

PROGRAM APPROVAL PROCESS
(Revised November 4, 2021)

Highlights of the Program Approval Process:

- The Regent universities shall submit the name and educational level of proposed programs that have already undergone an initial institutional review, are currently undergoing an in-depth institutional review, and are likely to be submitted for program approval by the Board of Regents. The proposed program must reside on the program planning list maintained in the Board office for at least three months prior to submitting a program proposal to allow sufficient time for discussion within the three Regent universities.
- The Board Office and the Council of Provosts shall review the annual program planning list at each Council of Provosts meeting.
- The universities shall complete their in-depth review of the proposed programs and submit their proposals to the Board Office using a program approval format developed by the Board Office (Form A).
- Letters of support from the other universities must be included with the program proposal.
- A review by the Iowa Coordinating Council for Post-High School Education (ICCPHSE) shall also occur prior to being submitted for Board approval. A program with unresolved concerns by the ICCPHSE should be so noted.
- The program proposals shall be reviewed in-depth by the Council of Provosts and the Board Office.
- With the recommendation for approval by the Board Office and the Council of Provosts, the program proposal shall be submitted to the Board of Regents Academic Affairs Committee and Board of Regents for discussion and action.
- Substantial expenditures for the proposed program or advertising/marketing of the proposed program shall not occur until after the program is approved by the Board of Regents. This means that the institutions shall not hire any new faculty, secure facilities, develop curriculum, or advertise the program until it has been approved by the Board of Regents.

FORM A
Board of Regents, State of Iowa

**REQUEST TO IMPLEMENT A NEW BACCALAUREATE, MASTERS,
DOCTORAL, OR PROFESSIONAL DEGREE PROGRAM**

THE PURPOSE OF ACADEMIC PROGRAM PLANNING: Planning a new academic degree program provides an opportunity for a Regent university to demonstrate need and demand as well as the university's ability to offer a quality program that is not unnecessarily duplicative of other similar programs offered by colleges and universities in Iowa.

Institution: _____ Iowa State University _____

CIP Discipline Specialty Title: (SVPP) _____

CIP Discipline Specialty Number (six digits)(SVPP) _____

Level: B _____ X _____ M _____ D _____ P _____

Title of Proposed Program: _____ Biomedical Engineering _____

Degree Abbreviation (e.g., B.S., B.A., M.A., Ph.D.): _____ B.S. _____

Mode(s) of Delivery (check all that apply): On-campus (face-to-face) Off-campus (face-to-face) _____
 Online Hybrid Other _____

Approximate date to establish degree: Month _____ Jan _____ Year _____ 2023 _____

Contact person: (name, telephone, and e-mail) _____ Ian Schneider, Associate Professor, Chemical and Biological Engineering (4-0450, ians@iastate.edu), Sriram Sundararajan, Associate Dean for Academic Affairs (4-1050, srirams@iastate.edu) _____

College that will administer new program: _____ Engineering _____

Please provide the following information (use additional pages as needed). Do not use acronyms without defining them.

1. Describe the proposed new degree program, including the following:
 - a. A brief description of the program. If this is currently being offered as a track, provide justification for a standalone program.

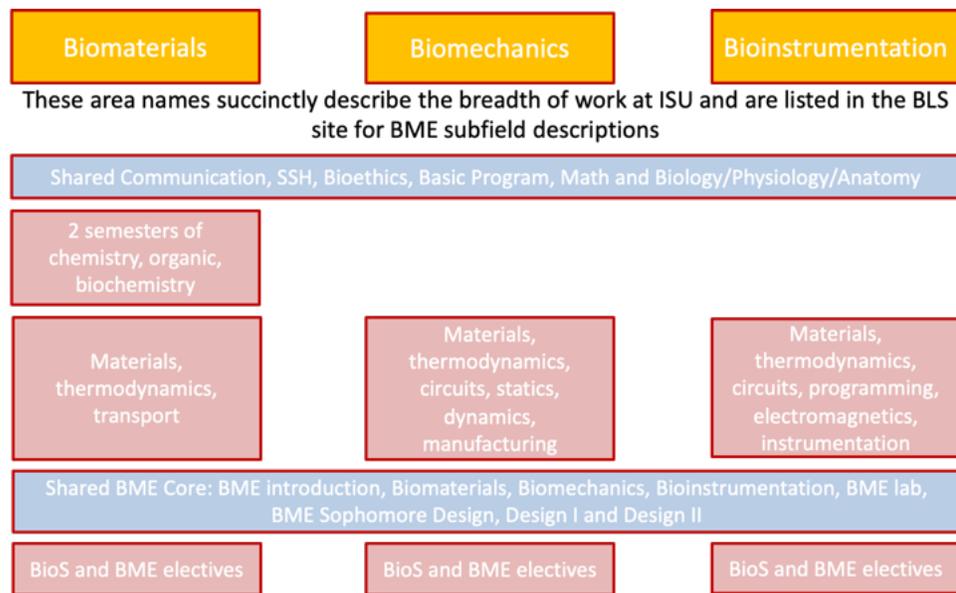
The proposed B.S. in Biomedical Engineering will leverage the faculty expertise in the engineered medicine area and academic and research collaborations across campus to offer an engineering degree program that is popular amongst prospective students. This will be an interdisciplinary major housed administratively in the department of Chemical and Biological Engineering (CBE) and supported by the departments of Electrical and Computer Engineering, Materials Science and Engineering and Mechanical Engineering. A minor is currently available with increased enrollment over the last seven years.

The Biomedical Engineering Program at Iowa State University will prepare students for a career in serving society through understanding, designing and manufacturing biomedical systems that improve human health. Our students will graduate with both a broad and deep understanding of the fundamental principles of biomedical engineering as well as their applications in diverse areas such as biomaterials, biomechanics and bioinstrumentation in order to address healthcare challenges in injury prevention and recovery, next generation personal protective equipment, neurodegenerative disorders, antibiotic resistance and infectious diseases. The

curriculum will be flexible offering concentration in three fundamental emphasis areas and multiple different application areas, but allowing students to assemble the curriculum that best fits their needs. Students in this program will be exposed to a transdisciplinary approach to healthcare, an ethos that has been a feature of Iowa State University since the 1960s. Interactions with faculty and students in the human sciences will be complemented by a strong collaboration with veterinary sciences, providing students with unique opportunities to explore interesting animal models for physiology and disease and embrace a comparative medicine approach. There will be opportunities for students to interact with regionally and nationally recognized laboratories and centers including the Veterinary Diagnostic Lab, Nanovaccine Institute, Virtual Reality Application Center (VRAC) as well as collaborators such as the National Animal Disease Center. Our Student Innovation Center represents a commitment by Iowa State to encourage innovation in undergraduate students and strong student support and student-centered teaching practices speak to Iowa State's dual commitment as a land grant institution to research that benefits society and education that trains the next generation of workers.

The BME program will be built upon three foundational emphasis areas which include biomaterials, biomechanics and bioinstrumentation with biocomputation as a possible area of future interest. The foundational emphasis areas will be delineated by specific sets of foundational science and engineering classes (see appendix). In addition, they will map to application areas such as disease therapeutics, prosthetic rehabilitation, medical devices as well as a pre-vet/pre-med area. These application areas will inform senior-level technical electives and represent areas of strength in the college of engineering at ISU and delineate ourselves from strengths within BME at the University of Iowa.

A structural schematic of the curriculum is shown below with a course listing and 4-year plans included at the end of the document.



b. A statement of academic objectives;

The objectives of the Biomedical Engineering Program at Iowa State University are to produce graduates who will:

- Excel in careers as professional biomedical engineers in industries aimed at understanding, designing and manufacturing biomedical systems that improve human health
- Successfully pursue research and advanced studies in biomedical engineering, other health related areas or in related professional fields such as medicine, law and business

Graduates will have acquired a broad and deep understanding of the fundamental principles of biomedical engineering as well as their applications in diverse areas such as disease therapeutics, advanced diagnostics, prosthetic rehabilitation, organ biomechanics, medical devices and biosensors in order to address healthcare challenges in injury prevention and recovery, next generation personal protective equipment, neurodegenerative disorders, antibiotic resistance and infectious diseases.

c. [What the need for the program is and how the need for the program was determined;](#)

The need for the program was identified through an analysis by the Dean's office of 1) opportunities to align academic offerings and research area growth/expertise; 2) opportunities for new programs based on current and prospective student interest; 3) opportunities to enhance the diversity of our college and campus community.

1) Engineered medicine is a strategic area of growth in the college. Faculty across the college have been successful at establishing and growing research programs with strong collaborations with colleagues across campus in Veterinary Medicine and the Sciences as well as medical institutions in the state and beyond. Tangible examples include the Nanovaccine Institute and programs in computational medicine, biosensors and theranostics and human factors. These high impact research lends itself to an opportunity to offer an undergraduate major in the biomedical engineering area that leverages the unique nature of the work at ISU.

2) As described later in section i, discussions with the Office of Admissions indicated that there is student demand for health-related undergraduate degree options for which there is no obvious pathway in engineering and for which a biomedical engineering major becomes a solid option to attract new students to the university and college.

3) One of the strategic goals for the college (and university) is to continue to diversify the student body. According to data from the American Society of Engineering Education (ASEE), the biomedical engineering major has the second largest percentage of women students receiving a degree (amongst all engineering majors, 48.1%). The current percentage of women receiving engineering degrees at ISU is about 18%. Thus, the proposed major offers a tangible pathway to attract more diverse group of students to the college.

d. [The relationship of the proposed new program to the institutional mission and how the program fits into the institution's and college's strategic plan;](#)

The proposed program aligns with the institution's efforts to 1) increase visibility and offer programs in the area of health; 2) bring new students to the university who might otherwise not have considered ISU; 3) promote and support collaborative efforts aligned with the university's grand challenge research areas (Enabling healthy lives).

The proposed program aligns with the college's efforts to 1) Provide a high-quality, experiential education that prepares students to meet the global challenges of the 21st century (health); 2) Leverage the faculty expertise and research efforts across the college in the area of engineered medicine; 3) Diversify the college's student body – Biomedical Engineering is a top-two engineering major nationwide for gender diversity.

- e. The relationship of the proposed new program to other existing programs at the institution; describe how the proposed program will enhance other programs at the university. Will the proposed program duplicate existing programs at the university?

ISU has never offered a B.S. in Biomedical Engineering major. This program does not duplicate existing programs at ISU. It will complement other health and biology-related programs currently being offered at ISU including Biological Systems Engineering, Bioinformatics/Computational Biology, Biochemistry, Biophysics, Biological/Pre-Medical Illustration, Biomedical Sciences and Kinesiology and Health. A collaborative cross-campus task force with members recommended by the Dean's offices of Agriculture and Life Sciences, Human Sciences, Liberal Arts and Sciences and Veterinary Medicine in addition to key engineering faculty members were involved in recommending the curriculum for this degree program.

- f. The relationship of the proposed new program to existing programs at other colleges and universities in Iowa, including how the proposed program is different or has a different emphasis than the existing programs.

University of Iowa offers a B.S. in Biomedical Engineering. We are delineating from the University of Iowa degree in a number of ways. Fundamentally, our research strengths are oriented towards biosensing, drug delivery, devices and manufacturing, which can be seen in the electives that we currently offer. This differs from the focus at the University of Iowa in the areas of bioimaging, bioinformatics and cardiovascular biomechanics. We also have several unique features of the program including 1) early exposure to biomedical engineering problems in the freshman year and through a sophomore year class in biomedical engineering design; 2) opportunities for our students to take cadaver anatomy labs; 3) a bioethics requirement; 4) design projects and research/independent study opportunities that leverage interactions with both human and veterinary sciences on campus.

The University of Iowa was engaged in the development of our proposed degree and have provided a letter of support. We anticipate opportunities to collaborate on electives and further enhancing current research and academic collaborations in this area.

- g. Special features or conditions that make the institution a desirable, unique, or appropriate place to initiate such a degree program.

There are several research efforts in the college of engineering in the area of engineered medicine resulting in an initial core group with the expertise to help deliver the program. Academic and research collaborations with several programs and colleges across campus in this area allow for a curriculum focused on our strengths (see response in section f above). Access to unique centers and faculty expertise available on or close to campus including the Nanovaccine Institute and the National Animal Disease Center also mark ISU as an appropriate place to offer such a program.

- h. Describe the personnel, facilities, and equipment necessary to establish and maintain a high-quality program. Include any reallocations from other programs or areas of the university.

Based on the recommendations of a cross-campus task force we put together to help formulate this degree program, the estimated personnel, facilities and equipment necessary to establish and maintain a high-quality program include the elements listed below. Initial resources to launch the program with these elements are new allocations that have been included in the college budgeting plan and process. No reallocations from other programs and areas are planned. As indicated in section 9, we expect program growth to result in additional resource flow to the college via the university's budget model (Resource Management Model) to help support future needs.

- Faculty hiring: Based on the proposed curriculum and projection of initial new core courses needed, the initial number of new faculty across the college in the first 3 years is estimated to be 6 tenure/tenure track faculty: 2 in Chemical and Biological Engineering, 2 in Mechanical Engineering, 1 each in Electrical and Computer Engineering and Materials Science & Engineering. These 6 faculty lines will help support new course development and faculty responsibilities related to program governance.
- Salary support for Professor in Charge of the program.
- Staff needs: One full-time academic advisor (with advising load up to about 200), one full time equivalent laboratory coordinator to help support laboratory development and functioning.
- TA support: Up to 5 TA lines/per year for years 1-3 to support the laboratory and design courses, with increased lines as enrollment grows.
- Laboratory needs: Initial investment costs for equipment needs for the 3 laboratory core courses have been estimated at about \$1M. We anticipate renovating or reconfiguring space for these labs in college-owned spaces including in Black Engineering, Coover Hall, Student Innovation Center and Sweeney Hall with an estimated cost of about \$500,000. In addition, funds for materials and supplies for laboratory courses will be provided until special course fees can be established.
- Other needs: Scholarship support for juniors and seniors for the major estimated at \$25,000/year in addition to any foundation funds that can be used/applied. Programmatic needs aimed at student engagement estimated at \$5,000 per year.

As the program grows, we anticipate increased resource needs for many if not all of the above areas and resource allocations will occur through the annual resource request and allocation process currently used by the Dean's office to support all engineering programs.

i. **How does student demand for the proposed program justify its development? What are the anticipated sources of students to enroll in this new program?**

We anticipate attracting new undergraduate students to ISU and to the College of Engineering who might otherwise not have considered engineering due to a lack of a clear choice in the biomedical/health area. According to data from the Office of Admissions, biomedical related disciplines are amongst the top disciplines of interest amongst prospective students. Fall 21 national estimates were about 33,000 such prospective students including about 3000 for pre-med programs. With the launch of this degree program, we will therefore be able to attract and recruit a healthy number of students to ISU and to the College. We anticipate some draw from students who may otherwise have considered another engineering major, but we expect these to be few since there is little overlap in core curricular content with other current engineering majors. We also anticipate attracting more diverse group of students through the offering of this major. According to data from the American Society of Engineering Education (ASEE), the biomedical engineering major has the second largest percentage of women students receiving a degree (amongst all engineering majors, 48.1%). The current percentage of women receiving engineering degrees at ISU is about 18%.

2. **Estimate the number of majors and non-majors students that are projected to be enrolled in the program during the first seven years of the program.**

a. **Undergraduate**

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7
Majors	25	60	100	150	200	220	250

Non-Majors							
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b. Graduate/Professional
N/A

3. Describe the state and/or national workforce need and/or demand for graduates of the proposed program currently and in the foreseeable future (provide the sources of data used to estimate workforce need and demand).

The Bureau of Labor statistics (<https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>) predicts a 6% job growth rate for Biomedical Engineers with Bachelor's degrees over the next decade resulting in the need for an additional 1100 employable engineers. The demand for biomedical engineers in the state of Iowa is about 10 per year while the demand in the Midwest and neighboring states around Iowa is around 150-200 per year based on the 6% projected growth rate. Illinois and Minnesota, two of our neighboring states from which we draw many students, are among the top 10 states in the country with the highest concentration and need for Biomedical Engineers. In addition, Biomedical Engineering is a popular major for graduate and pre-med students – and our proposed curriculum is designed to meet pre-med track requirements.

4. List all other public and private institutions of higher education in Iowa currently operating programs similar to the proposed new degree program. (For comparison purposes, use a broad framework, e.g., such identification should not be limited to programs with the exact same title, the same degree designation, having the same curriculum emphasis, or purporting to meet exactly the same needs as the proposed program.)

If the same or similar program exists at another public or private institution of higher education in Iowa, respond to the following questions:

a. Do other colleges in Iowa offer programs similar to the proposed program?

The only Iowa institution that offers a B.S. Biomedical Engineering degree is the University of Iowa. Dordt College offers a general engineering degree with a biomedical concentration as one of 6 concentration areas.

b. Has there been consultation in developing the program proposal? Provide a summary of the response of each institution consulted.

Dean Easterling, Associate Dean Sundararajan and Prof. Ian Schneider (Chemical and Biological Engineering and chair of our task force) from the College of Engineering at ISU presented the proposed program to Dean Nembhard and Associate Dean Grosland of the College of Engineering and Prof. Reinhardt, Chief Executive Officer of the Roy J Carver Department of Biomedical Engineering at the University of Iowa in Fall 2021. They shared the proposal with key faculty and provided constructive feedback to us. Subsequently, Dean Nembhard provided a letter of support (attached to this proposal).

c. Has the possibility of an inter-institutional program or other cooperative effort been explored? What are the results of this study? (Consider not only the possibility of a formally established inter-institutional program, but also how special resources at other institutions might be used on a cooperative basis in implementing the proposed program solely at the requesting institution.)

This was not raised in our discussions with the University of Iowa by either institution. We foresee opportunities in exploring how elective courses that leverage institutional strengths could be offered for students in either program.

d. Are letters of support included with the program proposal?

Yes – University of Iowa Support Letter. A letter from the chairs of the stakeholder departments in the college of engineering is also attached.

5. If there are plans to offer the program away from the campus, briefly describe these plans, including potential sites and possible methods of delivery instruction. Will off-campus delivery require additional **HLC accreditation**?

This will be an on-campus degree.

6. Will the proposed program apply for programmatic accreditation? When?

Yes. As with all our engineering programs, the proposed program will seek accreditation by ABET, which is the primary accreditation body for engineering programs nationwide. The college will apply for accreditation the term that a first student graduates from the program. We anticipate this to be in 2027.

7. For undergraduate programs: Will articulation agreements be developed for the proposed program? With whom?

The program will participate in articulation agreements already developed by the college of engineering with community colleges and other universities. Examples include ones with Des Moines Area Community College (DMACC) and other community colleges and William Penn University. Agreements will be updated as the program comes into maturity.

8. Describe any opportunities for experiential learning (e.g. internships, clinicals, research, community engagement/service learning).

Engineering Career Services supports a robust program that offers internship and cooperative learning experiences for engineering students. Currently about 76% of engineering students participate in at least on internship or coop. We anticipate students in this major also participating in these opportunities. We currently have 55 employers who are in the biomedical engineering/health areas already engaging with the college to facilitate these opportunities.

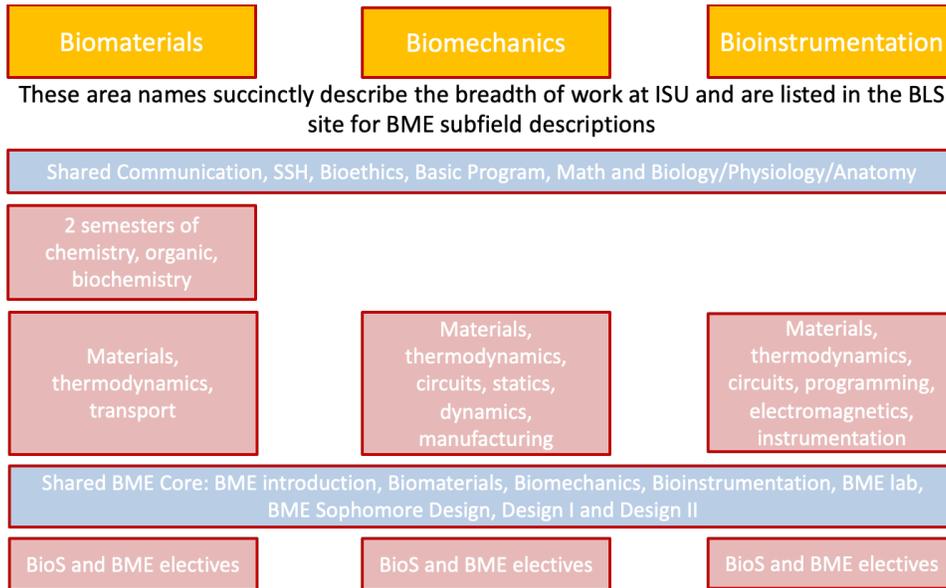
9. From where will the financial resources to cover the costs for the proposed program come (list all that apply, e.g., department reallocation, college reallocation, grants, new to the university)?

All financial resources will be provided from the Dean's office in the College of Engineering. Initial resources to launch the program are new allocations that have been included in the college budgeting process. As the program grows, we expect resource flow to the college from via the university's budget model (Resource Management Model) to help support future needs. Although not needed to launch the program, the Dean's office will also pursue opportunities with ISU foundation and other external agencies to augment or enhance resources to this program.

10. Include any additional information that justifies the development of this program.

Curriculum overview and 4 year plans

Schematic outlining the curricular structure for the proposed BME curriculum for the three emphasis areas.



Common curriculum for all emphasis areas:

- **Basic Program:**
 - BME 160
 - Chem 167 or Chem 177 (Biomaterials)
 - Other courses same for all ENG programs
- **Comms**
 - ENGL 250, ENGL 314
- **Math/Science:**
 - Chem 167L or 177L (Biomaterials)
 - Math 265 (Calc III); Math 267 (Diff Eqs);
 - Physics 232 and 232L;
 - Biol 212 (Principles of Biology II)
 - Biol 335 (Animal and Human Physiology)
 - Biol 350/BMS 447 or 448 – Anatomy
 - Stat 305 (Statistics for Engineers)
- **Bioethics – one of Phil 331 (Medicine)/336 (Biotech)**
- **Engineering principles**
 - ME 231 – Thermodynamics
 - Mat E 273 – Intro to Materials
 - EE 442 – Intro to Circuits
- **BME core**
 - BME 220 (Intro to BME) - ME
 - BME 230 (Sophomore Design) - ME
 - BME 340 (Computational Methods for BME)
 - BME 350(Bioinstrumentation)
 - BME 350L (Bioinstrumentation Lab)
 - BME 352 (Biomechanics)
 - BME 352L (Biomechanics Lab)
 - BME 354 (Biomaterials)
 - BME 354L (Biomaterials Lab)
 - BME 420 and 430 (Senior Design I and II)
- **SSH, Tech electives, BME electives and BioSci electives**

Emphasis area-based curriculum:

- **Biomaterials**
 - Chem 178 and 178L (General Chemistry II)
 - Chem 231 (Organic Chem)
 - BBMB 303 (Biochemistry)
 - Ch E 356 (Transport Phenomena I)
 - Ch E 357 (Transport Phenomena II)
- **Biomechanics**
 - CE 274 (Statics)
 - ME 345 (Dynamics)
 - ME 324 (Manufacturing)
 - Ch E 356 (Transport Phenomena I)
 - Ch E 357 (Transport Phenomena II)
- **Bioinstrumentation**
 - Com S 207 (Programming)
 - CPRE 281 (Digital Logic)
 - EE 448 (AC Circuits and Motors)
 - EE 311 (Electromagnetic Fields and Waves)
 - ME 370 (Engineering Measurements)

Biomaterials		Basic Program	Communication	SSH	Math
		Biology	Science	Engineering	
		BME Core	BME Elective	BMS Elective	
Year	Semester	Class	Class Description	Credit	
Freshman	Fall				
	16	MATH 165	calculus 1		4
		ENGL 150	composition 1		3
		Chem 177	general chemistry 1		4
		Chem 177L	general chemistry lab 1		1
		BME 160	introduction to engineering problem solving		3
		LIB 160	library		1
		ENGR 101	introduction to engineering		0
Freshman	Spring				
	16	Math 166	calculus 2		4
		Chem 178	general chemistry 2		3
		Chem 178L	general chemistry lab 2		1
		PHYS 231	physics 1		4
		PHYS 231L	physics 1 lab		1
		Biol 212	biology 2		3
Sophomore	Fall				
	15	ENGL 250	composition 2		3
		PHYS 232	physics 2		4
		PHYS 232L	physics lab 2		1
		Chem 231	organic chemistry		3
		MATH 267	differential equations		4
Sophomore	Spring				
	17	Biol 335	animal and human physiology		3
		ME 231	thermodynamics		3
		BME 220	introduction to BME		3
		MATE 273	principles of materials		3
		BME 230	sophomore design		2
		Phil 331 or 336 or Bioethics			3
Junior	Fall				
	17	Biol 350, BMS 447	anatomy		4
		MATH 265	calculus 3		4
		BME 352	Biomechanics		3
		BME 352L	Biomechanics Lab		1
		BME 340	Computational Methods in Biomedical Engineering		3
		EE 442	introduction to cirucuits and instruments		2
Junior	Spring				
	17	BME 350	Bioinstrumentation		3
		BME 350L	Bioinstrumentation Lab		1
		BME 354	Biomaterials		3
		BME 354L	Biomaterials Lab		1
		Stat 305	statistics for engineers		3
		ChE 356	momentum, heat and mass transport		3
		ENGL 314	technical writing		3
Senior	Fall				
	17	BME 420	BME Design I		2
		BBMB 303	biochemistry		3
		BME Elective			3
		SSH Elective			3
		SSH Elective			3
		ChE 357	momentum, heat and mass transport		3
Senior	Spring				
	17	BME 430	BME Design II		2
		SSH Elective			3
		Tech Elective			3
		BME Elective			3
		BioSci Elective			3
		SSH Elective			3

Biomechanics		Basic Program	Communication	SSH
		Biology	Science	Engineering
		BME Core	BME Elective	BMS Elective
Year	Semester	Class	Class Description	Credit
Freshman	Fall			
	16	MATH 165	calculus 1	4
		ENGL 150	composition 1	3
		Chem 167	general chemistry for engineering students	4
		Chem 167L	general chemistry for engineering students	1
		BME 160	introduction to engineering problem solving	3
		LIB 160	library	1
		ENGR 101	introduction to engineering	0
Freshman	Spring			
	15	Math 166	calculus 2	4
		SSH Elective		3
		PHYS 231	physics 1	4
		PHYS 231L	physics 1 lab	1
		Biol 212	biology 2	3
Sophomore	Fall			
	15	ENGL 250	composition 2	3
		PHYS 232	physics 2	4
		PHYS 232L	physics lab 2	1
		CE 274	statics	3
		MATH 267	differential equations	4
Sophomore	Spring			
	17	Biol 335	animal and human physiology	3
		ME 231	thermodynamics	3
		BME 220	introduction to BME	3
		MAT E 273	principles of materials	3
		BME 230	sophomore design	2
		Phil 331 or 336 or 343	Bioethics	3
Junior	Fall			
	17	Biol 350, BMS 447, BMS 448	anatomy	4
		MATH 265	calculus 3	4
		BME 352	Biomechanics	3
		BME 352L	Biomechanics Lab	1
		BME 340	Computational Methods in Biomedical Engineering	3
		EE 442	introduction to circuits and instruments	2
Senior	Fall			
	17	BME 350	Bioinstrumentation	3
		BME 350L	Bioinstrumentation Lab	1
		BME 354	Biomaterials	3
		BME 354L	Biomaterials Lab	1
		Stat 305	statistics for engineers	3
		ChE 356	momentum, heat and mass transport	3
		ENGL 314	technical writing	3
Senior	Fall			
	17	BME 420	BME Design I	2
		ME 345	dynamics	3
		ME 324	manufacturing	3
		BME Elective		3
		SSH Elective		3
		ChE 357	momentum, heat and mass transport	3
Senior	Spring			
	17	BME 430	BME Design II	2
		SSH Elective		3
		Tech Elective		3
		BME Elective		3
		BioSci Elective		3
		SSH Elective		3

Biosensors/devices	Basic Program		Communication	SSH
	Biology	BME Core	Science	Engineering
Year	Semester	Class	BME Elective	BMS Elective
Year	Semester	Class	Class Description	Credit
Freshman	Fall			
	16	MATH 165	calculus 1	4
		ENGL 150	composition 1	3
		Chem 167	general chemistry for engineering students	4
		Chem 167L	general chemistry for engineering students	1
		BME 160	introduction to engineering problem solving	3
		LIB 160	library	1
		ENGR 101	introduction to engineering	0
Freshman	Spring			
	15	Math 166	calculus 2	4
		Com S 207	programming	3
		PHYS 231	physics 1	4
		PHYS 231L	physics 1 lab	1
		Biol 212	biology 2	3
Sophomore	Fall			
	15	ENGL 250	composition 2	3
		PHYS 232	physics 2	4
		PHYS 232L	physics lab 2	1
		CPR E 281	digital logic	3
		MATH 267	differential equations	4
Sophomore	Spring			
	17	Biol 335	animal and human physiology	3
		ME 231	thermodynamics	3
		BME 220	introduction to BME	3
		MAT E 273	principles of materials	3
		BME 230	sophomore design	2
		Phil 331 or 336 or 343	Bioethics	3
Junior	Fall			
	17	Biol 350, BMS 447, BMS 448	anatomy	4
		MATH 265	calculus 3	4
		BME 352	Biomechanics	3
		BME 352L	Biomechanics Lab	1
		BME 340	Computational Methods in Biomedical Engineering	3
		EE 442	introduction to circuits and instruments	2
Senior	Fall			
	17	BME 350	Bioinstrumentation	3
		BME 350L	Bioinstrumentation Lab	1
		BME 354	Biomaterials	3
		BME 354L	Biomaterials Lab	1
		Stat 305	statistics for engineers	3
		SSH Elective		3
		ENGL 314	technical writing	3
Senior	Fall			
	16	BME 420	BME Design I	2
		EE 448	introduction to AC/DC circuits	2
		EE 311	electromagnetic fields and waves	3
		BME Elective		3
		SSH Elective		3
		ME 370	measurement and instrumentation	3
Senior	Spring			
	17	BME 430	BME Design II	2
		SSH Elective		3
		Tech Elective		3
		BME Elective		3
		BioSci Elective		3
		SSH Elective		3

Support Letters



College of Engineering

Office of the Dean

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Engineering Arts and Sciences
Iowa City, Iowa 52242-1527
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engineering.uiowa.edu

November 17, 2021

W. Samuel Easterling
Dean of Engineering
Iowa State University
4100 Marston Hall
533 Morrill Road
Ames, IA 50011-2103

Dear Dean Easterling:

Thank you for briefing me on your plans to offer a new degree program in Biomedical Engineering at Iowa State University.

I look forward to future collaborations between the University of Iowa and Iowa State University and the potential for pipeline programs for our advanced degrees. The field of biomedical engineering is an important area to Iowans and the nation. We will need a larger workforce in the future and this new degree will provide a broader set of opportunities to fill the demand in human health.

We look forward to continuing to work with you to increase educational opportunities for aspiring engineers everywhere.

Sincerely,

Harriet B. Nembhard
Dean, College of Engineering
Roy J. Carver Professor of Engineering

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Engineering
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DATE: April 22, 2022

TO: Sriram Sundararajan, Associate Dean for Academic Affairs

FROM: Andy Hillier, Chair of Chemical and Biological Engineering
Ashfaq Khokhar, Chair of Electrical and Computer Engineering
Caroline Hayes, Chair of Mechanical Engineering
Chris Cornelius, Chair of Materials Science and Engineering

RE: Support for the B.S. Biomedical Engineering major



The four departments: Chemical and Biological Engineering (CBE), Electrical and Computer Engineering (ECPE), Mechanical Engineering (ME) and Materials Science and Engineering (MSE) will work with the Dean's office to support the development and delivery of the proposed B.S. in Biomedical Engineering (BSBME) as outlined in the new program proposal. Key aspects are summarized below.

- The BSBME program will be an interdepartmental program housed administratively in CBE with CBE, ECPE, ME and MSE supporting the curriculum through the development and delivery of core and elective courses. These obligations will be reviewed annually to assess frequency of offering and section needs.
- The chairs will also work with the Dean's office to institute the BME faculty and to ensure that their PRS and workloads are balanced between the needs of the BME program and the department.
- Initial resource needs for the program including faculty and staff needs are provided by the Dean's office. Subsequent resource needs necessitated by program growth will be through annual resource allocation processes used currently.

**Response to
Comments at First
Faculty Senate
Reading**

Paraphrased Comments from Genetics, Development and Cell Biology (GDCB):

Ian Schneider and Sriram Sundararajan consulted with Hala Bastawros, Carly Manz, Karri Haen Whitmer, Don Sakaguchi and Maura McGrail over email.

Ian Schneider and Sriram Sundararajan met with Carly Manz on 10/26/22.

GDCB comment: GDCB is developing a new physiology course that focuses on human physiology as opposed to human and animal physiology to fulfill the physiology requirement?

BME program response: We will consider adding BIOL 346x as a substitute for BIOL 335.

GDCB comment: Perhaps also give the opportunity to students to take a comparative anatomy course to pair with BIOL 335, if that is still allowed as a physiology course.

BME program response: We could consider adding BIOL 351 to the approved anatomy course list.

GDCB comment: It would likely benefit BME to have hands on training in biology. Consider adding at least one lab requirement.

BME program response: It does seem that the first biology course in BME programs tends to have approximately a 1 credit lab requirement and this lab is either attached to the class or as a stand alone class. We will consider adding BIOL 212L as a requirement for BME students.

GDCB comment: You may want to check on BMS 447 (graduate standing and introductory biology class or instructor permission) and 448 (BIOL 255 and introductory biology class) prerequisites as well as their ability to handle additional students to ensure this is an appropriate course for BME students.

BME program response: We contacted Michael Lyons, the instructor for the courses. His response is as follows. "We have been in discussions for a while to add another lab section of BMS 448. It usually fills and we load to 50, but I would like to double the section. We would have a large lecture and two labs so we should have not [not have a] problem accommodating your students with the additional lab section. I would be good with the BIOL 212 with 335 or 346X. The reason we have listed BIOL 255 [as a prerequisite] is we want some familiarity with anatomy terminology as it's an advanced class and we don't spend a lot of time on the basics."

Paraphrased Comments from Kinesiology (KIN):

Ian Schneider and Sriram Sundararajan consulted with Ann Smiley over email.

Ian Schneider will meet with Ann Smiley, Jason Gillette and Tim Derrick the week of Thanksgiving break due to a scheduling issue.

KIN comment: We are concerned about the overlap with BME 352/352L and KIN 355.

BME program response: Professor Chou, chair of the Department of Kinesiology and member of the BME exploratory task force was asked about overlap between B M E 352, which is already on the books, or a potential newly developed core BME biomechanics course. His assessment was that KIN 355 is probably not appropriate for BME majors to take as it is just a way of teaching kinesiology majors physics in a biological context.

The two large delineations are as follows:

1. Kin 355 primarily relies on non-differential calculus-based mechanical models to describe the behavior, given the prerequisites of PHYS 111 or 115. The prerequisites for the following B M E 352 are B M E 220, which requires PHYS 232, which includes differential calculus.
2. The largest difference is likely the content. Kin 355 is primarily focused on human performance and exercise, whereas B M E 352 focuses on biomechanical models spanning molecules through cells up to tissues as well as non-living BME relevant systems (implants, hydrogels, etc.) in the context of disease, injury, and tissue regeneration and rehabilitation. Finally the course is oriented toward engineering design. I think Professor Chou recognized that both the application as well as the length scales that B M E 352 covers are different from Kin 355.

Kin Comment: There may be other courses in comparative anatomy and injury biomechanics that would be beneficial as electives for students in BME.

BME program response: We have already including KIN 472 (neural basis of human movement) and KIN 480 (functional anatomy) as elective possibilities. We were unaware of KIN 515 (injury biomechanics), but would also be open to suggesting this as a possible elective.

Academic Program Approval Voting Record

This document is to be appended as the last page of the proposal for any new or revised academic program to record the successive votes of approval as the proposal moves through its required review and approval steps. Consult Faculty Handbook Section 10.8 or the Faculty Senate Curriculum Committee website for information regarding Committee review and voting requirements for each action.

Curricular Action: (check appropriate boxes below)

1. New Program Name Change Discontinuation Concurrent Degree for:
2. Undergraduate Major Graduate Major Undergraduate Minor Graduate Minor
 Undergraduate Certificate Graduate Certificate Other: _____
3. Name of Proposed Change: Biomedical Engineering _____
4. Name of Contact Person: Ian Schneider, Associate Professor, Chemical and Biological Engineering _____ e-mail address: ians@iastate.edu _____
5. Primary College: Engineering _____ Secondary College: n/a _____
6. Involved Department(s): This is an interdepartmental major with Chemical and Biological Engineering, Electrical and Computer Engineering (ECpE), Materials Science and Engineering (MSE), and Mechanical Engineering (ME) as stakeholder departments.

Voting record for this curricular action:

Voting Body	Votes			Date of Vote
	For	Against	Abstain	
Dept. or Program Committee – N/A since this will be an interdepartmental program with biomedical engineering faculty governing the curriculum				
College Curriculum Committee	8	0	0	4/22/22
College Approval Vote	146	9	4	5/11/2022
Graduate Council				
Faculty Senate Curriculum Committee	6	0	0	9/12/2022
Faculty Senate Academic Affairs Council	8	0	0	9/21/2022
Faculty Senate				