



August 16, 2021


Michael Baumgartner, Ph.D.  
Executive Director  
Coordinating Commission for Postsecondary Education  
PO Box 95005  
Lincoln, NE 68509-5005  
[mike.baumgartner@nebraska.gov](mailto:mike.baumgartner@nebraska.gov)

Dear Dr. Baumgartner:

Enclosed is a copy of the proposal to create the Doctor of Philosophy in Biomedical Engineering in the College of Engineering at the University of Nebraska-Lincoln. The proposal was approved by the Board of Regents at the August 13, 2021 meeting. Also enclosed is the Proposal for New Instructional Program Form 92-40.

Please do not hesitate to contact me if you have any questions.

With warmest personal regards,



Jeffrey R. Gold, M.D.  
Executive Vice President and Provost



Enclosures

JPG/cr

cc: Ronnie Green, Ph.D., Chancellor  
Elizabeth Spiller, Ph.D., Executive Vice Chancellor and Chief Academic Officer  
Lance Pérez, Ph.D., Dean, College of Engineering  
David Jackson, Ph.D., Vice Provost

**COORDINATING COMMISSION  
FOR POSTSECONDARY EDUCATION**

140 N. 8<sup>th</sup> Street, Suite 300  
Lincoln, NE 68508

Telephone: (402) 471-2847  
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**PROPOSAL FOR NEW INSTRUCTIONAL PROGRAM**  
Form 92-40

**SECTION I**

Institution Submitting Proposal: University of Nebraska-Lincoln

Title of Program: Biomedical Engineering

CIP Code: 14.0501

Organizational Unit in which program will be located:

College of Engineering

Name of contact person in the event additional information is needed: Dr. Jeffrey P. Gold

Telephone: 402-472-5242

Degree, Diploma, or Certificate to be offered (use separate submittal for each level):

PhD in Biomedical Engineering

Proposed date to initiate program: When approved by the Coordinating Commission

List the location(s) where this program will be offered: UNL

If the program has a projected ending date, please so indicate:

Date approved by Governing Board: August 13, 2021

(Attach all documents related to this proposal upon which the Governing Board made its decision to approve the proposal.)

Chief Executive Officer's or other Authorized Officer's signature:



Jeffrey P. Gold



TO: The Board of Regents Addendum XI-A-4  
Academic Affairs Committee

MEETING DATE: August 13, 2021

SUBJECT: Creation of a Doctor of Philosophy degree in Biomedical Engineering in the College of Engineering at the University of Nebraska-Lincoln

RECOMMENDED ACTION: Approval to create a Doctor of Philosophy (PhD) degree in Biomedical Engineering in the College of Engineering at the University of Nebraska-Lincoln (UNL)

PREVIOUS ACTION: April 13, 2012 – The Board approved the disaggregation of seven department-based tracks of the unified PhD in Engineering at UNL into stand-alone PhD degree programs: Architectural Engineering; Biological Engineering; Chemical and Biomolecular Engineering; Civil Engineering; Computer Engineering; Electrical Engineering; and Mechanical Engineering and Applied Mechanics.  
May 18, 1973 – The Board approved initiating a unified interdepartmental PhD program in Engineering.

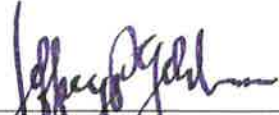
EXPLANATION: UNL currently offers a Biomedical Engineering specialization for its general PhD in Engineering degree; 25 students are enrolled in the specialization. As with the programs disaggregated from the PhD in Engineering in 2011, the discipline of Biomedical Engineering has developed, matured, and grown nationally and the need for Biomedical Engineering PhDs also is growing. The interdisciplinary field focuses on employing engineering techniques to improve human health by incorporating both engineering and biomedical knowledge and techniques. Student demand, faculty, and resources are in place to support the stand-alone program. The proposed PhD will promote greater visibility, resulting in more effective recruitment of prospective students and faculty, as well as placement of PhD graduates. The proposed degree will help Nebraska meet its goals for workforce development and the program’s research efforts will support improving human health throughout the world.  
This proposal has been approved by the Council of Academic Officers and the Executive Graduate Council. This proposal also has been reviewed by the Academic Affairs Committee.

PROGRAM COST: \$0 (No new faculty or resources are needed to operate this program.)

SOURCE OF FUNDS: N/A

SPONSORS: Elizabeth Spiller  
Executive Vice Chancellor and Chief Academic Officer  
Ronnie D. Green, Chancellor  
University of Nebraska-Lincoln

RECOMMENDED:



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Jeffrey P. Gold, M.D.  
Executive Vice President and Provost

DATE:

July 16, 2021



January 28, 2021

Susan Fritz, Executive Vice President and Provost  
University of Nebraska  
3835 Holdrege Street  
Lincoln, NE 68583-0745

Dear EVP Fritz,

I am forwarding to you materials related to a proposal to establish the Biomedical Engineering PhD program to be administered by the College of Engineering. Over the past decade the Biomedical Engineering field of study has grown nationally and the need for Biomedical Engineering PhDs has also grown. The College of Engineering has made significant institutional investments in faculty and resources to offer a standalone PhD program to meet student demand. The core courses are already established, there are adequate existing resources, and a sufficient number of quality faculty are available.

This proposal has the full endorsement of the Academic Planning Committee and it has my approval. I am requesting you approve it and that it be reported to the Board of Regents at an upcoming meeting.

Sincerely,

Ronnie D. Green, Ph.D.  
Chancellor

- c: Kurt Geisinger, Chair, Academic Planning Committee
- Elizabeth Spiller, Executive Vice Chancellor
- Lance Perez, Dean, College of Engineering
- Mike Zeleny, Associate to the Chancellor and APC Secretary
- Renee Batman, Assistant Vice Chancellor, Academic Affairs
- Suzi Tamerius, Project Coordinator, Academic Affairs
- Karen Griffin, APC File

# University of Nebraska-Lincoln

## New Graduate Major or Degree

### I. Descriptive Information

<b>Name of Institution Proposing New Major or Degree</b>	University of Nebraska-Lincoln
<b>Name of Proposed Major or Degree</b>	Biomedical Engineering
<b>Degree to be Awarded to Graduates of the Major</b>	PhD
<b>Other Majors or Degrees Offered in this Field by Institution</b>	None
<b>CIP Code</b> [IEA can help with CIP codes or browse here: <a href="http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55">http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55</a> ]	14.0501, Biomedical/Medical Engineering
<b>Subject Code</b>	14.0501, Biomedical/Medical Engineering
<b>Administrative Units for the Major or Degree</b>	College of Engineering
<b>Proposed Delivery Site</b>	College of Engineering, Lincoln and Omaha sites
<b>Program will be Offered</b> [full program, not individual courses]	<input checked="" type="checkbox"/> On-campus only <input type="checkbox"/> Distance only <input type="checkbox"/> Both (on-campus and distance)
<b>Date Approved by the Governing Board</b>	Pending
<b>Proposed Date the New Major or Degree will be Initiated</b>	When approved by the Coordinating Commission.

### II. Details

#### A. Purpose of the Proposed Major or Degree:

The PhD program currently in the College of Engineering (CoE) was established in 1973 under what was termed a Unified PhD. The original program included five fields of study, termed specializations, including mechanical engineering, civil engineering, and electrical engineering. Eventually, additional fields of study were created, including one in Biomedical Engineering (BME), whose specialization began in 2002. In 2011, the College of Engineering requested and was granted approval to develop seven stand-alone programs which related directly to the names of departments in the College. At that time, the Biomedical Engineering field of study was deemed

not ready to be a stand-alone Doctor of Philosophy degree program; therefore, Biomedical Engineering continues to be offered as a Specialization within the PhD in Engineering degree.

Since the specialization was approved the field of Biomedical Engineering has developed, matured, and grown nationally and the need for Biomedical Engineering PhDs. is also growing. As a result, for the program to be fully competitive necessitates a stand-alone PhD. The College recognized that national growth in the field necessitated strategic investments to support program growth and success. As a result, since 2012 the College has hired a cadre of faculty with background and expertise in biomedical engineering, and these faculty require a suitable academic home for their graduate students. This critical mass of faculty has successfully attracted graduate students who are seeking a fully established degree and the specialization has graduated 25 PhD students who have successfully moved on to academia and industry careers. In addition, there are currently 25 PhD students enrolled in the specialization. The number of applications to the specialization and enrolled students continue to grow, and we expect the growth will continue for some time and certainly increase should the stand-alone program be approved. The support network of inter-department graduate advisors has grown substantially. The number of graduate classes with a primary theme of biomedical engineering has also rapidly grown.

In sum, the College of Engineering is ready to continue its work from 2011 to establish Biomedical Engineering as a stand-alone PhD program. The student demand, faculty and resources are in place to support the stand-alone program. By doing so, the program will promote greater visibility, resulting in more effective recruitment of prospective students and faculty, as well as placement of PhD graduates. It is also an appropriate step given Nebraska's goals for workforce development across the state and criticality of the field of biomedical engineering in the world.

The existing doctoral major in Engineering, which has established specializations in Computer Engineering, Construction Engineering and Management, and Materials Engineering, will remain.

### **Purpose**

The Handbook of Biomedical Engineering<sup>1</sup> describes the field itself nicely:

"With almost continual technological innovation driving medical care, engineering professionals have become intimately involved in many medical ventures. As a result, the discipline of biomedical engineering has emerged as an integrating medium for two dynamic professions, medicine and engineering. In the process, biomedical engineers have become actively involved in the design, development, and utilization of materials, devices, and techniques for clinical research, as well as the diagnosis and treatment of patients . . ."

"Biomedical engineers apply electrical, mechanical, chemical, optical, and other engineering principles to understand, modify, or control human systems, as well as design and manufacture products that can monitor physiologic functions and assist in the diagnosis and treatment of patients...Biomedical Engineering is a rapidly growing field that encompasses a wide variety of activities, including:

- Application of engineering system analysis (physiologic modeling, simulation, and control) to biologic problems;
- Detection, measurement, and monitoring of physiologic signals (i.e. biosensors and biomedical instrumentation);
- Diagnostic interpretation via signal-processing techniques of bioelectric data;

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<sup>1</sup> Biomedical Engineering Handbook, J. D. Bronzino, ed, CRC Press, Boca Raton, Florida, 1995.

- Therapeutic and rehabilitation procedures and devices (rehabilitation engineering);
- Devices for replacement or augmentation of bodily functions (artificial organs);
- Computer analysis of patient-related data and clinical decision-making (i.e., medical informatics and artificial intelligence);
- Medical imaging, i.e., the graphic display of anatomic detail or physiologic function; and
- The creation of new biologic products (i.e., biotechnology and tissue engineering)."

"Typical pursuits of biomedical engineers, therefore, include:

- Research in new materials for implanted artificial organs;
- Development of new diagnostic instruments for blood analysis;
- Computer modeling of the function of the human heart;
- Writing software for analysis of medical research data;
- Analysis of medical device hazards for safety and efficacy;
- Development of new diagnostic imaging systems;
- Design of telemetry systems for patient monitoring;
- Design of biomedical sensors for measurement of human physiologic systems variables;
- Development of expert systems for diagnosis of diseases;
- Design of closed-loop control systems for drug administration;
- Modeling of the physiologic systems of the human body;
- Design of instrumentation for sports medicine;
- Development of new dental materials;
- Design of communication aids for the handicapped;
- Study of pulmonary fluid dynamics;
- Study of the biomechanics of the human body; and
- Development of material to be used as replacement for human skin."

The field is highly interdisciplinary, and the major emphasis is on employing engineering techniques to improve human health, by understanding both the engineering needs and the medical needs for the specific problem.

According to the American Society for Engineering Education<sup>2</sup>, graduate biomedical engineering program enrollments in the U.S. have risen from approximately 6,800 students in 2006 to roughly 10,000 in 2015. While there are at least 78 programs nationwide offering a PhD in Biomedical Engineering, there are relatively few in the Midwest. North Dakota, South Dakota, Kansas, Colorado, New Mexico, Wyoming, Montana, and Missouri do not have programs leading to a PhD in Biomedical Engineering, although the University of Oklahoma started one in the year 2000, University of Iowa has had such a program since 1986, and University of Minnesota's program started in 1972. Colorado State has an interdisciplinary studies specialization in Biomedical Engineering started in 1999.

The employment opportunities for biomedical engineers are strong. In 2011, the Bureau of Labor (BoL) Statistic's list of fastest growing occupations listed Biomedical Engineering as number one. The report, explained in a New York Times article, indicated a perceived 72% growth in BME positions (or 12,000 new jobs) by 2012. This information is in line with a similar report from the BoL in 2009, which noted

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<sup>2</sup> American Society for Engineering Education, <https://www.asee.org/papers-and-publications/publications/college-profiles/15EngineeringbytheNumbersPart1.pdf>



the aging of the population, and a growing focus on health issues will drive demand for better medical devices and equipment designed by biomedical engineers. Along with the demand for more sophisticated medical equipment and procedures, an increased concern for cost-effectiveness will boost demand for biomedical engineers, particularly in pharmaceutical manufacturing and related industries. Median annual earnings of biomedical engineers were \$88,550 in the 2018 report, up from \$82,550 in 2011.

The undergraduate Biomedical Engineering option within the Biological Systems Engineering major currently enrolls roughly 130 students. Of the students who graduate within the Biomedical Engineering option, approximately two-thirds go on to attend graduate school or medical school. Many attend graduate school at other universities since we do not have a PhD in Biomedical Engineering.

It is difficult to predict the enrollment in a new program such as the PhD in the field of biomedical engineering. We would expect that the program would be comparable in size to the other Engineering PhD fields within a few years. In Spring 2019 there were 345 students enrolled in UNL Engineering PhD programs, across 13 fields. Hence, if the program enrolled 26 students it would be an average-sized PhD program. However, we anticipate that this field will not simply be average, but in fact will grow rapidly after its creation.

The University of Nebraska system has a research-active Medical Center (UNMC), and the University of Nebraska-Lincoln has the only engineering research programs in the state of Nebraska, but neither has a stand-alone graduate program in Biomedical Engineering. We are seeking to add a Biomedical Engineering PhD program. This will focus attention on the activities in Biomedical Engineering in the state, will reduce the current barriers to biomedical engineering learning, and will provide the necessary framework to foster research and collaboration between engineers and the medical community.

Creation of a stand-alone Biomedical Engineering PhD program, administratively supported by the College of Engineering Dean's Office, is a natural next step in the continued growth of graduate education and research in this area. The College currently offers a PhD in Engineering with specialization in Biomedical Engineering which is successfully administered by the Dean's office. The Dean's office supports other interdisciplinary graduate programs, such as the Master of Engineering Management and the Complex Biosystems PhD.

Extensive resources have been dedicated to the effort with noted increases in collaborative externally funded research successes. The College of Engineering has made a concerted effort to hire faculty into multiple Departments whose teaching and research expertise and activities closely align with Biomedical Engineering, with nearly 15 tenure/tenure-track faculty hired at various ranks since 2014. Research collaborations between College of Engineering faculty and colleagues at UNMC and the University of Nebraska at Omaha (UNO) continue to increase, with faculty from all seven departments in the college recently or currently involved in externally funded research and graduate student advisement with one or both campuses.

At present, students who wish to enter the graduate program for the PhD in Engineering must identify one of several existing fields – Architectural Engineering, Biological Engineering, Chemical and Biomolecular Engineering, Civil Engineering, Computer Engineering, Mechanical Engineering, and Electrical Engineering. Fitting a biomedical engineering learning and research program into one of these molds is usually an awkward force-fit. For example, many of the courses essential for a degree in Engineering Mechanics are not vital for the study of Biomedical Engineering, while many of the courses essential to the study of Biomedical Engineering are not within the scope of the Engineering Mechanics program. Even in fields where the supervisory committee has substantial latitude in choosing the coursework, the qualifying exam for these disciplinary fields often relies heavily on discipline-specific knowledge that may not subsequently be useful in the biomedical area under study. For the truly

interdisciplinary needs of biomedical engineering learning and research, a more flexible interdisciplinary field-with more appropriate admissions and program requirements is essential.

Furthermore, by creating a stand-alone PhD in Biomedical Engineering, we formally take advantage of the synergism UNMC and UNO can provide in the future growth of the program. UNMC and UNO faculty are close to the state's research hospital facilities, and are often clinicians themselves, and can facilitate contact with human patients – which is always the target of biomedical engineering research. College of Engineering graduate partnerships with UNMC and UNO are thus natural in biomedical engineering and work to the benefit of the graduate student. These partnerships not only encompass joint research funding successes discussed above, but also include adjunct and/or courtesy faculty appointments that allow UNMC faculty to advise UNL College of Engineering graduate students. Facilities also are shared when necessary. Inclusion of UNMC and UNO faculty on Biomedical Engineering PhD graduate student supervisory committees will support existing collaborations and expand those activities to include continual review and enhancement of program curricula. Guest lectures from UNMC and UNO faculty in UNL graduate classes, and vice versa, have been beneficial for students as they provide a more comprehensive view of biomedical engineering topics. With creation of a stand-alone Biomedical Engineering PhD, such education collaborations could be formalized in a way that would permit, for example, co-taught graduate courses with each faculty member receiving teaching credit from their respective institution.

## Structure

### Synergistic Activities with UNMC and UNO

Improved human health is a shared research and education goal between Biomedical Engineering and many other departments at UNMC and UNO. It is natural, beneficial and desirable for UNL's Biomedical Engineering PhD program to leverage the different skill sets, knowledge bases and areas of expertise present at UNMC and UNO and for UNMC and UNO to reciprocate. For example, the Biomedical Engineering PhD program requires at least nine hours of graduate-level biology coursework with objectives in human health. Many courses offered at UNMC and UNO can augment biological science courses available at UNL. Several students in the current Biomedical Engineering Specialization of the Unified Engineering PhD program have taken courses at UNMC. An abbreviated list of courses currently available at UNMC and UNO for which many Biomedical Engineering PhD students would have the necessary biological science prerequisites are shown in Table 1. It also should be stated that graduate engineering courses at UNL are not limited to graduate engineering students and many graduate students in health-related disciplines offered at UNMC and UNO meet prerequisite requirements. Prerequisites for these courses vary and can include math, calculus-based physics, and engineering design. Examples of graduate biomedical engineering courses available at UNL that fall into this category are listed in Table 2. In addition, some courses under the UNO Master of Science in Biomechanics program and the PhD in Exercise Science would be candidates for potential cross-listing with the BME PhD program.

Further evidence of the collaboration between UNL and UNMC/UNO, and of the potential for strong cross-institutional collaboration, could be achieved by cross-listing courses in these tables under the College of Engineering's "BIME" prefix for biomedical engineering courses. They would be suitable for inclusion in a student's Program of Studies. As more students take these courses, it would be natural for research relationships between faculty instructors and the advisor of the student taking the class to develop.

**TABLE 1: SAMPLE COURSES SUITABLE FOR BME PH.D. BIOLOGY REQUIREMENT**

Course Number	Course Name
BMB 815	Metabolism
BMI 810	Introduction to Biomedical Informatics
BMB 915	Proteins and Nucleic Acid
CIP 806	Graduate Physiology
CIP 916	Cardiopulmonary Function in Health & Disease
GCBA 823	Fundamentals in Genetics and Genomics
GCBA 825	Human Histology
IPMM 916	Cardiopulmonary Function in Health & Disease
IPBS 801	Fundamentals of Biomolecules
IPBS 802	Molecular Cell Biology
IPBS 803	Fundamentals of Receptors & Cell Signaling
NSC 922	Molecular & Cellular Neuroscience
PAMM 857	Introductory Immunology
PHSC 910	Pharmacokinetics and Biopharmaceutics

**TABLE 2: SAMPLE GRADUATE BME COURSES SUITABLE FOR OTHER DISCIPLINES**

Course Number	Course Name
BSEN 812	Rehabilitation Engineering
BSEN 814	Medical Imaging Systems
BSEN 816	Introduction to Biomaterials
BSEN 818	Tissue Engineering
CHME 871	Stem Cell Engineering and Regenerative Medicine
CHME 876	Micro/Nano Systems for Engineering and Life Sciences
CHME 877	Molecular Bioengineering
MECH 836	Introduction to Continuum Biomechanics
MECH 837	Biomedical Device Design
MECH 838	Mechanics of Biomaterials
ECEN 850	Bioinformatics
ECEN 853	Computational and Systems Biology

### BME Program Differentiators

It is recognized that a joint PhD program exists in Exercise Science involving UNO Biomechanics and their School of Health and Kinesiology. Some of UNL's biomedical engineering courses are listed as program electives. UNL BME Faculty enjoy a close collaborative relationship with the UNO Biomechanics program as several faculty have collaborated on research projects and on graduate committees. What differentiates the Bioengineering PhD from the Exercise Science PhD is the existence of prerequisites that, as stated above, can include math, calculus-based physics, and engineering design. UNO's Exercise Science PhD degree does not require specific prerequisites.

Another important differentiator is that engineering is a licensed profession in the U.S. Every state has a Professional Engineering Board that issues and administers licenses. Licensed professional engineers are required to provide design services for any project regulated under the Nebraska Engineers and Architects Regulation Act. Two members of the BME PhD Graduate Committee hold a professional engineering license (P.E.), and our program will be active in encouraging other associated faculty

members to do so. There is no equivalent licensure or curricular requirements for biomechanics professions.

## Graduate Program Organization

### Graduate Committee

The Committee consists of six faculty members appointed by participating Graduate Faculty. One of the members, appointed by the Dean of Graduate Studies, shall serve as Committee Chair. The Graduate Committee reviews applications and approves admission to the graduate program. The Committee also administers program policies and responds to student concerns. The Graduate Committee Chair leads the activities of the committee, signs student forms, and works with the Dean of Engineering and the Associate Dean for Graduate Programs.

### Participating Graduate Faculty

Graduate Faculty in the BME PhD Program meet the definition of Graduate Faculty at <https://catalog.unl.edu/graduate-professional/graduate/faculty/>. The initial graduate faculty will consist of the Graduate Committee appointed by participating Graduate Faculty as described above. The Graduate Catalog describes the procedure for adding (nominating) graduate faculty to the interdepartmental area. Table 3 lists certain criteria for membership to the Graduate Faculty as written in the Graduate Catalog, and examples (not exclusive) of how these criteria may be met.

**TABLE 3: GRADUATE FACULTY MEMBERSHIP CRITERIA**

Graduate Catalog Criteria	Examples of meeting the criteria for biomedical engineering
"Hold the terminal degree normally accepted for academic employment in the discipline or its clear equivalent as determined by the Graduate Committee of the nominee's ... interdepartmental area"	<ul style="list-style-type: none"> <li>• A PhD in Biomedical Engineering</li> <li>• A PhD in another field of engineering where the dissertation work focused in human health</li> </ul>
"Be actively involved in scholarly activity and/or graduate teaching as part of his or her regular duties"	<ul style="list-style-type: none"> <li>• Recently served as a Graduate Committee member for a student in the UNL CoE Biomedical Engineering PhD program</li> <li>• Active attendee of the UNL CoE Biomedical Engineering Seminar</li> <li>• Have recently taught a graduate level class with a biomedical engineering focus</li> </ul>
"Have demonstrated clear evidence of continuing scholarly activity at the national level and potential in the discipline, beyond teaching"	<ul style="list-style-type: none"> <li>• Have recent funding from a national funding agency for which the project has a human health focus</li> <li>• Documented past, current and/or future research activities (e.g. publications, theses/dissertations by advisees, proposal submissions) in the past ten years that can be tied to Biomedical Engineering</li> </ul>

The Graduate Faculty review and discuss current best practices and continuous improvement in biomedical engineering graduate education. The Graduate Faculty may change program requirements (including prerequisites, admission policies, and core curriculum) by a two-thirds majority vote.

## **Advisor**

Each graduate student must have a major advisor who is a member of the Graduate Faculty. If the major advisor is not a faculty member with a regular appointment in the College of Engineering, s/he must have a co-advisor who is a faculty member with a regular appointment in the College of Engineering. Major advisors advise students regarding course work and general academic requirements and guide students through their chosen research program. A student's major advisor will serve as the chair of the student's Supervisory Committee.

## **Supervisory Committee**

The primary function of the Supervisory Committee is to assist the student in developing a program of study that is compatible with the goals of the student. In addition, the Supervisory Committee will also monitor the progress of the student and provide counsel if problems arise during the program. The Supervisory Committee ultimately functions to ensure that the student has reached a satisfactory level of academic and research achievement. This committee is responsible for conducting comprehensive and final examinations prior to conferring the PhD degree.

## **Program of Study**

The BME doctoral program follows and meets all of the requirements set forth for a Doctor of Philosophy (PhD) degree by the Office of Graduate Studies. Ninety credit hours beyond the Bachelor of Science (B.S.) degree are required. Any graduate coursework completed at another university may be considered for credit towards the PhD degree. A program of studies must be developed and approved by the student's Supervisory Committee and the Dean of Graduate Studies before a doctoral student has accumulated 45 credit hours, including credit hours from an M.S. degree.

## **Admission**

The steps for admission of a student into the BME Graduate Program are:

1. Student completes application in ADMIT (CollegeNET). The graduate chair is automatically notified when an application is complete.
2. After the deadline date (February 15), the graduate chair will assign two Graduate Committee members to review each applicant's file whose status is "complete".
3. Reviewers complete checklist in ADMIT. Each student will receive one of three possible initial recommendations:
  - a. Admit (for students who meet admission criteria and have secured funding)
  - b. Admit subject to funding (for students who meet admission criteria but have not secured funding)
  - c. Not admit (for students who do not meet admission criteria)
4. The Graduate Committee will consider all applicants, making a final recommendation on each.
5. After the committee reviews applicants, the graduate chair sends to all faculty with BME graduate faculty status a list of potential students who are recommended for admission and who are not already matched to faculty.
6. Students are notified of decision of Graduate Committee (change of status in ADMIT).
7. If a faculty member agrees to advise the graduate student:
  - a. The faculty member notifies the graduate chair that they agree to advise the student, and that they are offering an assistantship (or the student is self-funded)
  - b. The faculty advisor (or his/her designee) sends a letter of assistantship offer to the applicant, cc'ing the graduate chair.
  - c. Once signed, the faculty advisor forwards a copy to the graduate chair.

- d. The student is admitted to the BME PhD program. Any deficiencies are noted in the letter of admission coming from Graduate Studies.
8. Letters are sent out by the Graduate Committee to students admitted, not admitted, and admitted subject to funding.

Graduate students are admitted into the Biomedical Engineering PhD Program, but are often given assistantships administered by a university department. An offer of an assistantship from a department should include specific language requiring adherence to a graduate program's requirements. Suggested language:

- “[As part of accepting this assistantship,] you must be admitted into a degree program and adhere to that program's requirements”

#### **Prerequisites/Deficiency Procedures**

- All students, whether or not they have a master's degree, must have a B.S. in engineering, or show strong academic competency in the quantitative and physical sciences.
- All students must show basic academic competency in the life sciences.
- Specific prerequisites:
  - Engineering / Physical Sciences:
    - Math through differential equations
    - Two semesters of (preferably calculus-based) physics
    - Three courses of advanced (junior-level or higher) engineering courses
  - Life Sciences
    - One course in biology with laboratory or in physiology with laboratory
    - One additional course in the biological sciences
- If a student does not meet the above requirements, they may be admitted under a provisional status with a requirement to satisfy a list of deficiency courses, which will be presented at the time of their admission. Such deficiencies will be determined so as to prepare the student for success both in their graduate program and in their career as a biomedical engineer.
  - The deficiency courses will be noted in the student's admission letter from Graduate Studies.
  - The provisional status will be removed when the deficiency courses are completed.
  - Deficiency courses will not count towards the requirements for the graduate degree.
  - The deficiency courses must be completed before the student's comprehensive examination.
  - The Graduate Committee will review students with provisional status annually to check progress on deficiency courses.
  - The Graduate Committee chair is responsible for checking the program of studies before signing to ensure deficiency courses have been completed before the comprehensive examination.

#### **Core Curriculum**

The PhD degree in Biomedical Engineering requires a core curriculum of 42 credit hours, including the following:

- Statistics and Experimental Design (3 credit hours)
- Human Biology (9 credit hours)
  - The BME Graduate Committee will maintain, and annually review, a list of graduate courses that the graduate faculty have approved as acceptable “human biology” courses.
  - Courses may include relevant biological science offerings at UNO and UNMC.



- Engineering/Science Electives (30 credit hours)
  - 30 credit hours of electives, to include at least 12 credit hours of graduate-level engineering electives.
  - The BME Graduate Committee will maintain, and annually review, a list of graduate courses that the graduate faculty have approved as acceptable engineering courses.
  - Acceptable “science electives” are at the discretion of the supervisory committee, provided they are graduate-level courses.
  - Courses offered by UNO and UNMC also will be considered if they contain sufficient engineering and/or science content.

### **Appointment of Supervisory Committee**

At the time of a student’s admission to the BME doctoral program, an advisor for the student is assigned by the BME Graduate Committee Chair. Upon recommendation of the BME Graduate Committee, the Dean of Graduate Studies appoints, for each student, a Supervisory Committee. The Committee will be chaired by the student’s advisor, who is a Graduate Faculty member, and will consist of at least four Graduate Faculty Members or Associates. The Supervisory Committee must be appointed before a doctoral student has accumulated 45 credit hours using the Appointment of Supervisory Committee form.

The different members of the Supervisory Committee have designated roles as follows:

- Chair: The advisor of the student chairs the Committee. The Chair may not serve as an outside representative and must be a Graduate Faculty member with an appointment in the College of Engineering. Appointed Adjunct faculty and courtesy faculty affiliated with the College of Engineering may not serve as the Chair, but may co-chair the Committee.
- Member: Members of the Committee vote on admission to candidacy, extension requests, and the outcome of the dissertation defense.
- Reader: Two members of the Committee are designated as Readers. The Chair and the Readers review the dissertation draft to determine if the dissertation is ready to defend.
- Outside Member: At least one Committee member external to the BME Graduate Faculty, who is a member of the Graduate Faculty, must be included. When the student is pursuing a minor, a Graduate Faculty member from the minor department must be on the Supervisory Committee. The Supervisory Committee member from the minor department may serve as the outside representative. The Outside Representative may also serve as a Reader.
- Special Member: Faculty external to the University of Nebraska system may serve as a fifth member of the Committee. The Special Member may serve as a reader, but not as outside representative.

### **PhD Comprehensive Examination**

PhD students are required to complete a comprehensive examination that consists of a written and possibly oral (at the discretion of the Supervisory Committee) examination, as detailed in <https://catalog.unl.edu/graduate-professional/graduate/degrees/doctoral/>.

For the comprehensive examination, the style and format are at the discretion of the supervisory committee. A typical format is:

- Written exam: The student writes a research proposal. Research proposals follow the format for project narratives used by the NIH, NSF, or other national funding agency, as determined by the Supervisory Committee. It is not necessary to include the budget, conflict of interest, current and pending support, or other forms. The major advisor should be involved in the planning and development of the project but should not edit or rewrite the document prior

to submission to the Supervisory Committee. Thus, this document should be an accurate representation of the student's writing and reasoning abilities.

- The student orally defends the written proposal in the form of a seminar to the Supervisory Committee. The Committee will then examine the student on the research proposal. Areas to be evaluated include the student's knowledge of the science and methods to be used in the project, the student's ability to express his/her ideas orally, and the student's ability to answer questions related to the proposed project.

### **PhD Dissertation**

All PhD students must write a dissertation. Specifics concerning the organization and preparation of the document are published in the Graduate Studies Catalog. Additional information on form and style can be obtained from the "Guidelines for Preparing your Thesis or Dissertation" available from the UNL Office of Graduate Studies. Due dates for the relevant academic year can also be obtained from the Office of Graduate Studies website: <http://www.unl.edu/gradstudies/current/degrees>.

### **Direct-to-PhD Option**

Students having a Bachelor of Science degree can apply directly to the PhD program. Only exceptional applicants will be considered. It is expected that the exceptional applicants have outstanding grades and GRE scores, prior research experience, and superior letters of reference. When students are considering applying directly for the PhD program, we recommend they upload their research articles, reports, abstracts, conference proceedings, awards, recognitions, and so forth in their application package.

### **Assistantships**

Many BME graduate students receive a research assistantship (RA). These RAs are awarded on a very competitive basis. With these awards comes the expectation that the student will be fully committed to their academic program. This means graduate students are expected to work during academic holidays such as spring break, semester break, and so on in the same manner as University support staff (i.e., whenever the University is open). The University offers no vacation benefit for graduate students. Therefore, time off must be negotiated with the major advisor. Assistantship awards are renewable based on satisfactory performance by the student (see Annual Reviews and Expected Student Performance).

### **Research Areas**

Graduate students are expected to pursue an academic area and conduct research consistent with the interests of the major advisor. Research projects enable students to pursue their thesis/dissertation objectives and to satisfy the research objectives of the major advisor. The expected result is a thesis or dissertation for the student, the completion of grant objectives for the major advisor, and manuscripts published in scientific journals.

In addition to conducting their thesis/dissertation research, all RAs are not to exceed 19.6 hours per week for a maximum 0.49 FTE assistantship and are expected to assist their major advisor with special projects, to train other students, and to perform other relevant academic duties.

### **Tuition Benefits and Registration Requirements**

All graduate students receiving an assistantship qualify for tuition waivers. Students should consult the Graduate Studies Catalog for current guidelines on requirements for eligibility. Students holding assistantships may not exceed established registration limitations. During regular academic semesters, students holding full assistantships (0.49 FTE) must register for a minimum of nine credits and a maximum of 10 credits, while students with 0.33 FTE assistantships may enroll for a maximum of 12 credits. Students who do not hold an assistantship may enroll for up to 15 credits per semester.



### **Summer Registration**

Students do not have to be registered during the summer. If a graduate student has a qualifying assistantship that includes a summer tuition waiver, the student may choose to register in the summer terms (for a total of four credit hours--two credit hours in the first session, which lasts eight weeks, and two credit hours in the third session, which lasts five weeks; or two credits in each of the second and third sessions, which each last five weeks) but is not required to do so. When students do not enroll, they have limited access to such university facilities as the health center and campus recreation. International students should visit with the International Student Scholar Office to determine how summer enrollment affects the status of their visa. For additional information, see the "Guidelines for Good Practice in Graduate Education" on the Office of Graduate Studies website.

### **Expected Student Performance**

Graduate students are expected to make satisfactory progress in course work and research activities at all times. The Graduate College has the following scholarship requirements that must be satisfied to receive graduate credit:

1. A minimum grade of B is required in all 800-level courses within the core curriculum.
2. A minimum grade of C or P (pass) is required for 800-level courses in the student's minor, collateral, or supporting areas of work.
3. A minimum grade of C or P (pass) is required for 900-level courses, or 800-level courses without 400-level counterparts, within the core curriculum.

In the event that the student's academic and/or research performance has been unsatisfactory, the major advisor will notify the student and Supervisory Committee and make recommendations for further action. Students who receive an unsatisfactory progress report may be permitted to continue, but their assistantship will not be renewed if their performance continues to be unsatisfactory during the next semester. Students who were originally admitted on a provisional basis and who receive an unsatisfactory rating will not be permitted to continue in the graduate program.

## **III. Review Criteria**

### **A. Centrality to UNL Role and Mission**

The proposed Biomedical Engineering PhD Program is consistent with the role and mission of the University of Nebraska - Lincoln as the sole provider of graduate engineering programs in this state: "The University of Nebraska provides extensive, comprehensive postsecondary education to Nebraska citizens through its four campuses: University of Nebraska-Lincoln, University of Nebraska at Omaha, University of Nebraska at Kearney, and University of Nebraska Medical Center.

This proposed degree will directly assist the College of Engineering and the University of Nebraska-Lincoln in meeting targets to grow our graduate student populations.

### **B. Relationship of the proposal to the NU Strategic Framework**

The proposed Biomedical Engineering PhD program is consistent with the NU strategic framework: "The University of Nebraska, through its four campuses, strives to be the best public university in the country—as measured by the impact we have on our people and our state, and through them, the world."

This proposed degree is also aligned with the University of Nebraska-Lincoln College of Engineering's goals to transform to better serve the State's engineering workforce and

technology-based economic development needs. This proposed degree will directly benefit Nebraska engineering industries.

**C. Consistency with the Comprehensive Statewide Plan for Post-Secondary Education**

According to the Comprehensive State-Wide Plan for Postsecondary Education (July 2016), "UNL is the primary doctoral degree granting public institution in the state for fields outside the health professions." Given that UNL's College of Engineering is the sole engineering postsecondary degree granting institution in the state, the proposed Biomedical Engineering PhD program is consistent with this statement.

The proposed Biomedical Engineering PhD program meets the goals of the Comprehensive Statewide Plan for Postsecondary Education (the Statewide Plan). It meets the needs of students for high-quality educational programs that help them reach their career goals. Students in this program will be educated in advanced aspects of biomedical engineering that are in particular demand in Nebraska and across the Country.

**A. Evidence of Need and Demand**

1. Need:

According to the American Society for Engineering Education, graduate biomedical engineering program enrollments in the U.S. have risen from approximately 6,800 students in 2006 to roughly 10,000 in 2015. There are at least 78 programs nationwide offering a PhD in Biomedical Engineering; there are relatively few in the Midwest. North Dakota, South Dakota, Kansas, Colorado, New Mexico, Wyoming, Montana, and Missouri do not have programs leading to a PhD in Biomedical Engineering, although the University of Oklahoma started one in the year 2000, University of Iowa has had such a program since 1986, and University of Minnesota's program started in 1972. Colorado State has an interdisciplinary studies specialization in Biomedical Engineering started in 1999.

The employment opportunities for biomedical engineers seem strong. In 2011, the Bureau of Labor Statistics list of fastest growing occupations listed Biomedical Engineering as number one. The report, explained in a New York Times article, indicated a perceived 72% growth in BME positions (or 12,000 new jobs) by 2012. This information is in line with a similar report from the BoL in 2009, which noted the aging of the population, and a growing focus on health issues will drive demand for better medical devices and equipment designed by biomedical engineers. Along with the demand for more sophisticated medical equipment and procedures, an increased concern for cost-effectiveness will boost demand for biomedical engineers, particularly in pharmaceutical manufacturing and related industries. Median annual earnings of biomedical engineers were \$88,550 in the 2018 report, up from \$82,550 in 2011.

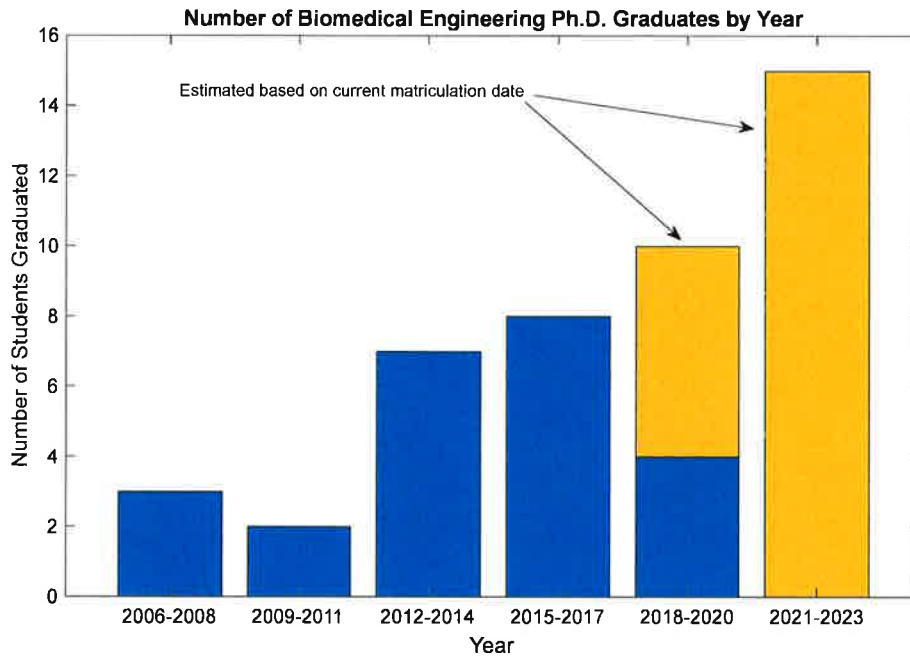
2. Demand:

As stated earlier, the undergraduate Biomedical Engineering option within the Biological Systems Engineering department currently enrolls roughly 130 students. Of the students who graduate within the Biomedical Engineering emphasis, approximately two-thirds go on to attend graduate school or medical school. Many attend graduate school at other universities since we do not have a PhD in Biomedical Engineering.

The Biomedical Engineering specialization in the Unified PhD in Engineering has now graduated 25 PhD students who have successfully moved on to academia and industry careers (Table 4). In addition, there are currently 25 PhD students enrolled in the specialization. The number of

applications to the specialization and enrolled students continues to grow, and we expect this growth to continue for some time.

**TABLE 4: BIOMEDICAL ENGINEERING GRADUATION DATA**



**D. Avoidance of Unnecessary Duplication**

The Biomedical Engineering PhD program currently offered at the University of Nebraska-Lincoln is a specialization in the Unified PhD program and this program will supplant that. It does not duplicate Biomechanics at UNO, which does not offer a PhD, only a M.S., and constitutes study of the forces that act on a body and the effects they produce. Biomedical Engineering focuses on solving medical problems using engineering skills. There are no PhD programs at UNMC whose foci demonstrate some level of duplication. Also, potential licensure of engineers in the State of Nebraska ensures avoidance of unnecessary duplication.

While there are at least 78 programs nationwide offering a PhD in Biomedical Engineering, there are relatively few in the Midwest. North Dakota, South Dakota, Kansas, Colorado, New Mexico, Wyoming, Montana, and Missouri do not have programs leading to a PhD in Biomedical Engineering, although the University of Oklahoma started one in the year 2000, University of Iowa has had such a program since 1986, and University of Minnesota's program started in 1972. Colorado State has an interdisciplinary studies specialization in Biomedical Engineering started in 1999.

**E. Adequacy of Resources:**

**1. Faculty/Staff**

As stated earlier, the University of Nebraska has made significant institutional investment in faculty who would support the Biomedical Engineering PhD program. The resources necessary to offer the proposed additional degree are already in place. No additional budgetary resources will be required to implement the proposed degree.

All the courses that will be required by the proposed degree are already being offered. This additional degree offering may increase enrollment in these classes, but not to a level that new sections will need to be offered for the planning period encompassed by this proposal.

The College of Engineering has an Associate Dean for Graduate and International Programs (Daniel Linzell) and two staff members (Graduate Program Director Kayla Person and Administrative Associate Cameron Adams) who currently support the specialization and would support the proposed program. A survey of graduate faculty interested in engaging with the program from UNL, UNO and UNMC elicited 33 names as listed in Table 5. Faculty program support would be via the Graduate Committee as discussed in Section II.

**TABLE 5: BIOMEDICAL ENGINEERING GRADUATE FACULTY**

<b>Faculty Name</b>	<b>Department/Campus</b>
Andrew Dudley	Genetics, Cell Biology and Anatomy/UNMC
Alexey Kamenskiy	College of Education/UNO
Angie Pannier	Biological Systems Engineering/UNL
Ben Terry	Mechanical and Materials Engineering/UNL
Bonita Sharif	Computer Science and Engineering/UNL
Carl Nelson	Mechanical and Materials Engineering/UNL
Deepak Keshwani	Biological Systems Engineering/UNL
Erica Ryherd	Durham School of Architectural Engineering and Construction/UNL
Fadi Alsaleem	Durham School of Architectural Engineering and Construction/UNL
Forrest Kievit	Biological Systems Engineering/UNL
Greg Bashford	Biological Systems Engineering/UNL
Hani Haider	Orthopedic Surgery and Rehabilitation/UNMC
Hasan Otu	Computer Science and Engineering/UNL
Jennifer Keshwani	Biological Systems Engineering/UNL
Josephine Lau	Durham School of Architectural Engineering and Construction/UNL
Juan Cui	Computer Science and Engineering/UNL
Jung Yul Lim	Mechanical and Materials Engineering/UNL
Khalid Sayood	Electrical and Computing Engineering/UNL
Mark Beatty	Department of Adult Restorative Dentistry/UNMC
Massimiliano Pierobon	Computer Science and Engineering/UNL
Michael P Sealy	Mechanical and Materials Engineering/UNL
Nicole Iverson	Biological Systems Engineering/UNL
Nick Stergiou	College of Education/UNO
Rebecca Wachs	Biological Systems Engineering/UNL
Ruiguo Yang	Mechanical and Materials Engineering/UNL
Ryan Pedrigi	Mechanical and Materials Engineering/UNL
Sangjin Ryu	Mechanical and Materials Engineering/UNL
Shane Farritor	Mechanical and Materials Engineering/UNL
Shudipto Dishari	Chemical and Biomolecular Engineering/UNL
Sri Kidambi	Chemical and Biomolecular Engineering/UNL
Yuguo Lei	Chemical and Biomolecular Engineering/UNL
Yinying Wang	Special Education and Communication Disorders/UNL

## 2. Library/Information Resources

Current library resources are adequate to support this proposed degree program. No additional instructional equipment or informational resource needs are anticipated.

### 3. Physical Facilities and Equipment

Classrooms on the Lincoln campus are located in Scott Engineering Center, Hardin Hall, Nebraska Hall and Othmer Hall. Classrooms are distributed throughout the buildings and range in size from 20 to 110 seats. On the Scott campus in Omaha, classrooms are located in the Peter Kiewit Institute and Scott Technology Center and range in size from 20 to 64 seats.

Each faculty member listed in Table 5 maintains physical laboratory spaces in Lincoln and Omaha that can be used for laboratory-based graduate courses and for research.

### 4. Instructional Equipment and Informational Resources

Associated equipment typically available in classrooms includes LCD projectors, projector screens, PCs, white boards, document camera units, connection for portable computers, tables and chairs, overhead projectors, and laptop computers. Each classroom is equipped with a wireless network, including Internet access.

The Lincoln and Omaha engineering campuses are connected via video conferencing equipment. There are currently six distance education classrooms on the Lincoln campus and three on the Omaha campus. These classrooms are supported and maintained by the CoE Learning Spaces Project Manager with additional support provided by the IT staff and student workers.

### 5. Budget Projections

Currently, we do not expect additional funds will be required to support this program, as we can deliver the program with existing faculty, staff, and courses (CCPE Table 1).

Revenue projections are based on attracting 10 new students to UNL in total to the program to join the existing 25 current students in the PhD Biomedical Engineering specialization in the Unified PhD program who would move to the stand-alone PhD program once approved. The total enrollment capacity of the Biomedical Engineering PhD program is 35 students, without additional faculty and resources.

CCPE Table 2 shows gross tuition revenue for the 10 new students which is predicted to be in place by Year 2 of the program, in 2022-23. The total gross tuition revenue associated with 10 new students, using the College of Engineering historic distribution of resident and non-resident graduate students would be \$685,788.

Understandably, doctoral students in this type of program will likely be on graduate assistantships with the benefit of full tuition waivers. The College plans to support the tuition waiver benefit up to \$15,000 per new student from externally funded research. We are conservatively assuming no revenue increases, either based on tuition rates or increased research activity, will occur during the first five years of the program. This means that with an anticipated new enrollment of 10 PhD students per year, the program will generate \$600,000 in funded tuition waivers (remission) over the next five years (Table 6).

**Table 6: TUITION WAIVERS SUPPORTED BY EXTERNAL GRANTS**

	FY(22) Year 1	(FY23) Year 2	(FY24) Year 3	(FY25) Year 4	(FY26) Year 5	<b>Total</b>
Tuition Waivers (Remission) Offset <sup>1</sup>	\$0	\$150,000	\$150,000	\$150,000	\$150,000	\$600,000
Total Revenue	\$0	\$150,000	\$150,000	\$150,000	\$150,000	\$600,000

<sup>1</sup>Tuition only. Estimated annual tuition waivers (remission) offset through external research funding of \$15,000/student. Estimating 10 enrolled students beginning in FY23.

## IV. Appendices

- A. Abstract of Proposal
- B. Letters of Support
- C. Faculty CVs (available upon request)

## Appendix A: Abstract of Proposal

Biomedical engineering (BME) is one of the most rapidly expanding areas of engineering education, research, and job growth in the U.S. UNL has the only engineering graduate and research programs in the state of Nebraska and successful BME undergraduate academic and graduate research activities. CoE faculty and graduate students actively and successfully collaborate with UNMC researchers at the Medical Center and with UNOs Biomechanics Department in this area.

We are seeking to add a stand-alone Biomedical Engineering PhD program to replace the specialization within the Unified Engineering PhD. This will provide a focal point for BME activities in the state, will reduce the current barriers to BME learning, and will provide the necessary framework to grow research and collaboration between engineers and the medical community.

We envision that formation of a BME PhD program in the College of Engineering that engages a vibrant coalition of engineers, scientists, clinicians and students in Nebraska will prominently place UNL on the landscape of BME graduate education and research institutions in the U.S. The program would use an interdisciplinary approach to develop skills employing engineering techniques to improve human health via understanding engineering and medical needs associated with important problems.

We see the day when the best students in the country will want to receive a PhD in BME through UNL, and, subsequently, when our doctoral program rivals those from the best institutions in the U.S. Our vision is that "Nebraska Biomedical Engineering improves the quality of human life," which was developed with the idea that leadership from UNL CoE and healthy collaborations with faculty from UNL, UNMC and UNO, when coupled with joint research projects involving UNMC, UNO, Creighton, Madonna, Bryan LGH, and companies such as Stanley Security Solutions and LICOR, will make us the center of BME education and research in the region. It is our belief that we can compete with leading national programs in the region such as Rice, Washington University, and the Universities of Iowa and Minnesota.

Coupled with the educational mission is a desire to complete preventative, acute and long-term health care research. We envision that the program will: (i) be known as a program of excellence in BME education; (ii) be nationally recognized for BME research; (iii) reflect the interdisciplinary nature of BME in our graduate teaching, research and outreach programs; and (iv) foster economic development and improve human health through technology transfer of new biomedical engineering developments.

Coupled with leveraging rapid growth in BME nationally, the proposed program will also leverage a successful and growing undergraduate BME track in Biological Systems Engineering, successful faculty and recent hires across the NU system whose expertise and success would directly enhance and benefit from the PhD program and existing, successful collaborations between UNL CoE, other UNL Colleges, UNMC and UNO to fulfill the vision and mission. We would expect it would be one of the larger PhD programs in CoE within a few years.

The proposed program is supported by a number of junior and faculty. The faculty are housed in multiple colleges at UNL and UNMC and Biomechanics Department at UNO.

## Appendix B: Letters of Support





January 21, 2021

University of Nebraska-Lincoln  
Academic Planning Committee

To Whom It May Concern –

We are writing this letter to express our support for the proposed standalone doctoral program in Biomedical Engineering and for our faculty who are participating in the program. Creation of a standalone doctoral program is essential to ensure that the College's and University's biomedical engineering efforts continue to thrive.

Faculty contributions to this graduate program, which has existed as a Specialization of the Engineering PhD program for two decades, are incorporated in annual evaluations the same way contributions to departmental programs are. The program itself does not have an evaluative role.

Sincerely,

*Jerry L. Hudgins*

\_\_\_\_\_  
Jerry L. Hudgins, Ph.D.  
Chair and Professor  
Department of Electrical and Computer Engineering

*David Jones*

\_\_\_\_\_  
David Jones, Ph.D.  
Department Head and Professor  
Department of Biological Systems Engineering

*Hossein Nouredini*

\_\_\_\_\_  
Hossein Nouredini, Ph.D.  
Chair and Professor  
Department of Chemical and Biomolecular Engineering



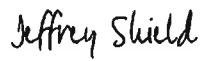
**College of Engineering**

114 Othmer Hall | P.O. Box 880642 | Lincoln, NE 68588-0642 | 402.472.3181 | FAX 402.472.7792  
1110 S. 67<sup>th</sup> St. | The Peter Kiewit Institute | Omaha, NE 68182-0176 | 402.554.6009 | FAX 402.554.2309  
engineering.unl.edu



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Jay Puckett, Ph.D.  
Director and Charles W. & Margre H. Durham Distinguished  
Professor of Engineering & Technology  
Durham School of Architectural Engineering and Construction



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Jeffrey Shield, Ph.D.  
Chair and Robert W. Brightfelt Professor  
Department of Mechanical and Materials Engineering



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Marilyn Wolf, Ph.D.  
Chair and Koch Professor of Engineering  
Department of Computer Science and Engineering

**DATE:** January 31, 2020

**FROM:** Daniel Linzell, Associate Dean for Graduate and International Programs



**TO:** Tim Carr, Associate Vice Chancellor and Dean of Graduate Education

**SUBJ:** Biomedical Engineering (BME) Ph.D. Program Proposal

**CC:** Lance Perez, Greg Bashford

I am writing to inform you the proposal referenced above was unanimously supported by College of Engineering Graduate Chairs at their 1/31/2020 meeting. I also support the proposal on behalf of the College of Engineering.

Enclosures: BME Ph.D. proposal

January 9, 2020

**DATE:** February 3,  
2020

**FROM:** Ron Nelson, Ph.D., Interim Chair of the Department of Special Education and  
Communication Disorders

**TO:** Tim Carr, Associate Vice Chancellor and Dean of Graduate  
Education

**SUBJ:** Biomedical Engineering (BME) Ph.D. Program Proposal

**CC:** Daniel Linzell, Lance Perez, Greg Bashford

I am writing to inform you that I support the proposal on behalf of Department of Special  
Education and Communication Disorders.

February 10, 2020

TO: Tim Carr, Associate Vice Chancellor and Dean of Graduate Education

SUBJECT: Biomedical Engineering (BME) Ph.D. Program Proposal

CC: Dan Linzell, Lance Perez, Greg Bashford

Dear Dr. Carr,

I am writing to inform you that I support the proposal on behalf of Dr. Andrew Dudley.

Sincerely,

A handwritten signature in blue ink that reads "Vimla Band". The signature is written in a cursive style and is underlined with a single horizontal line.

Vimla Band, PhD  
Ardith and Anna Von Housen Professor and Chair  
Department of Genetics, Cell Biology and Anatomy  
Associate Director of Center for Breast Cancer Research  
UNMC-Eppley Cancer Center  
University of Nebraska Medical Center  
Phone: (402) 559-8565  
Email: [vband@unmc.edu](mailto:vband@unmc.edu)

**TO:** Tim Carr, Associate Vice Chancellor and Dean of Graduate Education

**FROM:** Dr. Steven E. Haas, DMD, JD, MBA  
Interim Department Chair, Adult Restorative Dentistry

**DATE:** February 3, 2020

**RE:** Biomedical Engineering (BME) Ph.D. Program Proposal

**CC:** Daniel Linzell, Lance Perez, Greg Bashford

I am writing to inform you that I support the proposal on behalf of Mark Beatty, DDS, MSE, MSD, MS.

A handwritten signature in black ink, appearing to read "Steven E. Haas DMD, JD, MBA". The signature is written in a cursive, somewhat stylized font.

**DATE:** February 4, 2020

**FROM:** David W. Mercer, M.D.; McLaughlin Professor and Chairman, Department of Surgery  
University of Nebraska Medical Center

**TO:** Timothy Carr, Ph.D.; Associate Vice Chancellor and Dean of Graduate Education  
University of Nebraska – Lincoln

**SUBJ:** Biomedical Engineering (BME) Ph.D. Program Proposal

**CC:** Daniel Linzell, Ph.D.; Lance C. Pérez, Ph.D.; Greg Bashford, Ph.D.

Dear Dr. Carr,

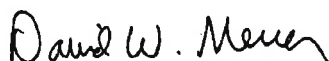
It is my pleasure to inform you and the rest of your team that I am in full support of Alexey Kamenskiy, Ph.D., who has expressed an interest in being part of the Graduate Faculty affiliated with your program.

As Chairman of the Department of Surgery at the University of Nebraska Medical Center (UNMC), we had the good fortune to work closely with Dr. Alexey Kamenskiy when we recruited him from the University of Nebraska – Lincoln (UNL) to work alongside Jason MacTaggart, M.D. That relationship was incredibly fruitful and led to funding of several NIH grant proposals. He rapidly rose through the ranks in the College of Medicine, being promoted to Associate Professor in 2017, and was granted tenure in July of 2019. Dr. Kamenskiy had adjunct appointments in the Department of Mechanical & Material Engineering at UNL and in the Department of Biomechanics at the University of Nebraska – Omaha (UNO). He was recruited to UNO in August of 2019, but continues to have a faculty appointment here and maintains a working relationship with Dr. MacTaggart.

It is noteworthy that Dr. Kamenskiy developed a new graduate course that is offered at UNO and UNL, Vascular Mechanobiology, which was developed in the spring of 2016 and represents a 3 credit hour graduate-level course. In addition, Dr. Kamenskiy has mentored more than 20 medical students, 7 undergraduate students, and 8 graduate students from the U.S. and abroad. He was also the advisor for several Ph.D. students, postdoctoral students, and general surgery residents within the Department of Surgery at UNMC. Working with Dr. MacTaggart, Dr. Kamenskiy obtained over \$5 million dollars in extramural funding and obtained over \$700 thousand dollars as a Co-PI. Prior to leaving, he had filed over 10 patents and received a number of awards for his work. These include, but are not limited to, Recognition of Service Award (2017), the New Investigator Award (2015), and the Most Promising Invention (2013-2014) at UNMC. He is well published and is recognized nationally and internationally in his research area.

In summary, I highly recommend Dr. Alexey Kamenskiy to become part of the Graduate Faculty affiliated with the Biomedical Engineering Program. If there are any questions regarding this outstanding individual, do not hesitate to call.

Sincerely yours,



David W. Mercer, M.D.  
McLaughlin Professor and Chairman

February 4, 2020

FROM: Dr. Nick Stergiou  
University of Nebraska at Omaha  
Biomechanics Research Building, 214  
Omaha NE, 68182

TO: Tim Carr, Associate Vice Chancellor and Dean of Graduate Education

RE: Biomedical Engineering (BME) Ph.D. Program Proposal

CC: Daniel Linzell, Lance Perez, Greg Bashford

I am writing to inform you that I support the proposal on behalf of the Biomedical Engineering (BME) Ph.D. program proposal.

Sincerely,



**Prof. Dr. N. Stergiou (Nick)**

Assistant Dean and Director of the Division of Biomechanics and Research Development, University of Nebraska at Omaha  
Distinguished Community Research Professor and Founding Chair, Department of Biomechanics, University of Nebraska at Omaha  
Director, Center for Research in Human Movement Variability (MOVCENTR), University of Nebraska at Omaha  
Professor, Department of Environmental Agricultural and Occupational Health, University of Nebraska Medical Center  
President-Elect, American Society of Biomechanics





**ORTHOPAEDIC ACADEMIC FACULTY**

**ADULT RECONSTRUCTION SURGERY**

Kevin L. Garvin, M.D., Chairman  
Curtis W. Hartman, M.D.  
Beau J. Kildow, M.D.  
Beau S. Konigsberg, M.D.

**ADULT SPINE SURGERY**

Chris A. Cornett, M.D., Vice Chair of Clinical Services  
Scott A. Vincent, M.D.

**BIOMECHANICS & ADVANCED SURGICAL TECHNOLOGIES LABORATORY**

Hani Haider, Ph.D., Director

**FOOT & ANKLE SURGERY**

Alexander B. Sawatzke, M.D.

**HAND, WRIST & MICROVASCULAR SURGERY**

Daniel E. Firestone, M.D.  
Joseph A. Morgan, M.D.  
Philipp N. Streubel, M.D.

**MUSCULOSKELETAL ONCOLOGY**

Sean V. McGarry, M.D.

**ORTHOPAEDIC TRAUMATOLOGY &**

**LOWER EXTREMITY**

Sara M. Putnam, M.D.  
Matthew A. Mormino, M.D., Program Director  
and Vice Chair of Education  
Justin C. Siebler, M.D.

**PEDIATRIC ORTHOPAEDIC & SPINE SURGERY**

Paul W. Esposito, M.D.  
Matthew A. Halanski, M.D., Vice Chair of Research  
Brian P. Hasley, M.D.  
Ryan J. Koehler, M.D.  
Nicholas J. Nahm, M.D.  
Susan A. Scherl, M.D.  
Maegen J. Wallace, M.D.  
Walter W. Huurman, M.D., Professor Emeritus

**SPORTS MEDICINE &**

**ARTHROSCOPIC SURGERY**

Katie L. Freeman, M.D.  
Matthew A. Tao, M.D.

**SHOULDER & ELBOW SURGERY**

Philipp N. Streubel, M.D.  
Matthew J. Teusink, M.D.

**ADJUNCT FACULTY**

Kenneth W. Bayles, Ph.D.  
Julia A. Bridge, M.D.  
Paul D. Fey, Ph.D.  
Angela L. Hewlett, M.D.  
Steven H. Hinrichs, M.D.  
Tammy L. Kielian, Ph.D.  
Mark E. Rupp, M.D.  
Elizabeth Wellsandt, Ph.D.

**ADMINISTRATIVE DIRECTOR**

Julie A Zetterman, M.B.A.

**Date:** February 10, 2020  
**To:** Tim Carr, Associate Vice Chancellor and Dean of Graduate Education  
**From:** Kevin L. Garvin, M.D. *Kevin L. Garvin*  
L. Thomas Hood, M.D., Professor  
**Subject:** Hani Haider, Ph.D., Professor  
Biomedical Engineering (BME) Ph.D. Program Proposal

I am writing in support of the proposed renewal of the Biomedical Ph.D. Program. One of our faculty, Dr. Hani Haider, is an engineer and was among the founders who conceived of this course years ago and worked with the University of Nebraska-Omaha to create it. Since then, the course has done well, and serves the collaborative work needed for teaching and innovation research work across our university.

In March of 2000, we were fortunate to attract Dr. Haider as Director of our Orthopaedic Biomechanics and Advanced Surgical Technologies Laboratory. Dr. Haider is an extremely talented researcher and has brought great enthusiasm to our research team and has maintained that enthusiasm with a high level of productivity. Dr. Haider's outstanding research and scholarly activity, especially in the areas of orthopaedic implant technology and biomechanics has brought prestige to the Department of Orthopaedic Surgery and to the University of Nebraska. The Biomedical Engineering PhD program is a good conduit to supply fresh potential research talent for our lab, and others across UNMC and other campuses.

It is therefore with great pleasure that I continue to support Dr. Haider's and our Department participation in the University of Nebraska's Biomedical Engineering Ph.D. program.

**CC:** Daniel Linzell, Lance Perez, Greg Bashford



Department of Orthopaedic Surgery  
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**TABLE 1: PROJECTED EXPENSES - NEW INSTRUCTIONAL PROGRAM  
UNL PhD in Biomedical Engineering**

	(FY2022) Year 1		(FY2023) Year 2		(FY2024) Year 3		(FY2025) Year 4		(FY2026) Year 5		Total Cost
	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost	
<b>Personnel</b>											
Faculty											
Professional											
Graduate Assistants											
Support Staff											
Subtotal	0.0	\$0	0.0	\$0	0.0	\$0	0.0	\$0	0.0	\$0	\$0
<b>Operating</b>											
General Operating		\$0		\$0		\$0		\$0		\$0	\$0
Equipment											
New or renovated space											
Library/Information Resources											
Subtotal		\$0		\$0		\$0		\$0		\$0	\$0
<b>Total Expenses</b>		\$0		\$0		\$0		\$0		\$0	\$0

**TABLE 2: PROJECTED REVENUES - NEW INSTRUCTIONAL PROGRAM  
UNL PhD Biomedical Engineering**

	(FY2022) Year 1		(FY2023) Year 2		(FY2024) Year 3		(FY2025) Year 4		(FY2026) Year 5		Total
Reallocation of Existing Funds											
Required New Public Funds											
1. State Funds											
2. Local Tax Funds (community colleges)											
Tuition and Fees <sup>1</sup>		\$0		\$171,447		\$171,447		\$171,447		\$171,447	\$685,788
Other Funding											
<b>Total Revenue</b>		\$0		\$171,447		\$171,447		\$171,447		\$171,447	\$685,788

<sup>1</sup> Gross tuition only. Estimating 10 new enrolled students each year beginning in FY23, 40.9% resident and 59.1% non-resident (using the College of Engineering historic percentage of resident and non-resident graduate students).

Student Type	(FY2022) Year 1		(FY2023) Year 2		(FY2024) Year 3		(FY2025) Year 4		(FY2026) Year 5	
	R	NR	R	NR	R	NR	R	NR	R	NR
Est. Tuition per student	\$8,496	\$23,130	\$8,496	\$23,130	\$8,496	\$23,130	\$8,496	\$23,130	\$8,496	\$23,130
Est. Total Enrollment in Major	25		25		25		25		25	
Est. Total New Students in Major	0		10		10		10		10	
Est. New Enrollment - Student Type	0	0	4	6	4	6	4	6	4	6
Est. New Tuition & Fees	\$0	\$0	\$34,749	\$136,698	\$34,749	\$136,698	\$34,749	\$136,698	\$34,749	\$136,698
Est. New Tuition & Fees	\$0		\$171,447		\$171,447		\$171,447		\$171,447	
<b>Est. New Total Tuition &amp; Fees</b>					<b>\$685,788</b>					