**TO:** The Faculty of the College of Engineering

**FROM:** The School of Agricultural and Biological Engineering

**RE** Curriculum Changes - Biological Engineering Plan of Study

The faculty of the School of Agricultural & Biological Engineering have approved the following changes to the curriculum for Biological Engineering. The requested change to the plan of study adds additional course options to accommodate a new specialization.

**Summary of Changes:**

1. Add ABE 32500 – Soil and Water Resources Engineering as an option in addition to ABE 58000 – Process Engineering of Renewable Resources.
2. Add AGRY 25500 to list of one of the requirements for Biological and Food Sciences.
3. Add BioEnvironmental Selective to list of Biological & Science Selectives

**Reasons:**

ABE faculty have recognized an increasing demand for an environmental-focused curriculum within Biological Engineering from both students and industry. Bioprocessing manufacturers, including food and pharmaceutical industries are looking for innovative environmental controls, waste processing, and water treatment to meet corporate sustainability goals and to comply with increasingly strict governmental regulations. The engineering "rules-of-thumb" and design heuristics based on past practices that have been the standard in municipal wastewater treatment design are less applicable to treating the highly variable waste stream characteristics of specialized industries. In addition, there exists a high potential for identifying value added products from these water streams. Our core BE curriculum provides students with the necessary biology, microbiology, and process engineering skills to tackle these challenging environmental design issues, but needs specific topics in environmental and bioprocessing engineering to focus the skills and marketability of our graduates. Interest from current students in Biological Engineering has been confirmed by the questions raised about environmental options and research opportunities after listening to presentations from the Environmental and Natural Resources Engineering faculty during our sophomore seminar series. Additionally, we know that a growing number of our alumni are already doing work in this area as these environmental and treatment operations must be seamlessly integrated into the existing manufacturing processes that bioengineers already design and support. This new specialization builds upon two core strengths in ABE at Purdue: bioprocessing, and environmental and natural resource engineering, and this concentration will allow the faculty to build both programs by leveraging joint course offerings.

**Biological Engineering: Minimum Degree Requirements; Credit Hours Required for Graduation**

| **Present** | **Total Credit Hours** | **129** | **Proposed** | **Total Credit Hours** | **129** |
|---|---|---|---|---|---|
| ***Courses*** | | ***Credit Hours*** | ***Courses*** | | ***Credit Hours*** |
| **Mathematics and Basic Sciences** | | | **Mathematics and Basic Sciences** | | |
| Calculus: MA16500, 16600, 26100, 26200, 30300 | | **19** | Calculus: MA16500, 16600, 26100, 26200, 30300 | | **19** |
| *****Chemistry: CHM 11500, 11600, 25700 (or 25500 and 25501) | | **12 - 13** | *****Chemistry: CHM 11500, 11600, 25700 (or 25500 and 25501) | | **12 - 13** |
| Physics: PHYS 17200 | | **4** | Physics: PHYS 17200 | | **4** |
| Computer Science: CS 15900 | | **3** | Computer Science: CS 15900 | | **3** |
| **Biological and Food Sciences** | | | **Biological and Food Sciences** | | |
| Biological Sciences or Biotechnology: BIOL 11000 and 221 or IT 22600 with Biological Sciences selective and BIOL 23000 or BIOL 23100 | | **8** | Biological Sciences or Biotechnology: BIOL 11000 and BIOL 22100 or ABE 22600 with Biological Sciences selective and BIOL 23000 or BIOL 23100 | | **8** |
| *****BCHM 30700 or NUTR 20500 or CNIT 22700 or IT 22700; (option to add BCHM 30900, 1 cr. lab) | | **3** | *****BCHM 30700 or NUTR 20500 or CNIT 22700 or ABE 22700; (option to add BCHM 30900, 1 cr. lab) or AGRY 25500 | | **3** |
| *****Biological Sciences & Science Selectives | | **3** | *****Biological, Science, and BioEnvironmental Selectives | | **3** |
| **Engineering Tools and Skills** | | | **Engineering Tools and Skills** | | |
| ENGR 13100, ENGR 13200, CHE 32000 | | **7** | ENGR 13100, ENGR 13200, CHE 32000 | | **7** |
| **Professional Development** | | | **Professional Development** | | |
| ABE 29000, 49000 | | **2** | ABE 29000, 49000 | | **2** |
| **General Education:** | | | **General Education:** | | |
| Students must satisfy the requirements of both the College of Engineering's General Education Program and the College of Agriculture's Core. Selections must be chosen from approved lists in accordance with counsel from an advisor. COM 11400 and 3 credits of English Composition are required, 3 credit hours must be in economics (UCC approved) and 3 must be in the humanities (UCC approved). The remaining credit hours needed to attain the minimum of 24 should be chosen carefully and should also be used to meet College of Agriculture requirements for International Understanding and Multicultural Awareness. | | **24** | Students must satisfy the requirements of both the College of Engineering's General Education Program and the College of Agriculture's Core. Selections must be chosen from approved lists in accordance with counsel from an advisor. COM 11400 and 3 credits of English Composition are required, 3 credit hours must be in economics (UCC approved) and 3 must be in the humanities (UCC approved). The remaining credit hours needed to attain the minimum of 24 should be chosen carefully and should also be used to meet College of Agriculture requirements for International Understanding and Multicultural Awareness. | | **24** |
| **Core Engineering Courses** | | | **Core Engineering Courses** | | |
| Thermodynamics and Bioprocessing: ABE 20100, 20200, 30100, 30300 | | **13** | Thermodynamics and Bioprocessing: ABE 20100, 20200, 30100, 30300 | | **13** |
| Bioprocessing; Momentum, Heat and Mass Transfer: ABE 30400,30700, 30800 | | **9** | Bioprocessing; Momentum, Heat and Mass Transfer: ABE 30400,30700, 30800 | | **9** |

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|---|---|---|---|
| Kinetics and Reaction Engineering: ABE 37000 | **3** | Kinetics and Reaction Engineering: ABE 37000 | **3** |
| Sensors and Process Control: ABE 46000 | **3** | Sensors and Process Control: ABE 46000 | **3** |
| Transport Processes and Operations: ABE 45700, 55700 | **6** | Transport Processes and Operations: ABE 45700, 55700 | **6** |
| Biol. and Food Process Design: ABE 55800 | **3** | Biol. and Food Process Design: ABE 55800 | **3** |
| Process Engineering: ABE 58000 | **3** | Process Engineering: ABE 58000 or Soil and Water Resources Engineering (ABE 32500) | **3** |
| Technical Elective or Design of Electric Systems (ABE 31400) | **3** | Technical Elective or Design of Electric Systems (ABE 31400) | **3** |

***The total number of credit hours in these categories sum to 21.**

Bernard A. Engel
Professor and Head
Agricultural and Biological Engineering Department

Date: January 30th, 2018

**Biological Engineering Plan of Study Revisions**

| Present | | | | Proposed |
|---|---|---|---|---|
| ***Freshman Year*** | | | | |
| **First Semester** | | | | |
| (4) | CHM | 11500 | General Chemistry I | |
| ***(3)*** | | | ***English Composition Selective*** | No Change |
| (2) | ENGR | 13100 | Transforming Ideas to Innovation I | |
| (4) | MA | 16500 | Plane Analytic Geometry and Calculus I | |
| (4) | PHYS | 17200 | Modern Mechanics | |
| **17** | | | | **17** |
| **Second Semester** | | | | |
| (4) | CHM | 11600 | General Chemistry II | |
| (3) | COM | 11400 | Fundamentals of Speech Communications | No Change |
| (4) | MA | 16600 | Plane Analytic Geometry and Calculus II | |
| (2) | ENGR | 13200 | Transforming Ideas to Innovation II | |
| (3) | CS | 15900 | Programming Applications for Engineers | |
| **16** | | | | **16** |
| ***Sophomore Year*** | | | | |
| **Third Semester** | | | | |
| (4) | ABE | 20100 | Thermodynamics of Biological Systems I | |
| (4) | MA | 26100 | Multivariate Calculus | |
| (4) | CHM | 25700 | Organic Chemistry or Organic Chemistry I 25500 and Organic Chemistry Lab I 25501 | |
| (4/5) | BIOL | 11000 | Fundamentals of Biology I or ABE 22600 (Biotech. Lab – 2 cr) with 3 cr. BIOL 23000 (Biology of the Living Cell) or BIOL 23100 (Cell Structure & Function) | No Change |
| (1) | ABE | 29000 | Sophomore Seminar | |
| **17/18** | | | | **17/18** |

**Fourth Semester**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (3) | ABE | 20200 | Thermodynamics of Biological Systems II | (3) | ABE | 20200 | Thermodynamics of Biological Systems II |
| (3) | CHE | 32000 | Statistical Modeling | (3) | CHE | 32000 | Statistical Modeling |
| (3/4 / 5) | NUTR | 20500 | Food Sci. I; or Biochemistry (BCHM 30700) option to add 1 cr. Lab (BCHM 30900); or take Econ. Selective along with Bioinformatics (CNIT 22700) or Biotech. Lab (IT 22700) | (3/4 / 5) | NUTR | 20500 | Food Sci. I; or Biochemistry (BCHM 30700) option to add 1 cr. Lab (BCHM 30900); or take Econ. Selective along with Bioinformatics (CNIT 22700) or Biotech. Lab (ABE 22700) or Soil Science (AGRY 25500) |
| (4) | MA | 26200 | Linear Algebra and Differential Equations | (4) | MA | 26200 | Linear Algebra and Differential Equations |
| (3) | | | Approved Humanities Selective | (3) | | | Approved Humanities Selective |
| **16/17/18** | | | | **16/17/18** | | | |

| **Present** | | | | **Proposed** | | | |
|---|---|---|---|---|---|---|---|
| ***Junior Year*** | | | | | | | |
| **Fifth Semester** | | | | | | | |
| (3) | ABE | 37000 | Biol./Microb. Kinetics & React. Engr. | (3) | ABE | 37000 | Biol./Microb. Kinetics & React. Engr. |
| (3) | ABE | 30300 | App of Phys. Chemistry to Biol. Processes | (3) | ABE | 30300 | App of Phys. Chemistry to Biol. Processes |
| (3) | ABE | 30700 | Momentum Transfer | (3) | ABE | 30700 | Momentum Transfer |
| (4) | BIOL | 22100 | Introduction to Microbiology or 3 cr Biology Selective | (4) | BIOL | 22100 | Introduction to Microbiology or 4 cr Biology Selective or ABE 32500 Soil and Water Resources Engineering |
| (3) | MA | 30300 | Differential Equations and Partial Differential Equations for Engineering and the Sciences | (3) | MA | 30300 | Differential Equations and Partial Differential Equations for Engineering and the Sciences |
| **16** | | | | **16** | | | |

**Sixth Semester**

| | | | | |
|---|---|---|---|---|
| (3) | ABE | 30100 | Modeling. & Cmptnl. Tools in Bio. Engr. | |
| (3) | ABE | 45700 | Transport Processes in Biol. & Food Process Systems | No Change |
| (3) | ABE | 30800 | Heat & Mass Tran. in Food & Biol. Sys. | |
| (3) | ABE | 30400 | Bioprocess Engineering Laboratory | |
| (3) | ABE | 31400 | Design of Electronic Systems | |
| (3) | | | Economics Selective | |
| **18** | | | | **18** |

***Senior Year***

**Seventh Semester**

| | | | | | | |
|---|---|---|---|---|---|---|
| (3) | ABE | 55700 | Transport Operations in Food & Biol. Engr. II | (3) | ABE | 55700 | Transport Operations in Food & Biol. Engr. II |
| (1) | ABE | 49000 | Professional Practice in Agr.& Biol. Engr. | (1) | ABE | 49000 | Professional Practice in Agr.& Biol. Engr. |
| (3) | ABE | 46000 | Sensors and Process Control | (3) | ABE | 46000 | Sensors and Process Control |
| (3/4) | | | Humanities or Social Sciences or Engineering Selective | (3/4) | | | Humanities or Social Sciences or Engineering Selective or Biology Selective |
| (3) | | | Written & Oral Communication Selective | (3) | | | Written or Oral Communication Selective |
| **13/14** | | | | **13/14** | | | |

**Eighth Semester**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (3) | ABE | 58000 | Process Engr. of Renewable Resources | (3) | ABE | 58000 | Process Engr. of Renewable Resources or BioEnvironmental Selective |
| (3) | ABE | 55800 | Process Design for Food & Biol. Systems | (3) | ABE | 55800 | Process Design for Food & Biol. Systems |
| (3) | | | Biol., Food Sci., or 3 cr. Pharm. Selective or Cell & Molecular Des. Prin. (ABE 440) | (3) | | | Biol., Food Sci., or 3 cr. Pharm. Selective or Cell & Molecular Des. Prin. (ABE 440) |
| (3) | | | Humanities or Social Sciences or Engineering Selective | (3) | | | Humanities or Social Sciences or Engineering Selective |
| (3) | | | Humanities or Social Science Selective (300+ level) | (3) | | | Humanities or Social Science Selective (300+ level) |
| **15** | | | | **15** | | | |

**Total 129** **Total 129**