of books (all publication years)	Number of books (publication 2018-present)
QH 324.2	Data processing. Bioinformatics.	208	65
R 857.B54	Biomedical Engineering - Biosensors.	56	19
R 857.D47	Biomedical Engineering - Digital signal processing.	2	0
R 857.M3	Biomedical Engineering - Biomaterials.	63	8
R 857.M34	Biomedical Engineering - Mathematics.	3	0
R 857.N34	Biomedical Engineering - Nanotechnology.	34	3
R 857.O6	Biomedical Engineering - Optical instruments Including imaging systems.	46	4
R 857.S47	Biomedical Engineering - Signal processing.	9	0
R 857.T55	Biomedical Engineering - Tissue engineering.	19	2
TA 1630-1653	Optical data processing.	872	206
TA 1654	Image analysis.	0	0
TK 5102.9	Signal processing.	481	100

Note:

Shaded rows indicate subject areas relevant to new course offerings or having gaps in the collection.

Library Budget Request

Appendix C provides cost estimates for new resources needed to support the proposed master's level program:

- funding to purchase approximately ten ebooks per year across the subject areas relevant to the new program highlighted in Table 1 (average current cost for these monographs is $270), and
- funding to subscribe to Acta Biomaterialia, which publish articles on subjects especially relevant to the new program and held by peer institutions with similar programs.

Because this program will rely largely on existing library resources, we have also included funding to cover anticipated annual inflationary cost increases for the library's current journals and research databases (estimated at ten percent per year) related to bioengineering. Without additional funding, the library cannot guarantee that we will be able to continue to subscribe to our current resources. Therefore, we ask that the library be given funds each year to assist us in continuing to subscribe to these necessary resources for computer science faculty and students.

Appendix A

Major Journals - Bioengineering

Title	Publisher	OU Access to current issues
ACS Applied Materials And Interfaces	ACS	yes
Acta Biomaterialia	Elsevier	recommend new subscription
Bioinformatics	Oxford University Press	yes
Biomaterials	Elsevier	via Interlibrary Loan
Biomedical Signal Processing And Control	Elsevier	via Interlibrary Loan
BMC Bioinformatics	Springer Nature	yes (open access)
Computers In Biology And Medicine	Elsevier	yes
Frontiers In Genetics	Frontiers Media S.A.	yes (open access)
Frontiers In Microbiology	Frontiers Media S.A.	yes (open access)
IEEE Access	IEEE	yes (open access)
IEEE Journal Of Biomedical And Health Informatics	IEEE	yes
IEEE Transactions On Biomedical Engineering	IEEE	yes
IEEE Transactions On Medical Imaging	IEEE	yes
International Journal Of Biological Macromolecules	Elsevier	via Interlibrary Loan
International Journal Of Molecular Sciences	MDPI	yes (open access)
Journal Of Biomedical Materials Research Part A	Wiley-Blackwell	yes
Journal Of Tissue Engineering And Regenerative Medicine	Wiley-Blackwell	yes (open access)
Materials Science And Engineering C (continued as Biomaterials Advances)	Elsevier	via Interlibrary Loan
Medical Physics	Wiley-Blackwell	yes
Physics In Medicine And Biology	IOP Publishing	yes
Plos One	Public Library of Science	yes (open access)
Scientific Reports	Springer Nature	yes (open access)
Tissue Engineering Part A	Mary Ann Liebert	via Interlibrary Loan

Note: shaded rows indicate journals recommended for subscription, with associated funding requested in Appendix C.

Appendix B

Major Conference Proceedings and Series - Bioengineering

Title	Publisher	OU Access to current issues
Lecture Notes In Computer Science Including Subseries Lecture Notes In Bioinformatics	Springer	yes
Progress In Biomedical Optics And Imaging Proceedings Of SPIE	SPIE	via Interlibrary Loan
Proceedings Of SPIE The International Society For Optical Engineering	SPIE	via Interlibrary Loan
ACM International Conference Proceeding Series	ACM	yes
Journal Of Physics Conference Series	IOP Science	yes (open access)
Advances In Intelligent Systems And Computing	Springer	yes
Studies In Health Technology And Informatics	IOS Press	via Interlibrary Loan (most recent content is OA)
Advanced Materials Research	Trans Tech	via Interlibrary Loan
Key Engineering Materials	Trans Tech	via Interlibrary Loan
Communications In Computer And Information Science	Springer	yes
Aip Conference Proceedings	AIP Publishing	yes
Ifmbe Proceedings	Springer	yes
(EMBS) Annual International Conference of the IEEE Engineering In Medicine And Biology Society	IEEE	yes
Lecture Notes In Electrical Engineering	Springer	yes
Ceur Workshop Proceedings	RWTH Aachen University	yes (open access)
Materials Today Proceedings	Elsevier	via Interlibrary Loan
Iop Conference Series Materials Science And Engineering	IOPScience	yes (open access)
Applied Mechanics And Materials	Trans Tech	via Interlibrary Loan

Appendix C

Library Budget for Proposed M.S. in Bioengineering

	Year 1	Year 2	Year 3	Year 4	Year 5
Monographs[1&2]	$ 2,700	$ 1,485	$ 1,634	$ 1,797	$ 1,977
Acta Biomaterialia[2]	$ 2,194	$ 2,413	$ 2,655	$ 2,920	$ 3,212
Support for current resources[2]	$ 5,000	$ 5,500	$ 6,050	$ 6,655	$ 7,321
Total	$ 9,894	$ 9,398	$ 10,339	$ 11,372	$ 12,510

[1]Purchase of 10 ebooks for the first year in various areas for which we have minimal holdings and 5 ebooks per year thereafter.

[2]Presumes a 10% annual inflation rate.

cc: Polly Boruff-Jones, Dean of University Libraries
Dominique Daniel, University Libraries Representative to University Senate

APPENDIX G

As this is the first graduate program proposed in the Department of Bioengineering, assessment procedures will follow those of MS programs established in SECS and CAS. The assessment plan for the new courses in the MS in Bioengineering degree (including core courses) will be coordinated by the BE department and will use both direct and indirect assessment to evaluate how well students are achieving the core outcomes of each individual course.

Direct assessments will include an anonymized assessment of student coursework to be sampled at random from the core courses. Selected student work will be cumulative and synthetic to each course, such as final projects, and BE program faculty will develop quality rubrics to assess the outcomes of each course and the level of achievement by current students. Direct assessments will occur annually.

Indirect assessments of the program and new core courses will include standard institutional metrics, including (but not limited to) enrollment data, completion and persistence rates, and student surveys (current students and alumni). The program will also conduct student interviews (group and individual) to understand student perceptions of program and course operation. Annual assessments of the program will be conducted for the first four years to continually improve the admissions rubric and to identify curricular gaps and employment trends, as well as program strengths and weaknesses. **Table 2** shows a provisional timeline for program assessment. A comprehensive program review will be conducted at the close of the program's fifth year.

Graduate students who complete this MS degree will be able to:

- Goal 1: Explain and evaluate key and emerging technologies in bioengineering
- Goal 2: Apply principles of bioengineering to real-world problems
- Goal 3: Analyze the unique ethical and societal implications of biotechnology
- Goal 4: Investigate current state-of-the-art biotechnology and identify new ways to tackle the growing bioengineering needs of society

Program assessment will be coordinated by BE. Two of the program goals above will be chosen to assess two required courses (core and depth area) for two consecutive years. Assessment plans for succeeding years will be developed during the second year of the program and we will follow the university's program assessment and review procedure.

Overview of the BE Dept. Assessment Process.
The Assessment process used in the BE Department has been developed over the years in conjunction with other departments from the School of Engineering and Computer Science and College of Arts and Sciences and refined to satisfy the relevant accreditation

bodies. The assessment plan is driven by the goals and mission of the department which are in line with the goals and missions of Oakland University and those of the SECS and CAS.

Goals and Objectives of the M.S. Programs.

1. Oakland University's Goals (from Mission Statement)

Programs and activities within the Bioengineering (BE) department are in line with the following goals of the Oakland University extracted from the University mission:

- *It offers instructional programs of high quality that lead to degrees at the baccalaureate, master's and doctoral levels as well as programs in continuing education;*
- *It advances knowledge and promotes the arts through research, scholarship, and creative activity; and*
- *It renders significant public service.*

2. School of Engineering and Computer Science's Goals (from mission statement)

The School of Engineering and Computer Science mission, found in the school website at http://www.oakland.edu/secs/, states that the overall mission of the School of Engineering and Computer Science is threefold:

- *To provide high-quality undergraduate and graduate programs of instruction in engineering and computer science to prepare graduates for careers in the coming decades,*
- *To advance knowledge through basic and applied research in relevant branches of engineering and computer science, and*
- *To provide service to both the engineering profession and public of the State of Michigan.*

3. Learning Outcomes of the Master programs offered by the BE Department

The MS in Bioengineering program is developed to serve the mission of the department and meet the needs of its main constituents. A set of learning outcomes were identified for the BE master program.

Program Learning outcomes:

The graduates of the M.S. in Bioengineering will:

- Explain and evaluate key and emerging technologies in bioengineering
- Apply principles of bioengineering to real-world problems
- Analyze the unique ethical and societal implications of biotechnology
- Investigate current state-of-the-art biotechnology and identify new ways to tackle the growing bioengineering needs of society

4. How the Learning Outcomes are met

Faculty in the Dept. of Bioengineering have chosen an embedded approach to program assessment. Key courses have been identified for the MS in Bioengineering program where students will have the opportunity to demonstrate the achievement of the program outcomes; the sets of key courses have been chosen to ensure that all of the program outcomes are demonstrated. Student materials will be collected from the key courses that provide evidence that the outcomes have been achieved. External evaluators, including faculty not directly involved with the course and departmental advisory board members, will review these materials to establish whether the students in that class have achieved some or all of the program outcomes. Every semester, BE faculty reviews the results of these external evaluations and generates appropriate plans to improve the achievement of the program outcomes.

Each BE course has a set of course outcomes, developed by the instructing faculty and the BE Graduate Committee, which ensures the logical sequence of topics necessary to the eventual achievement of the program outcomes. At the end of each semester, the students and faculty in each course rate how well that particular course section achieved its objectives. The faculty identifies the specific program outcome(s) achieved in the course and provide evidence in support of their contention. In addition, students and faculty are encouraged to comment on how well the course fits into the overall scheme of the program and to suggest improvements to the course, the course outcomes and the overall program of study. The BE Dept. holds a faculty meeting at the beginning of each semester to review all external evaluations and end-of-course evaluations from the prior semester and develop any needed plan for improvement.

Measures.

The overall success of the MS in Bioengineering is measured by whether the students can demonstrate achievement of all learning outcomes as they graduate. In order to assess the students' achievement, the BE Dept. faculty have selected one direct measure and one indirect measure.

Direct Measure. Key courses are identified in each of the M.S. programs where students have the opportunity to demonstrate the achievement of the program learning outcomes. These courses are chosen to ensure that all of the learning outcomes are demonstrated. When a key course is under review, student materials are collected that provide evidence that the outcomes have been achieved, such as homework assignments, laboratory assignments, project assignment and exams. External evaluators (faculty not directly involved with the course, engineers from industry and BE Dept. Advisory Board members)

review these materials to establish whether the students in that class have achieved some or all of the program outcomes.

The rubric used by the external evaluators is presented in the following. Note that every assignment is not expected to demonstrated competency in all learning outcomes. Hence, a customized rubric containing only the appropriate learning outcomes is generated for each assignment. The rubrics are generated by any BE Dept. faculty member from the SECS assessment website. The BE Dept. faculty meet to review the results of these external evaluations and generate appropriate plans to improve the achievement of the program outcomes.

Indirect Measure. Each BE M.S. course has a set of course outcomes, developed by the instructing faculty and the BE Dept. Graduate Committee, which ensures the logical sequence of topics necessary to the eventual achievement of the program outcomes. At the end of each semester, the students in each course rate how well that particular course section achieved its outcomes. The BE faculty review all of these course evaluations each semester at a department faculty meeting and generate appropriate plans to improve the achievement of the program outcomes.

Documentation of Assessment Process.
All actions taken at each step of the assessment process are documented properly. This record is used by the BE faculty to evaluate and improve the assessment process.

BE Dept. Faculty Involved in the Assessment Process.
All BE Dept. faculty members are involved in the assessment process.

APPENDIX H
Support Letters

LEAR

Making every drive better™

October 9, 2023

Re.: Master of Science in Bioengineering

Dear Dr Wiacek,

I have reviewed the proposal of MSc in Bioengineering at Oakland University, as I was engaged in the advisory board meeting discussions to establish the curriculum for this new and exciting program.

I strongly support this program because I see a current unmet need in the automotive industry. As the vehicle becomes more and more occupant-centric we are challenged in finding engineers with a biomedical background to design and develop the vehicles of the future, with a focus on health, wellness and safety of the occupant.

This program pairs advanced coursework in biological as well as engineering sciences very effectively. I believe that the additional courses in project management, human factor engineering and cybersecurity will prepare the new generation of engineers exceptionally well for the task ahead.

I look forward to seeing this program approved and being able to hire high quality, well-rounded engineering graduates.

Regards,

Francesco Migneco

Global Engineering Manager, Seating Comfort

21557 Telegraph Rd
Southfield, MI 48033 (248) 447-4505 Lear.com

Alycen Wiacek, PhD
Assistant Professor
Department of Electrical and Computer Engineering
Department of Bioengineering
Oakland University
Engineering Center 340
115 Library Dr., Rochester, MI 48309

October 5, 2023

Dear Dr. Wiacek,

As a member of the Industry Advisory Board for the Department of Bioengineering at Oakland University, I have been excited to follow the developments related to creating a Master of Science in Bioengineering degree program. This is great news and I fully support this effort!

I have had a long engineering and management career in the auto industry. I served as a technical fellow at GM specializing in crashworthiness and occupant injury prevention. I also later served as Vice President of Engineering at Humanetics, which is world's leading supplier of crash test dummies and related test equipment.

I have experienced firsthand the industry's need of blending engineering talents with biology sciences. I believe a Master of Science program will serve the auto industry and many other industries very well. Students who enter the workforce after completing the requirements for this degree will be able to be key contributors very quickly in our industry.

Please let me know how I can assist with this endeavor.

Best Regards,

Jack L Jensen

Jack L Jensen

Jensen Consulting, LLC
21jackj@gmail.com

STEMA_cg

Oct 2, 2023

Alycen Wiacek, PhD
Assistant Professor
Department of Electrical and Computer Engineering
Department of Bioengineering
Oakland University

Dear Dr. Wiacek,

I am writing to you today to express my strong support for the creation of a Masters in Bioengineering program at Oakland University (OU). Based on my understanding, as established during the recent advisory board meeting, I believe this program will deliver a strong interdisciplinary education that will develop a competitive and capable cohort of students for their subsequent professional career.

As product/strategy leader and advisor in the life sciences and healthcare industries for >13 years, I have seen firsthand the need for a more diverse and well-trained workforce that understands and is able to respond to the fast evolving challenges we face around human health and artificial intelligence. The M.S in Bioengineering program will provide graduate students with the training and mentorship they need to succeed in their future endeavors and will ensure the public benefits from better designed and performing products and services that improve consumer experience and health outcomes. I am pleased by the thoughtful program set forth by OU's Department of Engineering leadership and look forward to continuing to serve as a resource to support the program.

I urge you to approve the M.S in Bioengineering program at OU. Thank you for your time and consideration.

Sincerely,

Mida Pezeshkian, PhD
Founder, STEMA_cg
https://linktr.ee/mida.pezeshkian

September 29, 2023

To: Professor Shailesh Lal, Bioengineering department chair
Subject: Proposed Masters of Science in Bioengineering degree at Oakland University

Dear Dr. Lal,

I hope this message finds you well. In my capacity as a Research & Development Consultant and IAB member I had the privilege of attending the advisory board meeting, wherein we delved into a comprehensive review of the proposed Masters of Science in Bioengineering degree program. I am delighted to share my enthusiasm for the proposal's exceptional quality and its alignment with the pressing requirements of the biotechnology industry, particularly in the areas of project management, regulatory compliance, and data security.

Personally, I am committed to endorsing participation from the talented engineers and scientists who would benefit from this program. Furthermore, I pledge my commitment to providing ongoing feedback on the program's development and evolution.

I am genuinely excited about the prospect of collaborating with you and your esteemed institution in the realization of the MS in Bioengineering program. I eagerly anticipate the opportunity to extend and deepen my relationship with Oakland University as you continue this exciting journey.

Please do not hesitate to reach out if you require any additional information or if there are specific avenues for collaboration that you would like to explore further. I look forward to the opportunity to contribute to the success of this innovative program.

Sincerely,

Natalie Jameson-Kiesling
Oakland University Alumni, Class of 2006
Research and Development Consultant

Letter of Support for MS in Bioengineering Program

To,
Dr. Shailesh Lal,
Professor and Chair
Department of Bioengineering
Dodge Hall, Room 346
Oakland University (OU), Rochester, MI 48309.

Dear Dr. Lal,

I am glad to hear about the proposal to begin a MS in Bioengineering program at OU's Bioengineering department.

As per U.S. Bureau of Labor Statistics, *"Employment of bioengineers and biomedical engineers is projected to grow 5 percent from 2022 to 2032, faster than the average for all occupations. About 1,200 openings for bioengineers and biomedical engineers are projected each year, on average, over the decade"*. Therefore, I believe that the proposal to start new MS in Bioengineering program is a great initiation to support the increasing need for bioengineers in Michigan and countrywide.

Additionally, the successful accreditation of BS in Bioengineering program at OU by the Accreditation Board for Engineering and Technology (ABET) has enhanced the value and quality of education provided by the Bioengineering program at Oakland University.

With the above understanding, as a practicing biomedical and human factors engineer and as a member of Bioengineering External Advisory Board, I fully support the proposed MS in Bioengineering program. Also, I look forward to working with the faculty members and members of Advisory Board to enhance the bioengineering program at Oakland University.

Sincerely,

Avinash Konkani, Ph.D.
Alumni of Oakland University

APPENDIX I
Survey Data

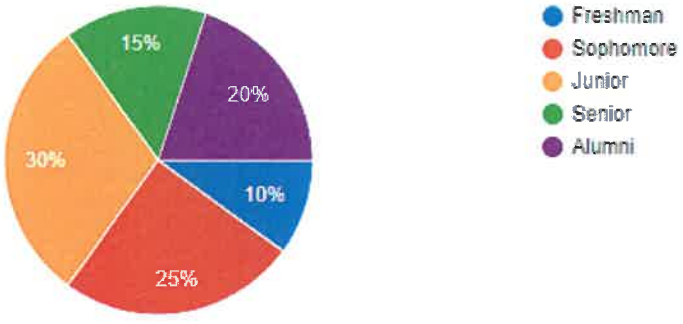
During the Fall semester of 2023, the BE department conducted a survey including current Bioengineering undergraduate students and alumni. The alumni consisted of graduates of both the bioengineering and engineering biology program since 2007 when the program was established. All current students and alumni who were open to receiving emails according to University Advancement Services were sent the 13-question survey via email. The survey was sent to approximately 200 people, with ~10% response rate. The results are summarized below:

80% of respondents said they were likely to pursue a Masters degree in Bioengineering, indicating we have a strong pool of students who are interested in this program. 63.2% of respondents were also interested in a 4+1 program, which is likely due to 80% of respondents being current students, however, it provides motivation for future 4+1 program development. Respondents were interested in the proposed depth areas and additional interest was in neural engineering and prosthetics, validating our strategic choice of targeted faculty hiring areas. Finally, respondents were split on whether they would prefer research, lectured, or independent study-based courses, and are interested in both full-time and part-time programs.

The complete survey responses are shown below:

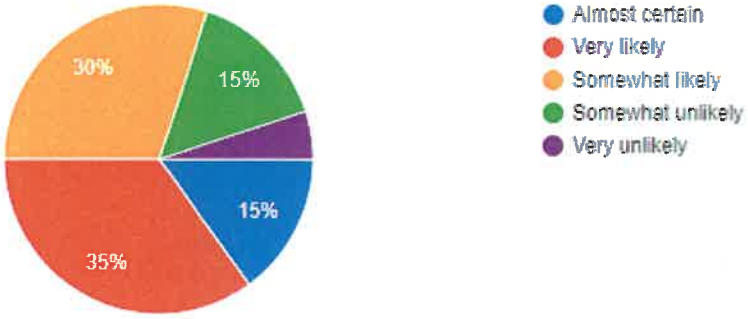
What is your current level in the undergraduate program?

20 responses



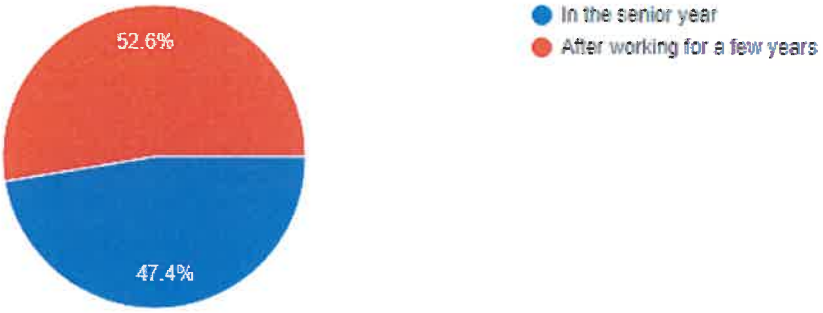
What is your likelihood of pursuing a Master degree in Bioengineering?

20 responses



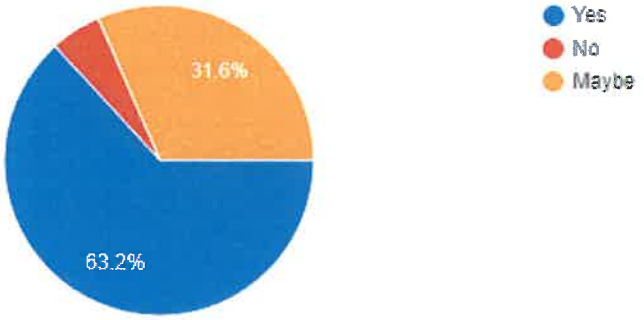
If you plan to apply to a graduate program in Bioengineering, will you apply

19 responses



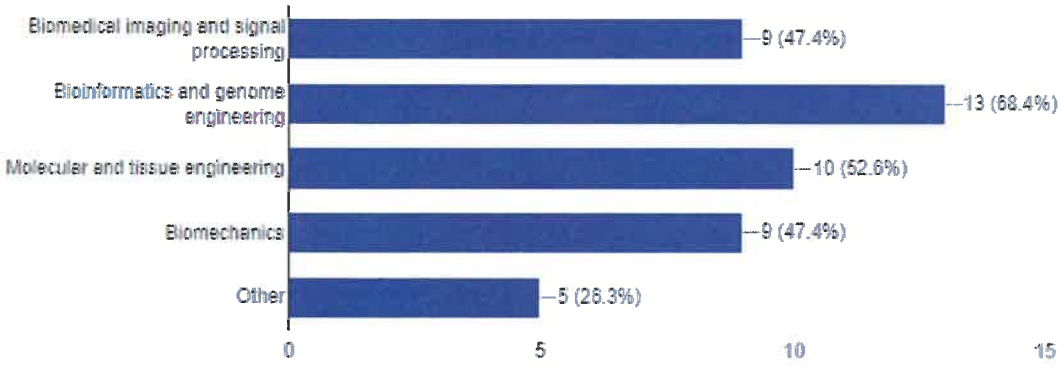
Are you interested in an accelerated master (4 + 1) program?

19 responses



What depth areas are you interested in a Bioengineering graduate program? (You may select more than one area.)

19 responses



If your answer is "Other" to the previous question, please specify which area you are interested in below.

5 responses

Prosthetic

Biomedical-prosthetics and orthotics

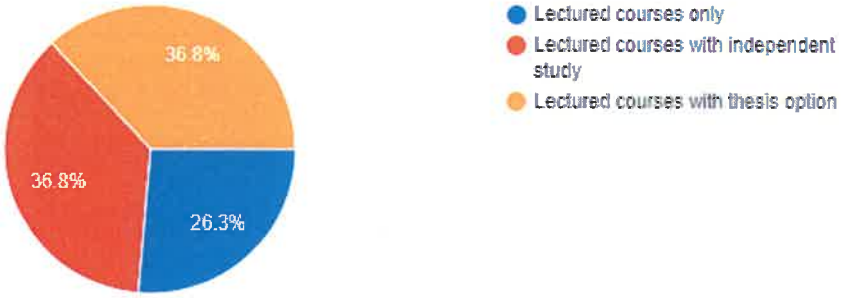
Medical devices, neural engineering, rehabilitation engineering

Human factors,ergonomics

Prosthetics and Othopedics

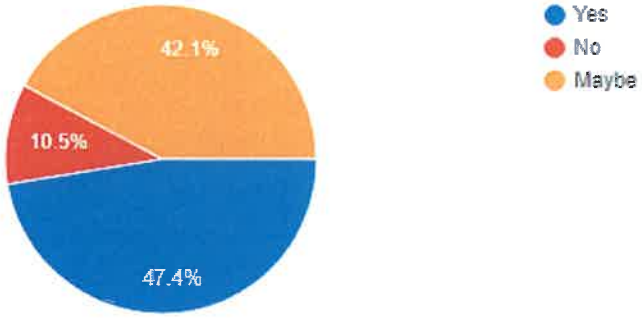
For a master program in Bioengineering, do you plan to take

19 responses



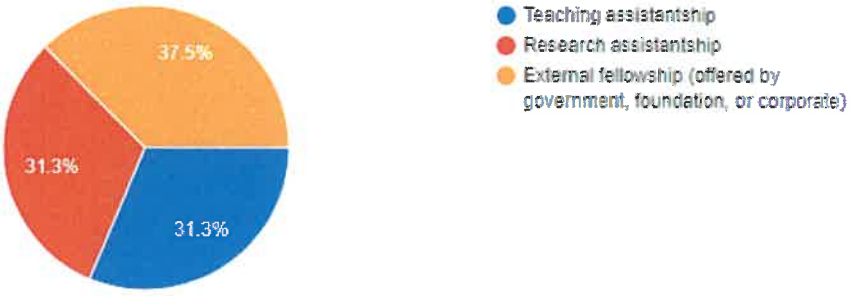
Do you expect to get any form of financial aid for graduate study?

19 responses



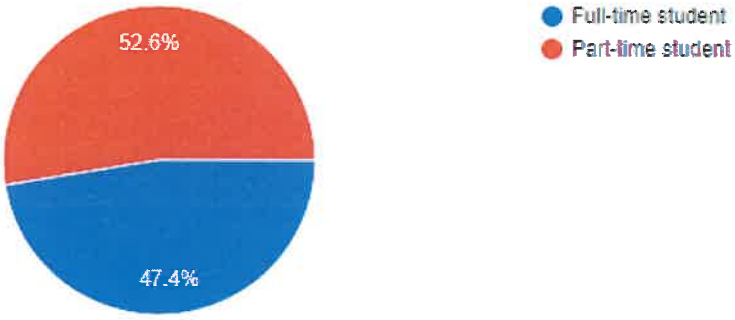
If your answer is "Yes" or "Maybe" to the previous question, which form of financial aid are you interested in?

16 responses



If you are admitted to a master program in Bioengineering, will you enroll as a

19 responses



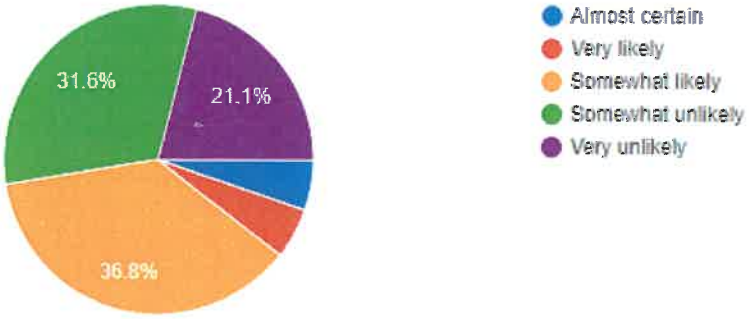
If your answer is "Other" to the previous question, please specify which university you prefer to attend for graduate study in Bioengineering.

0 responses

No responses yet for this question.

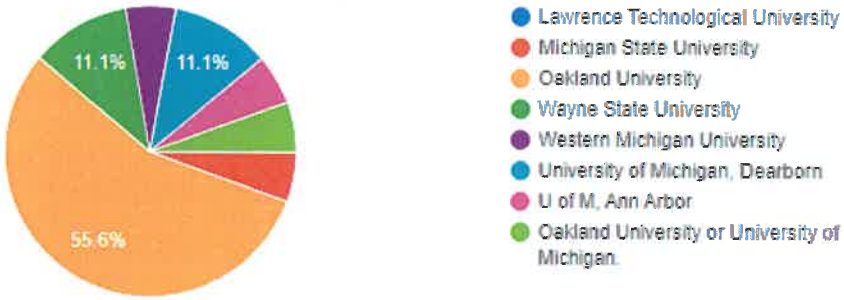
What is your likelihood of applying to a Ph.D. program in Bioengineering?

19 responses



If you are accepted to the Bioengineering graduate programs listed below, which would you attend

18 responses



Timeline
Typical Timeline for Approving Program Proposal

The following table contains critical points in the internal and external review process for program which is to begin in Fall semester. These dates assume that the process is not delayed by significant revisions.

Date	Event	Materials Needed
April 20x1	Review and approval of complete proposal by School of College	Completed proposal.
May 20x1 through June 20x1	Informal review by Graduate School	Completed proposal.
June 20x1	Completion of Library Report.	Completed proposal.
Sept 20x1	Initial review of complete proposal by the Graduate Council. (2 readings)	Completed proposal.
Nov 20x1	Final reviews of revised proposals by the Senate Planning Review Committee and by the Senate Budget Review Committee.	Completed proposal.
Jan. 20x2	Review by the University Senate (2 readings)	Final proposal and final cost estimate.
March 20x2	Review by Board of Trustees.	Final proposal.
May 20x2	Release by Provost to advertise	Final proposal
June 20x2	Presentation to Academic Affairs Officers Committee of the Presidents Council of State Colleges and Universities	Final proposal.
Sept. 20x2	AA approval for program start	Release curriculum code

SBRC Proforma Template

Bioengineering, MS

FY2025

Most Likely Scenario

		Year 1	Year 2	Year 3	Year 4	Year 5
Est. New Students to Program		14	15	17	19	21
1st Year Cohort Revenue		$ 204,960	$ 219,600	$ 248,880	$ 278,160	$ 307,440
2nd Year Cohort Revenue		$ -	$ 204,960	$ 219,600	$ 248,880	$ 278,160
3rd Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
4th Year Cohort Revenue		$ -	$ -	$ -	$ -	$ -
Gross Tuition Revenue		$ 204,960	$ 424,560	$ 468,480	$ 527,040	$ 585,600
Less: Avg Financial Aid (30%)						
Net Tuition Revenue		**$ 204,960**	**$ 424,560**	**$ 468,480**	**$ 527,040**	**$ 585,600**
Expenses						
Salaries						
Faculty Salaries	6101			$ 105,000	$ 109,200	$ 113,568
Visiting Faculty	6101					
Administrative Professionals	6201	$ 25,779	$ 25,779	$ 25,779	$ 25,779	$ 25,779
Clerical Technical	6211					
Administrative IC	6221					
Faculty Inload/Replacement Costs	6301					
Faculty Overload	6301					
Part-Time Faculty	6301	$ 30,000	$ 40,000	$ 30,000	$ 30,000	$ 30,000
Graduate Assistant	6311	$ 21,370	$ 32,055	$ 42,740	$ 42,740	$ 42,740
Casual/Temp	6401					
Out of Classification	6401					
Student Labor	6501					
Total Salary Expense		**$ 77,149**	**$ 97,834**	**$ 203,519**	**$ 207,719**	**$ 212,087**
Fringe Benefits	6701	$ 12,944	$ 13,744	$ 57,884	$ 59,681	$ 61,551
Total Compensation		**$ 90,093**	**$ 111,578**	**$ 261,403**	**$ 267,400**	**$ 273,638**
Operating Expenses						
Supplies and Services	7101	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000
Graduate Tuition	7101	$ 29,280	$ 43,920	$ 58,560	$ 58,560	$ 58,560
E-Learning Support	7102					
Travel	7201					
Equipment	7501					
Maintenance	7110					
Recruitment and advertising	7101	$ 25,000	$ 20,000	$ 5,000	$ 5,000	$ 5,000
Library	7401	$ 9,894	$ 9,398	$ 10,339	$ 11,372	$ 12,510
Faculty Startup Funding		$ -	$ -	$ 180,000	$ 120,000	$ 80,000
Total Operating Expenses		$ 68,174	$ 77,318	$ 257,899	$ 198,932	$ 160,070
Total Expenses		**$ 158,267**	**$ 188,896**	**$ 519,302**	**$ 466,332**	**$ 433,708**
University Overhead		$ 42,000	$ 87,000	$ 96,000	$ 108,000	$ 120,000
Net Income (Loss)		**$ 4,693**	**$ 148,664**	**$ (146,822)**	**$ (47,292)**	**$ 31,892**

[1]The tuition calculations do not account for any attrition of students.

Master of Science in Bioengineering

Board of Trustees

Bioengineering, M.S.

Department of Bioengineering,
College of Arts and Sciences &
School of Engineering and Computer Science

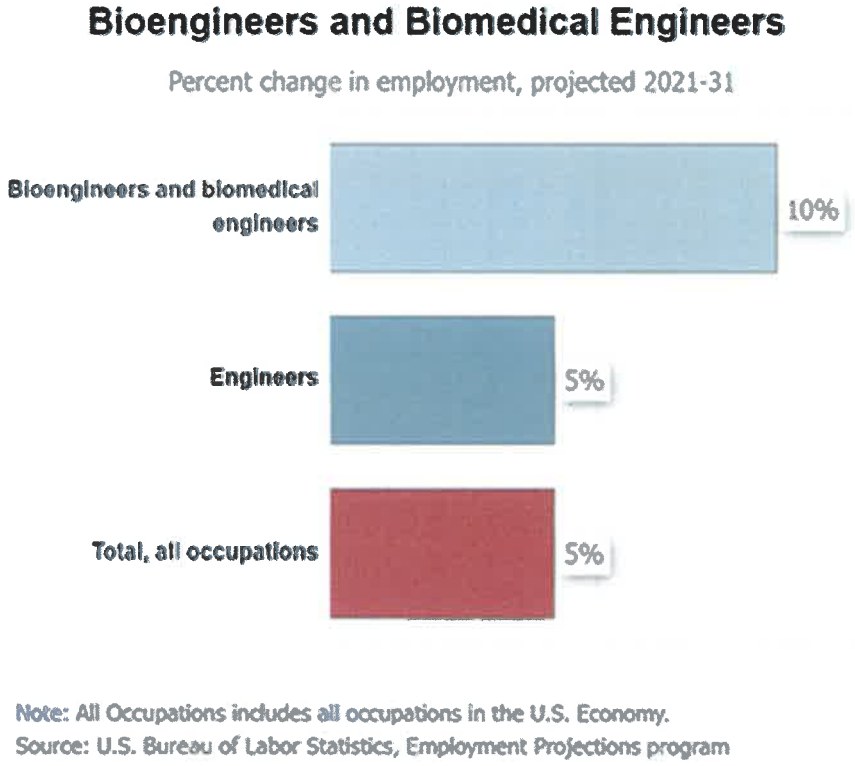
presented by: Alycen Wiacek, PhD
Shailesh Lal, PhD

OAKLAND UNIVERSITY

Summary of Need / Market Analysis

- There is a growing demand for individuals trained in advanced bio- and biomedical engineering

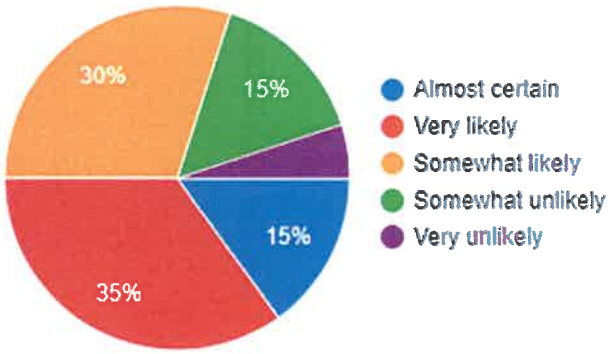
- According to MichBio, Michigan:
  - Is the 14th largest bioscience state
  - Is the 10th largest medical device state
  - Has over 39,000 bioscience jobs
  - With over $28 Billion in economic impact



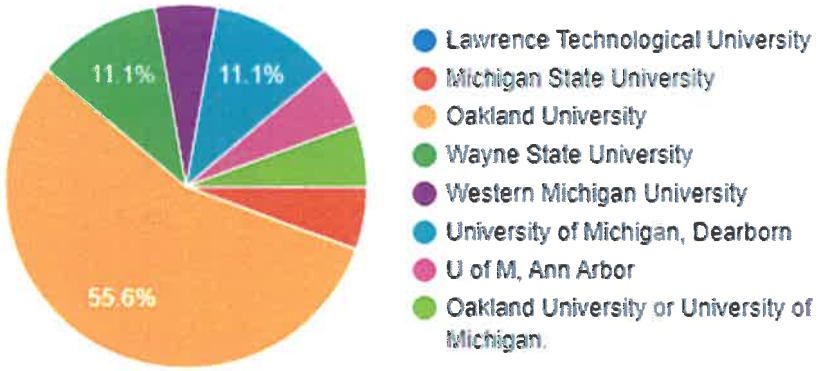
Summary of Need / Market Analysis

Survey sent during Fall 2023 semester shows significant interest in the proposed program:

What is your likelihood of pursuing a Masters degree in Bioengineering?



If you are accepted to the Bioengineering graduate programs listed below, which would you attend?



Over 55% of respondents are interested in pursuing a MS in Bioengineering at OU

Rationale

- Advanced training in bioengineering is both **in demand by industry and perspective students**
- Supports the **strategic growth** of bioengineering at OU
- Hiring of new faculty will provide **additional research opportunities** and **expand existing expertise**

- Overall, the program is designed to **synergistically pair advanced coursework in both biological sciences and engineering** to prepare students for the quickly evolving bioengineering needs both in **research and industry**

Description of Program

Modeled after existing 32 credit MS programs in SECS/CAS

Core (8 credits) + **Depth Areas (16 credits)** + **Electives (8 credits)** = 32 credits

1.Life Science Core (4 credits)

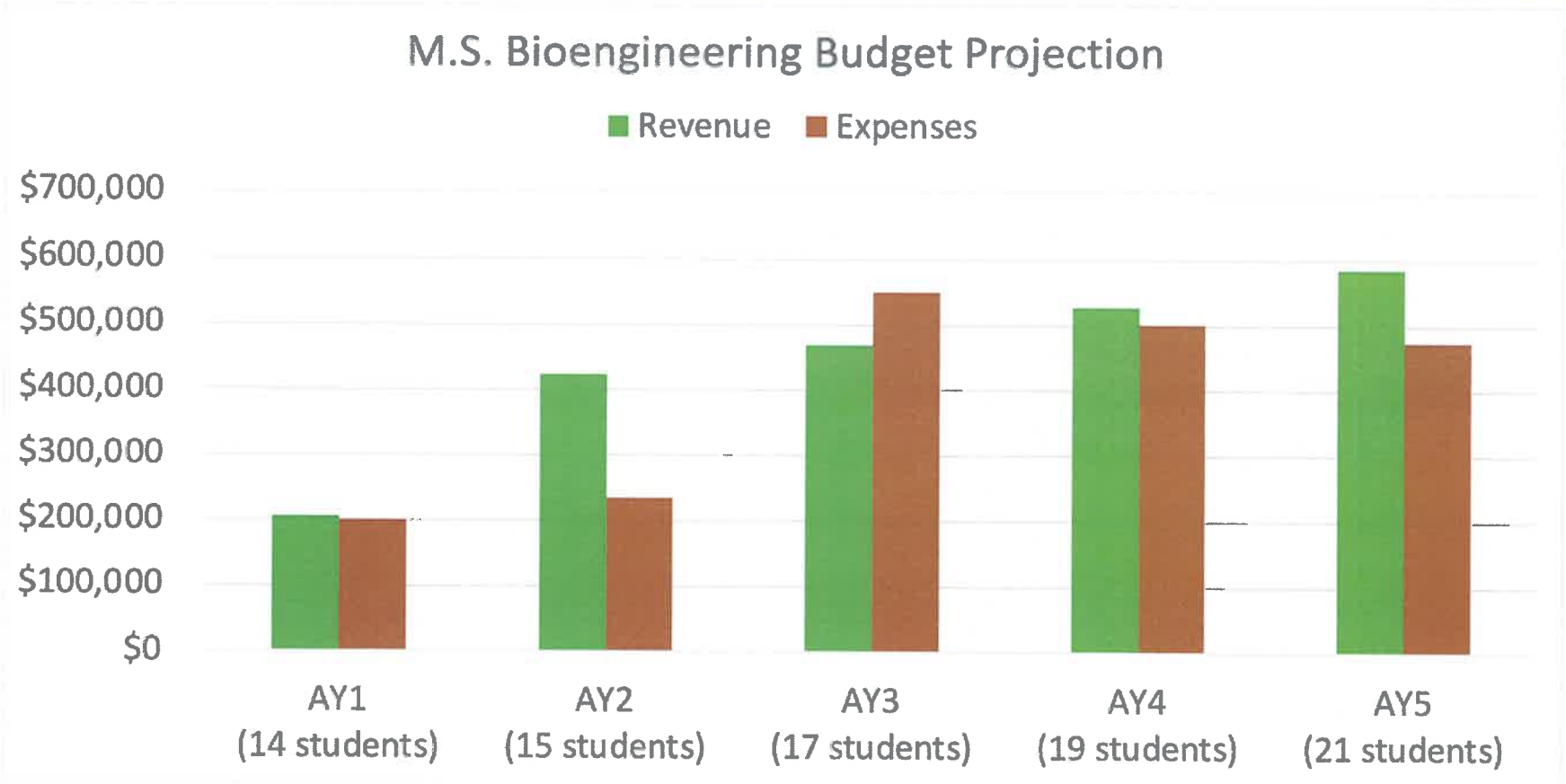
1.Mathematics Core (4 credits)

Research Track (16 credits)
- Master's Thesis Research (8-16 credits)
- Remaining credits from depth areas below

– OR –

Professional Track (16 credits)
Complete coursework in the following areas:
- Biomedical Imaging and Signal Processing
- Bioinformatics and Genome Engineering
- Molecular and Tissue Engineering

Proforma


M.S. Bioengineering Budget Projection
Revenue
Expenses
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
AY1
(14 students)
AY2
(15 students)
AY3
(17 students)
AY4
(19 students)
AY5
(21 students)

ROI - Return on Investment

- **Support Southeast Michigan** with highly trained graduates
- **Increased research opportunities** for graduate and undergraduate students
- Expand connections with existing **bioengineering alumni**
- Attract and provide **opportunities** to a more **diverse student population**
- **Retention plan** focuses on mentoring, networking, professional development, and continuous feedback