

: NEURAL ENGINEERING, BS

In Workflow

1. U Program Review (dforgacs@illinois.edu; eastuby@illinois.edu; aledward@illinois.edu)
2. 1343 Head (maa@illinois.edu; gunderhi@illinois.edu; smi@illinois.edu)
3. KP Committee Chair (bsnewell@illinois.edu; kcp@illinois.edu; jmakela@illinois.edu)
4. KP Dean (candyd@illinois.edu)
5. University Librarian (jpwilkin@illinois.edu)
6. Provost (kmartens@illinois.edu)
7. Senate EPC (bjlehman@illinois.edu; moorhouz@illinois.edu; kmartens@illinois.edu)
8. Senate (jtempel@illinois.edu)
9. U Senate Conf (none)
10. Board of Trustees (none)
11. IBHE (none)
12. HLC (kmartens@illinois.edu)
13. DMI (eastuby@illinois.edu; aledward@illinois.edu; dforgacs@illinois.edu)

Approval Path

1. Fri, 26 Mar 2021 13:24:09 GMT
Deb Forgacs (dforgacs): Approved for U Program Review
2. Fri, 26 Mar 2021 13:49:04 GMT
Mark Anastasio (maa): Approved for 1343 Head
3. Tue, 20 Apr 2021 18:35:24 GMT
Brooke Newell (bsnewell): Approved for KP Committee Chair
4. Tue, 20 Apr 2021 18:40:03 GMT
Candy Deaville (candyd): Approved for KP Dean
5. Tue, 20 Apr 2021 18:44:14 GMT
John Wilkin (jpwilkin): Rollback to KP Dean for University Librarian
6. Tue, 20 Apr 2021 18:48:03 GMT
Candy Deaville (candyd): Approved for KP Dean
7. Tue, 20 Apr 2021 19:42:40 GMT
John Wilkin (jpwilkin): Rollback to KP Dean for University Librarian
8. Tue, 20 Apr 2021 19:52:17 GMT
Brooke Newell (bsnewell): Rollback to KP Committee Chair for KP Dean
9. Tue, 20 Apr 2021 19:52:55 GMT
Brooke Newell (bsnewell): Approved for KP Committee Chair
10. Tue, 20 Apr 2021 19:53:07 GMT
Brooke Newell (bsnewell): Approved for KP Dean
11. Tue, 20 Apr 2021 19:53:40 GMT
John Wilkin (jpwilkin): Approved for University Librarian
12. Tue, 20 Apr 2021 20:15:18 GMT
Kathy Martensen (kmartens): Approved for Provost

New Proposal

Date Submitted: Fri, 26 Mar 2021 13:21:49 GMT

Viewing:: Neural Engineering, BS

Changes proposed by: Maddie Darling

Proposal Type

Proposal Type:

Major (ex. Special Education)

Proposal Title:

If this proposal is one piece of a multi-element change please include the other impacted programs here. *example: A BS revision with multiple concentration revisions*

Establish a major in Neural Engineering within the Bachelor of Science degree in the Grainger College of Engineering.

EP Control Number

EP.21.135

Official Program Name

Neural Engineering, BS

Effective Catalog Term

Fall 2022

Sponsor College

Grainger College of Engineering

Sponsor Department

Bioengineering

Sponsor Name

Mark A. Anastasio, Donald Biggar Willett Professor in Engineering, Head of Department of Bioengineering

Sponsor Email

maa@illinois.edu

College Contact

Jonathan Makela, Associate Dean for Undergraduate Programs, Grainger College of Engineering

College Contact Email

jmakela@illinois.edu

Program Description and Justification

Provide *abrief* description and justification of the program, including highlights of the program objectives, and the careers, occupations, or further educational opportunities for which the program will prepare graduates, when appropriate.

Neural engineering is a large and rapidly growing discipline in which engineering principles are applied to the design of technologies to repair and enhance the function of the nervous system. The Bachelor of Science (B.S.) degree in Neural Engineering (NE) seeks to provide a rigorous and focused

training at the intersection of neuroscience and engineering fundamentals. This degree program is expected to be completed in eight semesters of full-time studies and will be offered by the Bioengineering department (BIOE) in the Grainger College of Engineering (Grainger Engineering). The proposed program will be distinguished by attributes that are not available together in any individual degree program in the UI System, in the state of Illinois, or in the nation, including 1) an introduction to and an immersion in fundamentals of neuroscience, 2) integrated skill development in electrical and imaging systems, molecular and cellular engineering, biological interfacing, and computational data sciences, and 3) coursework framed around the application of design principles to solve modern problems in basic and translational neuroscience.

The 21st Century has been dubbed the “Century of the Brain” [1] with the expectation that the pursuit of an understanding of the function of the human nervous system will be a defining scientific and industrial endeavor over the forthcoming decades. Scientific efforts in neuroscience are becoming increasingly ambitious due to revolutionary advances in brain-machine interfaces, noninvasive functional neuroimaging, and high-resolution brain mapping, together with an increasing precision with which neuromodulatory stimuli and molecular and cellular technologies can be applied to control brain function. Large-scale basic research efforts are currently underway, supported by the National Institutes of Health BRAIN Initiative and Human Connectome Project, as well as the European Union Human Brain Project, while new companies such as Neuralink are inspiring curiosity from the next generation of STEM trainees. Simultaneously, there is an urgent need to translate research findings in neuroscience to clinical interventions due to the increasingly deleterious impact of neurological and psychiatric disorders on the worldwide population and the U.S. healthcare system, compounded by unsolved problems in clinical pain management and addiction. Modern western medicine has not succeeded in addressing these ailments in the same way as the leading causes of death, such as cancer and heart disease. For example, since 2000, the number of deaths due to Alzheimer’s disease has increased 146%, while deaths due to heart disease have decreased 7.8% [2].

We anticipate that the nation’s first NE B.S. degree program will be best suited to build from momentum created by broad interest in bioengineering, which has experienced 20 years of 10% average annual growth in enrollment nationwide to become the 6th most popular engineering degree program, and with the most demographically diverse students in engineering. It is natural that Illinois, as a world leader in bioengineering, electrical and computer engineering and artificial intelligence, should seize the opportunity to conceive the definitive educational modalities for training across the living and synthetic counterparts of signal processing and intelligent systems. Importantly, the depth of complexity of neural systems cannot be adequately addressed through current training programs in general bioengineering (even with curricular specialization), as neural engineering approaches require: (1) technological design thinking that is distinct from broader biological applications, focusing on interfacial bioelectric materials for information processing with computational algorithms that match the complexity of natural intelligent systems, and (2) foundational knowledge in basic neuroscience and neuroanatomy. For a program in neural engineering to succeed, it is also necessary to rapidly and continuously adapt course materials and content to match the pace of the field, which is already standard practice pursued by faculty in BIOE. Currently, 8 faculty members work actively in research directly relevant to core content of the proposed NE degree program, with 8 faculty specifically specializing in computational and systems engineering, while 10 work in molecular and cellular engineering.

Students receiving a NE B.S. degree will be uniquely trained in both neurosciences and quantitative sciences, will be skilled in the design and advancement of electrical and bio-interfacial devices, including brain-computer interfaces, neuroimaging systems, and neurostimulation devices. They will also be competent in analytical and computational approaches necessary for their function and use, and will possess a detailed mechanistic understanding of the molecular and cellular technologies used to modulate nervous system function. Graduates will thus be well positioned to pursue professional degree programs in medicine and graduate studies in the life and behavioral sciences, as well as diverse engineering disciplines. They will also be equally prepared to enter industry as engineers, particularly in healthcare sectors to immediately impact the nascent fields of neural prosthetics and rehabilitative and assistive robotics, and to work in research and development as well as clinical implementation. The strong industrial growth supporting the long-term availability and expansion of such positions is described in Market Demand. We further anticipate strong breadth of knowledge for NE B.S. recipients due to cohesive cocurricular experiences with a new Neuroscience B.S. program, the BIOE B.S. program, and the M.D. program through the Carle Illinois College of Medicine. The NE B.S. program is expected to attract a wide range of students who may have otherwise applied to programs in the natural or behavioral sciences, in addition to attracting new student interest across the nation, as no other campus currently offers such a degree program.

References

[1] Yuste R. & Church G. M., Technologies for Hacking the Brain, *Scientific American* 310, 3: 38-45 (March 2014) doi:10.1038/scientificamerican0314-38.

[2] 2020 Alzheimer’s disease facts and figures. *Alzheimers Dement.* 2020 Mar 10. doi: 10.1002/alz.12068. Epub ahead of print. PMID: 32157811.

Corresponding Degree

BS Bachelor of Science

Is this program interdisciplinary?

No

Academic Level

Undergraduate

Will you admit to the concentration directly?

No

Is a concentration required for graduation?

No

CIP Code

140501 - Bioengineering and Biomedical Engineering.

Is This a Teacher Certification Program?

No

Will specialized accreditation be sought for this program?

Yes

Describe the plans for seeking specialized accreditation:

ABET accreditation will ultimately be sought for this program following the graduation of the first cohort of students. When mapped to the bioengineering/biomedical engineering B.S. ABET criteria, the proposed curriculum satisfies criteria including engineering course hours.

Institutional Context

University of Illinois at Urbana-Champaign

Describe the historical and university context of the program's development. Include a short summary of any existing program(s) upon which this program will be built.

Explain the nature and degree of overlap with existing programs and, if such overlap exists, document consultation with the impacted program's home department(s).

The Urbana-Champaign campus is home to strengths in both engineering and neuroscience, with both broadly disseminated across campus units and departments. It is appropriate for the BIOE department to serve as the functional home for a training program at the intersection of the two disciplines, as research and training experiences have long been spearheaded and led across this interface by BIOE faculty, including initiatives and enterprises such as the Emergent Behaviors of Integrated Cellular Systems (EBICS) NSF Technology Center and REU Program, the Beckman Institute Biomedical Imaging Center, and the NSF Frontiers in Biomedical Imaging REU Program. In addition to core faculty specializing in particular in the area of neural imaging, neural data analysis and neural cellular and tissue engineering, BIOE faculty further have long-standing collaborations with faculty campus-wide with interests in neural, cognitive, and behavioral sciences in the School of Molecular and Cellular Biology (MCB), Veterinary Medicine, and Psychology, and likewise collaborate with faculty across Electrical and Computer Engineering (ECE) and Computer Science who develop technologies for neural interfacing and artificial intelligence. Eight BIOE faculty are appointed in the Carle Illinois College of Medicine, which shares a temporary home with BIOE in Everitt Laboratory, which is also permanent home to the Jump Simulation Center that allows realistic medical training experiences for medical students. Further, Neurotechnologies is a Major Thrust in the recently finalized Strategic Vision 2030 for the Holonyak Micro and Nanotechnology Laboratory (HMNTL), in which 4 BIOE faculty belong as core faculty.

The BIOE department currently offers a B.S., M.S., M.Eng., and Ph.D. in bioengineering, for which core and elective courses cover basic engineering principles relevant to the NE B.S. program. Our campus also offers a B.S. in Brain & Cognitive Science through the department of Psychology, and a Ph.D. in Neuroscience through the College of Liberal Arts & Sciences (LAS). Additionally, MCB is currently developing an undergraduate degree program in Neuroscience which is expected to share courses with the NE B.S. program. Cross-College support discussions between Grainger Engineering and LAS have been ongoing for nearly two years to build the program proposal that is described herein and to ensure that goals of the distinct programs are complementary, sustainable, and functionally independent in management. The NE B.S. program will build on the existing B.S. in BIOE to adopt three existing courses which have been deemed to be sufficiently scalable to meet the needs of a larger student population. Compared with the degree programs in Neuroscience and Brain & Cognitive Sciences, students in the NE program will develop skills in device design, molecular and cellular engineering, and as well as quantitative and computational data analysis. Compared with students pursuing degrees in BIOE, Computer Science, and ECE, NE students will gain in-depth, integrated, and comprehensive knowledge of neurobiology, biological interfaces, and human conditions relevant to clinical neuroscience.

University of Illinois

Briefly describe how this program will support the University's mission, focus and/or current priorities. Demonstrate the program's consistency with and centrality to that mission.

The proposed degree program will support the strategic initiatives of the university and Grainger Engineering. Foremost the program addresses the mission to be a pre-eminent public research university through the development of the nation's first undergraduate program in NE, which is expected to garner nationwide attention from students, researchers, clinicians, industry, and media. Being the first in its class will provide to us distinctions as leaders and innovators, and affording the responsibility to define the training aspects of the discipline. We expect the program to further catalyze the development of campus research initiatives in neuroscience and related disciplines which will remain at the cutting edge of life sciences and engineering for decades to come. For students, the degree will provide a transformative learning experience at the interface of engineering and neuroscience that is not available at any level at present on campus. With our strategic mission to have global impact, we will develop technologies focused on medical challenges associated with neurological and psychiatric disorders, neurotrauma, addiction, and pain, focus areas with a global impact that will become increasingly important with our aging population and increasing prevalence of these disorders. To address our land grant mission, we will particularly strengthen technical education for the people of the state of Illinois by providing cutting-edge interdisciplinary skills and knowledge, which can serve to fuel economic growth within the state.

Neural engineering is an area that is aligned with many current priorities of Grainger Engineering and the university. Directly relevant campus or college initiatives include:

- a) The Carle Illinois College of Medicine
- b) Health Care Engineering Systems Center
- c) Mayo Clinic & Illinois Alliance
- d) Interdisciplinary Health Science Institute
- e) Discovery Partners Institute
- f) Holonyak Micro and Nanotechnology Laboratory

State of Illinois

Indicate which of the following goals of the Illinois Board of Higher Education's Strategic Initiative are supported by this program: (choose all that apply)

High Quality Credentials to Meet Economic Demand - Increase the number of high-quality post-secondary credentials to meet the demands of the economy and an increasingly global society.

Integration of Educational, Research and Innovation Assets - Better integrate Illinois' educational, research and innovation assets to meet economic needs of the state and its regions.

Describe how the proposed program supports these goals.

The growing societal impact and healthcare cost associated with neurological and psychiatric diseases has fueled the expansion of industry sectors focused on these market demands. However no engineering B.S. programs currently exist within the State of Illinois to meet the economic demand for trained personnel ready to contribute integrative engineering skills in these sectors. Students in the NE B.S. program will be trained to meet this need and to gain holistic skills for the application of engineering principles to the study, imaging, and modulation of intact neural systems in order to meet expanding demand in more broad healthcare sectors

Admission Requirements

Desired Effective Admissions Term

Fall 2023

Provide a brief narrative description of the admission requirements for this program. Where relevant, include information about licensure requirements, student background checks, GRE and TOEFL scores, and admission requirements for transfer students.

Application processing at the freshman level will be administered by the Office of Undergraduate Admissions, with requirements commensurate with standards of Grainger Engineering.

Admission Requirements for Freshmen:

- The general admission requirements of the University apply
- Application fee
- Self-reported academic record (SRAR)
- Official test scores - Standardized test scores are required for admission review: either ACT (code 1154) or SAT I (code 1836) scores are accepted
- English proficiency
 - o International students must score at least 100 on the iBT version of the English as a Foreign Language test (TOEFL); or 7 on each section of the IELTS.

For more detailed information regarding application requirements and the application process, please visit the University of Illinois Admissions website at: www.admissions.illinois.edu.

Admission Requirements for Inter-College/Department Transfer Students and Pre-Engineering Students (ICT/IDT/PREP)

- Students originating outside of the Grainger College of Engineering who entered the University of Illinois Urbana-Champaign as first time freshmen will be required to participate in the Pre-Engineering Program to be reviewed for transfer into Neural Engineering
- Pre-Engineering and current University students should demonstrate interest in the major by:
- Earning grades of "B" or better in introductory courses such as CHEM 102, 103; MATH 221, 231; PHYS 211; and MCB 150.
- Maintain a cumulative minimum GPA of 3.00 or higher
- Successfully complete the ICT or IDT transfer application

Describe how critical academic functions such as admissions and student advising are managed.

A program committee will be established to administer the NE B.S. program. This committee will consist of tenured and tenure-track faculty members in the Department of Bioengineering including affiliate members from across Grainger Engineering who are engaged in neural engineering research and instruction. This committee will be responsible for making curricular decisions and responsible for managing the day-to-day management aspects of the program. A Program Director will be appointed to chair this committee. The Program Director will be responsible for allocating advising duties and for developing best practices for advising. The Program Director will also be responsible for coordinating recruitment efforts and coordinating with Campus Undergraduate Admissions and Grainger Engineering for transfers. During the ramp-up phase of the program when enrollment is small, current BIOE staff will assist with student recruitment, course scheduling and articulations, student interactions, scholarships, transfers (agreements, criteria, and advising), registration, study abroad agreements, student exchanges and other day-to-day business of running the program. As enrollment increases, a new staff position will be created to serve as the primary point of program contact, particularly for student advising and operational aspects of the program.

Enrollment

Number of Students in Program (estimate)

Year One Estimate

5th Year Estimate (or when fully implemented)

160

Estimated Annual Number of Degrees Awarded

Year One Estimate

0

5th Year Estimate (or when fully implemented)

35

What is the matriculation term for this program?

Fall

What is the typical time to completion of this program?

4 years

What are the minimum Total Credit Hours required for this program?

128

Delivery Method

This program is available:

On Campus

Budget

Will the program or revision require staffing (faculty, advisors, etc.) beyond what is currently available?

Yes

Please explain/describe:

While many existing BIOE faculty members will contribute to delivering the new degree, there will be a need for additional faculty. Four additional tenure track faculty or two teaching track faculty, or some combination of the two, will be hired to ensure that the Department of Bioengineering maintains sufficient personnel to meet the needs of the new program and the anticipated growth of the existing degree programs within the department. Neural Engineering has previously been identified as a strategic area for research growth in the department. The hires to support the new NE degree will therefore be consistent with the planned expansion of the department. These hires will be forthcoming due to a commitment to Dr. Anastasio by Grainger Engineering as part of his recruitment as department head.

In addition to the new faculty hires, existing faculty in the Department of Bioengineering will contribute to the teaching needs of the program. Research track faculty Dr. Catherine Best and Dr. Yogatheesan Varatharajah will teach one course. Both have contributed to the development of this program and have teaching experience. The Department of Bioengineering will also be hiring in several other areas over the coming years. As new faculty join the department, this will permit the realignment of some of the teaching assignments of the existing neural engineering faculty to support the proposed degree program. As such, due to these available resources and the department of Bioengineering's commitment to invest in neural

engineering, the proposed degree program will receive the staffing needed for its success. In fact, the department has already begun faculty recruiting in areas that are directly relevant to the proposed program.

For the first two years, while the program is ramping up, we will leverage our existing staff to support the administrative needs of the program. In Year 3, using program revenue, we will hire a new staff position. This person will oversee student advising, recruitment, course scheduling, and other day-to-day business of running the program.

Resource Implications

Facilities

Will the program require new or additional facilities or significant improvements to already existing facilities?

No

Technology

Will the program need additional technology beyond what is currently available for the unit?

No

Non-Technical Resources

Will the program require additional supplies, services or equipment (non-technical)?

No

Resources

For each of these items, be sure to include in the response if the proposed new program or change will result in replacement of another program(s). If so, which program(s), what is the anticipated impact on faculty, students, and instructional resources? Please attach any letters of support/acknowledgement from faculty, students, and/or other impacted units as appropriate.

Faculty Resources

Please address the impact on faculty resources including any changes in numbers of faculty, class size, teaching loads, student-faculty ratios, etc. Describe how the unit will support student advising, including job placement and/or admission to advanced studies.

We intend to fill new tenure-track and/or teaching track faculty positions that can contribute to the teaching needs of the proposed program before the third year of the program. Additional details are described in the budget description. There will be no impact on teaching loads for any bioengineering faculty. As neural engineering is already a significant focus in the department of Bioengineering, the new courses developed for the program will be made available to students outside of the new program. The new courses will satisfy the teaching load requirements of the faculty in the manner as those contributing to the existing B.S., M.S., M.Eng. and Ph.D. courses within the department. Three current courses that are core components of the BIOE B.S. program will experience an increased enrollment (BIOE 205, 210, 310) as they are also core courses in the NE B.S. program. These courses have already been scaled from enrollment of approximately 30 up to 100 in recent years, and will only be moderately impacted by the increase to 135–145. If needed, multiple sections of these courses will be offered. Other elective courses currently offered by the department are expected to experience a modest and reasonable increase in enrollment (from ~25 to ~35) as they serve as NE elective courses. With the increase in total undergraduate enrollment from ~400 BIOE students in fall of 2021 to include 145 NE students by 2027, we expect to increase faculty by 4 (see Budget section), so that our student:faculty ratio will rise from 17 to 20, which is still near the Grainger Engineering average of 17.

The appointed Program Director will be responsible for allocating advising duties and for developing best practices for advising. A new staff position will be created to serve as the permanent student advisor by the end of the second year of the program offering. Engineering Career Services is expected to be the primary facilitator of job placement for Grainger Engineering students. It is anticipated that the first several cohorts will yield high matriculation to graduate programs, as was the case with the first 5 years of BIOE B.S. recipients. Advisement for graduate and professional school placement will be through Bioengineering faculty, with personalized faculty advising for which individual student career interests will be paired to those faculty most capable of offering depth of knowledge and opportunities.

Library Resources

Describe your proposal's impact on the University Library's resources, collections, and services. If necessary please consult with the appropriate disciplinary specialist within the University Library.

Current library resources, including collections and services, are sufficient to address the needs of this program revision.

Instructional Resources

Will there be any reduction in other course offerings, programs or concentrations by your department as a result of this new program/proposed change?

No

Does the program include other courses/subjects impacted by the creation/revision of this program?

Yes

Required courses

PSYC 100 - Intro Psych
MCB 150 - Molec & Cellular Basis of Life
MCB 250 - Molecular Genetics
MCB 252 - Cells, Tissues & Development
CHEM 102 - General Chemistry I
CHEM 103 - General Chemistry Lab I
CHEM 104 - General Chemistry II
CHEM 105 - General Chemistry Lab II
CHEM 232 - Elementary Organic Chemistry I
MATH 221 - Calculus I
MATH 231 - Calculus II
MATH 241 - Calculus III
MATH 285 - Intro Differential Equations
PHYS 211 - University Physics: Mechanics
PHYS 212 - University Physics: Elec & Mag
CS 101 - Intro Computing: Engrg & Sci
RHET 105 - Writing and Research
ECE 410 - Neural Circuits and Systems
ECE 421 - Neural Interface Engineering

Explain how the inclusion or removal of the courses/subjects listed above impacts the offering departments.

All required courses would see a potential influx of 35-40 additional students each year. Letters of support are attached; additional letters of support from departments offering elective courses for the NE degree are also included (MechSE).

Attach letters of support from other departments.

BioE-PSY MOU for Neural Engineering__011821 (003).pdf
Chem - LOS C Murphy.pdf
Physics- LOS M Grosse-Perdekamp.pdf
MechSE LOS T Jacoby.pdf
MCB - LOS M Bagchi.pdf
MATH - LOS J Tyson.pdf
English LOS RMarkley.pdf
CS - LOS N Amato_M Viswanathan.pdf
Revised_ECE LOS B Hajek.pdf

Financial Resources

How does the unit intend to financially support this proposal?

As described in the budget section, the unit will support the new degree through strategic hiring of faculty as supported by existing commitments from Grainger Engineering and initially leveraging existing administrative resources, including BIOE program staff serving other degree programs in the department. Only one new introductory course needs to be offered during the first two years of the program. With the third cohort of students, we will hire a staff position to support operational procedures of the program.

Will the unit need to seek campus or other external resources?

No

Are you seeking a change in the tuition rate or differential for this program?

Yes

If yes, please enter your college budget office contact information and have them contact provostbudget@illinois.edu for next steps.

We will be using the already established Engineering tuition differential rate.

Market Demand

What market indicators are driving this proposal? If similar programs exist in the state, describe how this program offers a unique opportunity for students:

Major driving forces motivating the development of a NE degree program include growth in industries that develop technologies directly related to the subject matter of the degree proposal, including neurological devices, brain-computer interfaces, neurological disease treatments, and brain imaging technologies. The world market for neurology devices, primarily devices for cerebrospinal fluid management, neurostimulation, and neurosurgery, is projected to grow annually at a rate of 8.1% to reach \$17.4 billion by 2026 [1]. A major factor in this anticipated growth is the increasing population of geriatric patients across the world and higher frequency of procedures that are minimally invasive. Brain-computer interfaces is expected to grow at an even faster pace of 15.5% per year, reaching \$3.3 billion by 2026 [2], with nearly half of sales in medical applications. The broader market for neurological disease treatments is growing at 6.2% per year, and expected to reach \$137 billion by 2026 [3], with growth driven in part due to diagnostic technology development. Neurosciences markets, of which the largest share is brain imaging, is projected to grow at 4.1% per year, reaching \$36.3 billion by 2025 [4]. We note that many of the technologies central to neural engineering (e.g. brain-computer interfaces, artificial intelligence) are integral to other rapidly growing industries (e.g. video gaming, robotics).

To our knowledge, there are no neural engineering undergraduate degree programs in the country, although neural engineering is a common specialization within existing bio(medical) engineering degree programs. Given the unique training made available to NE students, the rapid growth in related industries, the popularity of neuroscience degree programs, and new high-profile companies (e.g. Neuralink), immediate and sustained enrollment and student employment are anticipated.

References

- [1] <https://www.alliedmarketresearch.com/neurology-devices-market-A05956>
[2] <https://www.grandviewresearch.com/industry-analysis/brain-computer-interfaces-market>
[3] <https://www.credenceresearch.com/press/global-neurological-diseases-treatment-market>
[4] <https://www.mordorintelligence.com/industry-reports/neuroscience-market>

What type of employment outlook should these graduates expect? Explain how the program will meet the needs of regional and state employers, including any state agencies, industries, research centers, or other educational institutions that expressly encourage the program's development.

As indicated above by the market demand, the employment outlook for graduates of the proposed program is expected to be robust and to grow considerably. Primary employers in the state include the numerous large healthcare companies in the ChicagoLand area that develop products related to clinical neurological diseases (e.g. Abbott, Abbvie, Baxter) as well as smaller companies developing more specialized products (e.g. Icometrix, Emalex Biosciences, Seurat Therapeutics, AveXis). Appropriate entry-level positions for NE B.S. recipients recently advertised by these companies have titles that include "Engineer I," "Data Platform Engineer," and "Quality Engineer" [1]. Neuralink, which will likely set a precedent, currently advertises entry-level position availability for "Neuroengineers" [2], which may set a precedent for other companies. More broadly in the MidWest, a further breadth of companies include Medtronic, Siemens, and Stryker. We further anticipate students having broad employment opportunities as research scientists and engineers in both academic and medical labs, and working as clinical engineers in neurological and psychiatric practices. Students will also be prepared for larger industry positions across healthcare, including life sciences, biotechnology, and pharmaceuticals.

References

- [1] <https://www.builtinchicago.org/2020/08/18/biotech-companies-chicago>
[2] <https://neuralink.com/careers/>

What resources will be provided to assist students with job placement?

Engineering Career Services is expected to be the primary facilitator of job placement for Grainger Engineering students. It is anticipated that the first several cohorts will yield high matriculation to graduate programs, as was the case with the first 5 years of BIOE B.S. recipients. Advisement for graduate and professional school placement will be through Bioengineering faculty, with personalized faculty advising for which individual student career interests will be paired to those faculty most capable of offering depth of knowledge and opportunities.

Program Regulation and Assessment

Briefly describe the plan to assess and improve student learning, including the program's learning objectives; when, how, and where these learning objectives will be assessed; what metrics will be used to signify student's achievement of the stated learning objectives; and the process to ensure assessment results are used to improve student learning. (Describe how the program is aligned with or meets licensure, certification, and/or entitlement requirements, if applicable).

The Neural Engineering (NE) Program Committee will be responsible for making NE curricular decisions. The NE Program Committee will consist of tenured and tenure-track faculty members in the Department of Bioengineering and will be tasked with mapping the NE program-level educational objectives (PEOs) to student outcomes through individual course session learning objectives (LOs) and linking them to specific course performance indicators for success. The program specific performance indicators comprise a combination of both direct (exam results) and indirect (survey data) measures.

Most performance indicators will measure two levels of student achievement: attainment of skills and mastery of skills, representing distinct levels in the curriculum. Student work will be analyzed against a rubric to determine the fraction of students achieving each level of performance, with the target goal of 70% of junior/senior students achieving a high performance level. We will use lower-level course attainment scores as formative feedback on how students are progressing in the desired skill. Data analysis and action items resulting from the review of outcomes will be presented in a self-study report. A detailed breakdown for each outcome will be made available for faculty review.

The NE Program Committee will be responsible for creating, continuous oversight, and evaluation of the NE degree curriculum. Annually, learning outcomes and LOs will be reviewed and revised to ensure that they are clearly written, student-centered, measurable, concise, meaningful, achievable, and outcome-based. Resources from the Center for Innovation in Teaching and Learning (CITL) will be used for guidance. Teaching and Learning will be assessed through both informal and formal methods administered throughout and at the end of each term. Informal early feedback during each semester will be gathered, analyzed, and utilized to act on student feedback while the class is in progress. Instructor and Course Evaluation System (ICES) will be used as the end-of-course evaluation tool of instructor and course effectiveness for both faculty and teaching assistants. Overall course performance will be used to guide subsequent instruction. Monitoring of changes and action items will be reviewed annually by the NE Program Committee.

Assessment instruments and performance indicators used to evaluate each course will be critiqued. Course directors will draft an assessment blueprint in which the content of the course will be divided into categories corresponding to (1) mastery of the fundamental principles of neuroscience,

(2) integrated skill development in electrical and imaging systems, molecular and cellular engineering, biological interfacing, and computational data sciences, and (3) the application of design principles to solve modern problems in basic and translational neuroscience. Percentage weights will be assigned to each category (e.g. 10%, 40%). The blueprint will then be referenced when creating exams.

The NE Program Committee will review courses taught for the first time and annually review all course descriptions. After offering all courses at least once, the NE Program Committee will reexamine all the embedded indicators and ensure that they map to the student outcomes and fully demonstrate the designated outcome. Areas in need of improvement will be identified and recommendations for improvement will be specified that can be implemented in future years. The systematic assessment of student outcomes will be used to track progress and improvement goals.

To continuously improve the NE program and student learning, data will be collected and evaluated every 3 years, allowing for the NE program to make and assess changes in program curriculum, advising processes, and the assessment process itself.

The Program Director will serve as the chair of the NE Program Committee and will be responsible for allocating advising duties, providing oversight of advising activities, and developing best practices for advising

Is the career/profession for graduates of this program regulated by the State of Illinois?

No

Program of Study

"Baccalaureate degree requires at least 120 semester credit hours or 180 quarter credit hours and at least 40 semester credit hours (60 quarter credit hours) in upper division courses" (source: <https://www.ibhe.org/assets/files/PrivateAdminRules2017.pdf>). For proposals for new bachelor's degrees, if this minimum is not explicitly met by specifically-required 300- and/or 400-level courses, please provide information on how the upper-division hours requirement will be satisfied.

All proposals must attach the new or revised version of the Academic Catalog program of study entry. Contact your college office if you have questions.

For new programs, attach Program of Study

NE side-by-side for CIM.xlsx

Catalog Page Text

Catalog Page Text: Description of program for the catalog page. This is not official content, it is used to help build the catalog pages for the program. Can be edited in the catalog by the college or department.

Bachelor of Science, Neural Engineering

The Bachelor of Science in Neural Engineering provides training at the intersection of neuroscience and engineering fundamentals. The program focuses on skill development in electrical and imaging systems, molecular and cellular engineering, biological interfacing, and computational data sciences. The first two years of the program provide foundational knowledge in applied formal sciences, physical sciences, and life sciences. Years three and four provide focused training in neural engineering fundamentals and applications through core courses, neuroscience courses, and neural engineering electives. Students will be prepared for employment as engineers in growing healthcare industry sectors related to neurological devices, brain-computer interfaces, neurological disease treatments, and brain imaging technologies. Graduates will also be positioned to pursue professional degrees in medicine and graduate studies in clinical, life, and behavioral sciences.

Minimum Hours for Graduation: 128

Graduation

To graduate, students must satisfy all University requirements as to residency, scholarship, and fees and must complete the University's general education requirements.

Highest honors/departmental distinction: Students completing a Bachelor's thesis with a minimum GPA of 3.8 will be eligible for highest honors.

Curriculum:

First Semester

CS 101 Introduction to Programming for Engineers and Scientists (3)
ENG 100 Engineering Orientation (0)
MATH 221 Calculus I (4)
MCB 150 Molecular and Cellular Basis of Life (4)
NE 100 Introduction to Neural Engineering (2)
PSYC 100 Introductory Psychology (4)

Credit hours: $3 + 0 + 4 + 4 + 2 + 4 = 17$ CR

Second Semester

CHEM 102 General Chemistry I (3)
CHEM 103 General Chemistry Lab I (1)
MATH 231 Calculus II (3)
PHYS 211 University Physics: Mechanics (4)
RHET 105 Writing and Research (4)
Social Sciences or Humanities elective (3)

Credit hours: $3 + 1 + 3 + 4 + 4 + 3 = 18$ CR

Third Semester

BIOE 210 Linear Algebra in Biomedical Data Science (3)
CHEM 104 General Chemistry II (3)
CHEM 105 General Chemistry Lab II (1)
MATH 241 Calculus III (4)
MCB 250 Molecular Genetics (3)
PHYS 212 University Physics: Electricity and Magnetism (4)

Credit hours: $3 + 3 + 1 + 4 + 3 + 4 = 18$ CR

Fourth Semester

BIOE 205 Signals and Systems in Bioengineering (3)
BIOE 310 Computational Tools for Biological Data (3)
CHEM 232 Elementary Organic Chemistry I (4)
MATH 285 Introduction to Differential Equations (3)
MCB 252 Cells, Tissues, and Development (3)

Credit hours: $3 + 3 + 4 + 3 + 3 = 16$ CR

Fifth Semester

NE 330 Neuroscience for Engineers (3)
NE 410 / ECE 410 Neural Circuits and Systems (3)
Neural Engineering elective (3)
Social Sciences or Humanities elective (3)

Credit hours: $3 + 3 + 3 + 3 = 12$ CR

Sixth Semester

NE 420 / ECE 421 Neural Interface Engineering (3)
NE 422 Introduction to Neuroimaging (3)
Neural Engineering elective
Free elective (3)
Social Sciences or Humanities elective (3)

Credit hours: $3 + 3 + 3 + 3 + 3 = 15$ CR

Seventh Semester

NE 412 Neural Data Analysis (3)
NE 430 Neural Cell and Tissue Engineering (3)
NE 431 Neural Cell & Tissue Engineering Lab (4)
Neural Engineering elective (3)
Social Sciences or Humanities elective (3)

Credit hours: 3 + 3 + 4 + 3 + 3 = 16 CR

Eighth Semester

NE 402 Neural Engineering Senior Design (4)
Free elective (3)
Neural Engineering elective (3)
Social Sciences or Humanities elective (3)
Social Sciences or Humanities elective (3)

Credit hours: 4 + 3 + 3 + 3 + 3 = 16 CR

Total program credit hours: 17 + 18 + 18 + 16 + 12 + 15 + 16 + 16 = 128 CR

Statement for Programs of Study Catalog

Graduation Requirements

Minimum Overall GPA:2.0

Minimum hours required for graduation:128 hours

General education:Students must complete theCampus General Education (<https://courses.illinois.edu/gened/DEFAULT/DEFAULT/>)requirements including the campus general education language requirement.

Orientation and Professional Development

Code	Title	Hours
ENG 100	Engineering Orientation	0
Total Hours		0

Foundational Mathematics and Science

Code	Title	Hours
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
CHEM 104	General Chemistry II	3
CHEM 105	General Chemistry Lab II	1
CHEM 232	Elementary Organic Chemistry I ¹	4
MATH 221	Calculus I ²	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 285	Intro Differential Equations	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
Total Hours		34

Neural Engineering Technical Core

Code	Title	Hours
BIOE 205	Signals & Systems in Bioengrg	3
BIOE 210	Linear Algebra for Biomedical Data Science	3

BIOE 310	Comp Tools Bio Data	3
NE 100	Introduction to Neural Engineering (Introduction to Neural Engineering)	2
NE 330	Neuroscience for Engineers (Neuroscience for Engineers)	3
NE 402	Neural Engineering Senior Design (Neural Engineering Senior Design)	4
NE 412	Neural Data Analysis (Neural Data Analysis)	3
NE 422	Introduction to Neuroimaging (Introduction to Neuroimaging)	3
NE 430	Neural Cell and Tissue Engineering (Neural Cell and Tissue Engineering)	3
NE 431	Neural Cell & Tissue Engineering Lab (Neural Cell & Tissue Engineering Lab)	4
ECE/NE 410	Neural Circuits and Systems (Formerly ECE 498NS - submitted for permanence as ECE/NE 410: Neural Circuits and Systems)	3
ECE 421/NE 420	Neural Interface Engineering (Neural Interface Engineering - newly proposed course)	3
CS 101	Intro Computing: Engrg & Sci	3
MCB 150	Molec & Cellular Basis of Life	4
MCB 250	Molecular Genetics	3
MCB 252	Cells, Tissues & Development	3
PSYC 100	Intro Psych	4
Total Hours		54

Technical Electives

(List of Pre-Approved Neural Engineering Electives)

Code	Title	Hours
Must choose 12 hours from the following:		12
Bioengineering:		
BIOE 420	Intro Bio Control Systems	
BIOE 460	Gene Editing Lab	
BIOE 476	Tissue Engineering	
BIOE 483	Biomedical Computed Imaging Systems	
BIOE 484	Statistical Analysis of Biomedical Images	
BIOE 485	Computational Mathematics for Machine Learning and Imaging	
BIOE 486	Applied Deep Learning for Biomedical Imaging	
BIOE 487	Stem Cell Bioengineering	
BIOE 488	Applied High-Performance Computing for Imaging Science	
BIOE 489	Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning	
BIOE 498	Special Topics (Quantitative Pharmacology)	
BIOE 498	Special Topics (Introduction to Synthetic Biology)	
BIOE 498	Special Topics (Soft Robotics)	
BIOE 498	Special Topics (Immunoengineering)	
Electrical and Computer Engineering		
ECE 416	Biosensors	
ECE 442	Silicon Photonics	
ECE 459	Communications Systems	
ECE 460	Optical Imaging	
ECE 461	Digital Communications	
ECE 467	Biophotonics	
ECE 470	Introduction to Robotics	
ECE 480	Magnetic Resonance Imaging	
Mechanical Engineering		
ME 483	Mechanobiology	
Psychology		
PSYC 210	Behavioral Neuroscience	
PSYC 404	Cognitive Neuroscience	

Physics

PHYS 475 Introduction to Biophysics

Electives

Code	Title	Hours
	The Grainger College of Engineering Liberal Education course list, or additional courses from the campus General Education lists for Social and Behavioral Sciences or Humanities and the Arts. ³	6
	Free electives. Additional unrestricted course work, subject to certain exceptions as noted by the College, so that there are at least 128 credit hours earned toward the degree. ⁴	6
Total Hours of Curriculum to Graduate		128

¹ MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.

² May be taken for 3 or 4 credit hours; the extra hour may be used to help meet free elective requirements.

³ The Grainger College of Engineering approved liberal education course list can be found here (<https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-GeneralEducationElectives>). Note that these credit hours could carry the required cultural studies designation required for campus general education requirements.

⁴ The Grainger College of Engineering restrictions to free electives can be found here (<https://wiki.illinois.edu/wiki/display/ugadvise/Degree+Requirements/#DegreeRequirements-FreeElectives>).

EP Documentation

Attach Rollback/Approval Notices

Neural Engineering BS Proposal - Correspondence with Sponsor.pdf

DMI Documentation

Program Reviewer Comments

Deb Forgacs (dforgacs) (Tue, 02 Feb 2021 19:17:06 GMT):Rollback: Requested.

Brooke Newell (bsnewell) (Tue, 16 Feb 2021 23:20:28 GMT):Rollback: Per request

Deb Forgacs (dforgacs) (Wed, 17 Feb 2021 21:21:41 GMT):Rollback: requested.

Brooke Newell (bsnewell) (Fri, 26 Feb 2021 20:24:02 GMT):Rollback: per email

Deb Forgacs (dforgacs) (Fri, 12 Mar 2021 20:25:46 GMT):I needed to perform an admin Update to fix XML parsing issue in the 2021 Catalog, per LeapFrog.

Brooke Newell (bsnewell) (Thu, 25 Mar 2021 16:20:36 GMT):Rollback: Per Dept Request

John Wilkin (jpwilkin) (Tue, 20 Apr 2021 18:44:14 GMT):Rollback: Can I have the proposers confirm with GELIC whether our current collection and service resources are sufficient to support the program?

John Wilkin (jpwilkin) (Tue, 20 Apr 2021 19:42:40 GMT):Rollback: Please confirm with GELIC (e.g., Bill Mischo) that current library collections and services are adequate to support this program.

Brooke Newell (bsnewell) (Tue, 20 Apr 2021 19:52:17 GMT):Rollback: .

Key: 1044

MEMORANDUM OF UNDERSTANDING

Between the Department of Bioengineering (BIOE) and the Department of Psychology (PSYC) for the allocation of course seats in PSYC undergraduate courses for students in the BS in Neural Engineering program

This MOU calls for the Department of Psychology to allow students in the BS in Neural Engineering program to register for undergraduate courses in PSYC as follows:

Elective courses for the Neural Engineering degree:

PSYC 210: Behavioral Neuroscience

PSYC 404: Cognitive Neuroscience

Registration Procedures:

1. Each semester, Neural Engineering students will meet with an academic advisor in BIOE and declare an interest in a particular PSYC course for a forthcoming term.
2. Each academic year, the BIOE advisor will notify the PSYC Undergraduate Studies Office (Laura Lang, llang@illinois.edu) of the anticipated number of needed seats in each PSYC course in the next academic year.
3. Anticipated enrollment needs and requested terms are as follows:
 - a. PSYC 210, 30 seats, fall or spring
 - b. PSYC 404, 30 seats, fall or spring
4. Depending on faculty and classroom space availability, seats will be reserved in each course by the PSYC program staff for the Neural Engineering students. If students encounter any difficulties registering for the PSYC courses, they will contact the PSYC department via email with the BIOE advisor copied.

The terms of this agreement can be revised as necessary to meet the needs of the units and the program.

MEMORANDUM OF UNDERSTANDING

Between the Department of Bioengineering (BIOE) and the Department of Psychology (PSYC) for the allocation of course seats in PSYC undergraduate courses for students in the BS in Neural Engineering program

Signatures:

Wendy Heller

January 18, 2021

Wendy Heller, Head, Dept. of PSYC

Date

Mark Anastasio

January 29, 2021

Mark Anastasio, Head, Dept. of BIOE

Date

Cc: Jonathan Makela, Associate Dean, Grainger College of Engineering



January 29, 2021

Professor Mark Anastasio
Head, Department of Bioengineering
Grainger College of Engineering

Dear Prof. Anastasio,

The Department of Chemistry supports Bioengineering's proposed new degree program in neural engineering. We understand that this will likely result in an increase in undergraduate enrollments in the following courses: CHEM 102, CHEM 103, CHEM 104, CHEM 105 and CHEM 232. Therefore, we are willing to work with your department, college and the College of LAS to increase the TA support for chemistry to cover this as necessary.

Best regards,



Catherine J. Murphy
Head, Department of Chemistry
Larry R. Faulkner Endowed Chair in Chemistry



THE GRAINGER COLLEGE OF ENGINEERING

Department of Physics
211 Loomis Lab, MC-704
1110 W. Green St.
Urbana, IL 61801-3003

January 27, 2021

Professor Mark Anastasio
Head, Department of Bioengineering

Dear Professor Anastasio,

I write in response to your request for support from the Department of Physics in establishing a new degree of Bachelor of Science in Neural Engineering in the Department of Bioengineering.

Physics will be able to support the additional enrollment from students in the new major that you project for three of our courses: 40 students annually for PHYS 211 and 212 as well as 10 students in PHYS 475 per offering. We ask that you notify us at the earliest time possible, should a class cohort entering PHYS 211 and 212 exceed 50 students in a given year.

Best Wishes for the success of the new degree,

A handwritten signature in blue ink, appearing to read 'M. Grosse Perdekamp', with a stylized flourish at the end.

Matthias Grosse Perdekamp
Head, Department of Physics



THE GRAINGER COLLEGE OF ENGINEERING

Department of Mechanical Science & Engineering
Office of the Department Head
144 Sidney Lu Mechanical Engineering Building, MC-244
1206 W. Green St.
Urbana, IL 61801

28 January, 2021

Mark Anastasio
Head, Department of Bioengineering &
Donald Biggar Willett Professor in Engineering

Dear Professor Anastasio,

It is my pleasure to support your request to include ME 483 *Mechanobiology* in your proposed degree of Bachelor of Science in Neural Engineering in the Department of Bioengineering, Grainger College of Engineering.

Best regards,

A handwritten signature in black ink, appearing to read 'Anthony M. Jacobi', with a large, stylized flourish at the end.

Anthony M. Jacobi
Head of Mechanical Science and Engineering

From: [Bagchi, Milan K](#)
To: [Anastasio, Mark A](#)
Cc: [Shubert, Donna Marie](#)
Subject: Re: Update MOU for NE proposal
Date: Thursday, January 28, 2021 10:46:53 AM

Dear Mark:

The School of Molecular and Cellular Biology is pleased to allow students in the BS in Neural Engineering program to register for undergraduate courses in MCB as follows:

Required courses for the Neural Engineering degree:

MCB 150: Molecular & Cellular Basis of Life

MCB 250: Molecular Genetics

MCB 252: Cells, Tissues & Development

MCB intends to provide 50 seats to Neural Engineering students in MCB 150 and 250 in fall terms; 50 seats in MCB 252 in Spring terms. Given the fact that our new Neuroscience degree is expected to add a minimum of 50 students per year to the MCB courses, our program staff will have to give preference to MCB students for enrollment in these courses. Any changes to the historical course time offerings or limitations with respect to instructor availability, classroom space, and overall course capacity for any of the required courses would be sent to BIOE as soon as practical so that BIOE can advise NE students of any necessary enrollment modifications.

All the best,
Milan

--

Milan K. Bagchi, Ph.D.
Deborah Paul Endowed Professor
Director, School of Molecular and Cellular Biology
University of Illinois at Urbana-Champaign
534 Burrill Hall, 407 South Goodwin
Urbana, IL 61801



MATHEMATICS

College of Liberal Arts & Sciences
273 Altgeld Hall, MC-382
1409 W. Green Street
Urbana, IL 61801 USA

January 24, 2021

To the members of the Senate Educational Policy Committee:

The Department of Mathematics supports the proposal by the Department of Bioengineering to establish a new degree of Bachelor of Science in Neural Engineering. We acknowledge the inclusion of the following MATH courses in the curriculum as required courses for this new major:

MATH 221 – Calculus I
MATH 231 – Calculus II
MATH 241 – Calculus III
MATH 285 – Introduction to Differential Equations

The Mathematics Department is prepared to handle the anticipated increase in enrollments in these courses due to this new major.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. Tyson'.

Jeremy Tyson
Professor and Chair
Department of Mathematics
University of Illinois at Urbana-Champaign

January 22, 2021

Professor Mark Anastasio, Head
Department of Bioengineering
Grainger College of Engineering
University of Illinois

Dear Professor Anastasio:

Thank you for your letter of January 7, 2021 concerning your proposal to establish a new degree, a Bachelor of Science in Neural Engineering in the Department of Bioengineering. The English Department will be able to accommodate approximately 40 students per year in Rhetoric 105 as a required course for this degree. Please note that it is our understanding that because 105 is a Gen Ed course, regulated by Comp I rules, it cannot be required for students who have already received credit for it elsewhere.

Good luck with your proposal. And please let me know if I can be of any further help.

With best wishes for the new semester,



Robert Markley
Head and W. D. and Sara E. Trowbridge Professor



DEPARTMENT OF COMPUTER SCIENCE

Thomas M. Siebel Center for Computer Science
201 N. Goodwin Ave.
Urbana, IL 61801-2302 USA

NANCY M. AMATO

Abel Bliss Professor and Head
2248 Siebel Center
namato@illinois.edu

January 28, 2021

Dear Professor Anastasio,

On behalf of the Department of Computer Science, I support the establishment of a new Bachelor of Science in Neural Engineering degree.

In particular, we support the inclusion of "CS 101: Introduction to Computing: Engineering and Science", as a required course in the major. The CS department should be able to absorb the anticipated addition of 40 students per year in this class.

We are very happy to support this exciting new degree program and wish it success.

Sincerely,

A handwritten signature in black ink that reads "Nancy Amato". The signature is written in a cursive, flowing style.

Nancy M. Amato
Abel Bliss Professor and Head
Department of Computer Science

March 1, 2021

Professor Mark Anastasio
Head, Department of Bioengineering

Dear Mark,

The Department of Electrical and Computer Engineering (ECE) is supportive of the proposed exciting new major of BS in Neural Engineering within the Department of Bioengineering. ECE is happy to have one of its courses included in the required core courses and ECE can provide seats for the possible 5 – 10 students per elective course in ECE as well. Lists are below. Similarly, ECE expects that if similar numbers of ECE students were wanting to take some courses taught in Bioengineering that they would be welcome. It is fantastic that the Grainger College of Engineering can offer a variety of courses in the broad neural engineering area.

- Required core courses
 - o ECE 410/NE 410: Neural Circuits and Systems
 - o ECE 421/NE 420: Neural Interface Engineering

- Elective options
 - o ECE 416: Biosensors
 - o ECE 442: Silicon Photonics
 - o ECE 459: Communications Systems
 - o ECE 460: Optical Imaging
 - o ECE 461: Digital Communications
 - o ECE 467: Biophotonics
 - o ECE 470: Introduction to Robotics
 - o ECE 480: Magnetic Resonance Imaging

Sincerely,



Bruce Hajek
Head, Department of Electrical and Computer Engineering
Center for Advanced Study Professor of Electrical and Computer Engineering
Hoeft Endowed Chair in Engineering
Professor, Coordinated Science Laboratory

From: Makela, Jonathan J <jmakela@illinois.edu>
Sent: Wednesday, April 28, 2021 3:28 PM
To: Miller, Nolan H <nmiller@illinois.edu>; Anastasio, Mark A <maa@illinois.edu>
Cc: Newell, Brooke <bsnewell@illinois.edu>
Subject: Re: Neural Engineering BS Proposal

Hi Nolan,

There is a typo regarding the Technical Core in the CIM – P Program of Study itself, whereas the side by side is correct. That category should be 54 credit hours. Sorry about that mistake. If you can take care of it on your side, that would be great. Otherwise, we can fix it if it gets rolled back.

For Grainger Engineering students, several of the gen ed categories (Comp I, NST and QR) are satisfied by required engineering courses (many of our programs also have a required course that satisfies Advanced Comp, as well). The required 18 gen ed hours are used so students satisfy the remaining gen ed categories. In addition, our college specifically requires students to take 6 of those 18 hours from a liberal education list to ensure students have a breadth of knowledge/skills (since there are multiple courses that satisfy multiple gen ed categories and our students are good at optimizing; we want to make sure they get adequate liberal education rather than satisfying the gen eds in the minimum number and then taking additional gen eds in NST or QR to satisfy our 18 credit requirement).

As a result of all of this, most of our students are satisfying their GenEds within the 18 credit hours, and the 6 free electives really remain free.

Let me know if you need further clarification or information.

Jonathan

JONATHAN J. MAKELA

Associate Dean for Undergraduate Programs, The Grainger College of Engineering
Professor, Electrical and Computer Engineering
University of Illinois at Urbana-Champaign

206 Engineering Hall
1308 W. Green St.
Urbana, IL 61801
Phone: (217) 333-2280
Fax: (217) 244-4974

<http://airglow.ece.illinois.edu/>



Under the Illinois Freedom of Information Act any written communication to or from university employees regarding university business is a public record and may be subject to public disclosure.

From: Miller, Nolan H <nmiller@illinois.edu>

Date: Wednesday, April 28, 2021 at 11:42 AM

To: Makela, Jonathan J <jmakela@illinois.edu>, Anastasio, Mark A <maa@illinois.edu>

Subject: RE: Neural Engineering BS Proposal

Hi Jonathan,

As long as I'm bothering you....

In the table in CIM-P, the Neural Engineering Technical Core lists a total of 55 hours, but the excel spreadsheet (and my punching the numbers into a calculator) say it is 54. If you confirm this is a typo and the table should say 54, I'll see if we can get this corrected without having to roll the proposal back.

If you could walk me through the practicalities of the Gen Eds in Grainger, that would help me respond to my colleague's concern. The excel sheet lists 18 hours for the Gen Ed (not including Comp I) and another 6 hours of free electives. So, there are 24 hours within the 128 to fulfill the Gen Eds and Foreign Language requirement. Let's not worry about Foreign Language, since my impression is that most students fulfill this with HS work. I assume Grainger students fulfill some of the Gen Eds through required coursework. How easy is it to fulfill the rest of the gen eds using 24 hours? (It looks like QRs go with the math requirements, Social Science goes with Psych 100, Physics gets Physical Science). So is it really just advanced comp, humanities, and cultural studies they still need to do? That could be done in Adv Comp = 3, Humanities = 6, Cultural Studies = 9, total = 18, even without double dipping or cutting into the 6 hours of free electives.

Is my understanding of this correct? If so, I will respond to my colleague who raised the issue that there are 24 hours of electives to cover the gen eds, which can be done in 18 even without doubling up.

Thanks,

Nolan



NOLAN H MILLER

Daniel and Cynthia Mah Helle Professor in Finance | Department of Finance

Director, Center for Business and Public Policy

Gies College of Business | University of Illinois at Urbana-Champaign

217.244.2847 | nmiller@illinois.edu | <http://www.business.illinois.edu/nmiller>

Under the Illinois Freedom of Information Act any written communication to or from university employees regarding university business is a public record and may be subject to public disclosure.

Current Requirement	Current Hours
Orientation and Professional Development	0
ENG 100: Engineering Orientation	0
Foundational Mathematics and Science	34
CHEM 102: General Chemistry I	3
CHEM 103: General Chemistry Lab I	1
CHEM 104: General Chemistry II	3
CHEM 105: General Chemistry Lab II	1
CHEM 232: Elementary Organic Chemistry I ¹	4
MATH 221: Calculus I ²	4
MATH 231: Calculus II	3
MATH 241: Calculus III	4
MATH 285: Intro Differential Equations	3
PHYS 211: University Physics: Mechanics	4
PHYS 212: University Physics: Elec & Mag	4
Neural Engineering Technical Core	54
CS 101: Introduction to Programming for Engineers and Scientists	3
PSYC 100: Introductory Psychology	4
MCB 150: Molecular and Cellular Basis of Life	4
MCB 250: Molecular Genetics	3
MCB 252: Cells, Tissues, and Development	3
NE 100: Introduction to Neural Engineering	2
BIOE 205: Signals and Systems in Bioengineering	3
BIOE 210: Linear Algebra in Biomedical Data Science	3
BIOE 310: Computational Tools for Biological Data	3
NE 330: Neuroscience for Engineers	3
NE 422: Introduction to Neuroimaging	3
NE 412: Neural Data Analysis	3
NE 430: Neural Cell and Tissue Engineering	3
NE 431: Neural Cell & Tissue Engineering Lab	4
NE 410 / ECE 410: Neural Circuits and Systems	3
ECE 421/NE 420: Neural Interface Engineering	3
NE 402: Neural Engineering Senior Design	4
Technical Electives	12
List of Pre-Approved Neural Engineering Electives	
Bioengineering:	
BIOE 420: Bioengineering Control Systems	3
BIOE 460: Gene Editing Lab	3
BIOE 476: Tissue Engineering	3
BIOE 483: Biomedical Computed Imaging Systems	3
BIOE 484: Statistical Analysis of Biomedical Images	4
BIOE 485: Computational Mathematics for Machine Learning and Imaging	3
BIOE 486: Applied Deep Learning for Biomedical Imaging	3
BIOE 487: Stem Cell Bioengineering	3
BIOE 488: Applied High-Performance Computing for Imaging Science	3
BIOE 489: Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning	4
BIOE 498: Quantitative Pharmacology	3
BIOE 498: Introduction to Synthetic Biology	3
BIOE 498: Soft Robotics	4
BIOE 498: Immunoengineering	3
Electrical and Computer Engineering:	
ECE 416: Biosensors	3
ECE 442: Silicon Photonics	3
ECE 459: Communications Systems	3
ECE 460: Optical Imaging	3
ECE 461: Digital Communications	3
ECE 467: Biophotonics	3
ECE 470: Introduction to Robotics	4
ECE 480: Magnetic Resonance Imaging	3
Mechanical Engineering:	
ME 483: Mechanobiology	3
Psychology:	
PSYC 210: Behavioral Neuroscience	3
PSYC 404: Cognitive Neuroscience	3
Physics:	
PHYS 475: Introduction to Biophysics	3

General Education Requirements		
A minimum of six courses is required, as follows:		18
Social and Behavioral Sciences		6
Humanities & the Arts		6
The Grainger College of Engineering Liberal Education course list, or from the campus General Education lists for Social and Behavioral Sciences or Humanities and the Arts		6
Cultural Studies: Non-Western Cultures (1 course)		
Cultural Studies: U.S. Minorities Cultures (1 course)		
Cultural Studies: Western/Comparative Cultures (1 course)		
Non-Primary Language Requirement	0-9	
Completion of the third semester or equivalent of a non-primary language is required. Completion of three years of a single language in high school satisfies this requirement.		
University Composition	4-6	
RHET 105: Writing and Research		4
CMN 111: Oral & Written Comm I		3
& CMN 112: and Oral & Written Comm II		3
ESL 111: Intro to Academic Writing I		3
& ESL 112: and Intro to Academic Writing II		3
ESL 115: Principles of Academic Writing		4
Advanced Composition May be satisfied by completing a course in either the liberal education or free elective categories which has the Advanced Composition designation.		
Free Electives		6
Free electives. Additional unrestricted course work, subject to certain exceptions as noted by the College, so that there are at least 128 credit hours earned toward the degree.		
Total Hours of Curriculum to Graduate		128
Footnotes		
¹ MATH 220 may be substituted, with four of the five credit hours applying toward the degree. MATH 220 is appropriate for students with no background in calculus.		
² May be taken for 3 or 4 credit hours; the extra hour may be used to help meet free elective requirements.		
³ The Grainger College of Engineering approved liberal education course list can be found here. Note that these credit hours could carry the required cultural studies designation required for campus general education requirements.		
⁴ The Grainger College of Engineering restrictions to free electives can be found here.		

