PART I – NEW ACADEMIC PROGRAMS AND PROGRAM CHANGES

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

1. Request to change the requirements for the Bachelor of Science degree in Food Science in the Department of Food Science and Human Nutrition.

The concentrations in the Bachelor of Science degree in Food Science are noted on the student’s academic record when the requirements for the degree have been completed.

a. Under the heading Requirements for the Bachelor of Science Degree in Food Science make the following changes:

(1) In the Food Business and Industry concentration, add the following courses in item (2):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB 265</td>
<td>Hospitality Food Service Systems I</td>
<td>3</td>
</tr>
<tr>
<td>HB 347</td>
<td>Hospitality Supply Chain Process</td>
<td>3</td>
</tr>
<tr>
<td>HB 358</td>
<td>Hospitality Entrepreneurship</td>
<td>3</td>
</tr>
<tr>
<td>HB 365</td>
<td>Hospitality Foodservice Systems II</td>
<td>3</td>
</tr>
<tr>
<td>HB 409</td>
<td>Introduction to Wine</td>
<td>3</td>
</tr>
<tr>
<td>HB 411</td>
<td>Hospitality Beverages</td>
<td>3</td>
</tr>
</tbody>
</table>

(2) In the Food Technology concentration, delete the following courses in item (2):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB 100</td>
<td>Introduction to Hospitality Business</td>
<td>2</td>
</tr>
<tr>
<td>HB 267</td>
<td>Management of Food and Beverage Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Add the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB 100</td>
<td>Introduction to Hospitality Business</td>
<td>3</td>
</tr>
<tr>
<td>HB 347</td>
<td>Hospitality Supply Chain Process</td>
<td>3</td>
</tr>
<tr>
<td>HB 358</td>
<td>Hospitality Entrepreneurship</td>
<td>3</td>
</tr>
<tr>
<td>HB 365</td>
<td>Hospitality Foodservice Systems II</td>
<td>3</td>
</tr>
<tr>
<td>HB 411</td>
<td>Hospitality Beverages</td>
<td>3</td>
</tr>
</tbody>
</table>

Effective Fall 2024.

COLLEGE OF ENGINEERING

1. Request to establish a Minor in Smart Agricultural Systems in the Department of Department of Biosystems and Agricultural Engineering. The University Committee on Undergraduate Education (UCUE) recommended approval of this request at its March 7, 2024 meeting.

a. Background Information:

The overall purpose of the Minor in Smart Agricultural Systems (SAS) is to provide students with an understanding of current digital and emerging technologies such as artificial intelligence, machine learning, Internet of Things (IoT), sensors and automation that support modern, sustainable, productive, and resilient agriculture. The SAS Minor is a crosscutting minor providing broader employment opportunities to students in engineering majors. Students completing the minor will have the ability to:

- Identify current and emerging technologies that monitor, measure, and analyze agriculture, food, fiber, feed, and bioenergy systems;
- Identify, develop, and deploy technological solutions for agricultural systems to improve system efficiency, sustainability, and resiliency.

Engineering technology and innovations have contributed to transforming agriculture into a highly productive and efficient sector of the U.S. economy. In 2021, the agrifood sector contributed roughly $1.264 trillion to the U.S. gross domestic product (GDP), a 5.4% share (USDA ERS). Total U.S. agricultural exports were valued at $177 billion in 2021, more than any other sector of the
Innovations such as the diesel engine, rural electrification, and agricultural mechanization have played a significant role in transforming agriculture and increasing farm productivity. In the early 1900s, nearly 2/3 of the 135 million U.S. population was engaged in farming. Today, this number is less than 5% while creating more than 10% of total U.S. employment in the agrifood related industries. The National Academy of Engineers (NAE) has listed agricultural mechanization as the 7th most significant engineering achievement of the 20th Century.

Global agrifood system faces many challenges including population growth, climate change, rapid urbanization, and diet transformation. It is expected that by the year 2100 the global population will reach 10.9 billion with Africa and Asia comprising more than 80% of the population. It is also projected that by 2050 the global middle class will increase to 70% resulting in a significant increase in demand for animal protein. According to the Global Harvest Initiative 2014 Gap Report (GHI, 2014), by 2030 demand for poultry will increase by 63%, milk by 55% and meat by 44%. Producing this extra amount will require land, water, and energy resources that are already limited. For example, agricultural land will shrink to 0.17 ha/capita in 2025 from 0.44 ha/capita in 1960. It is also expected that by 2030 energy demand will increase by 50% (IEA) and water by 30% (IFPRI). Clearly, to meet the growing demand, global agriculture will need to be productive, efficient, resilient, and sustainable. Emerging engineering technologies and innovations such as artificial intelligence, data analytics, sensors and sensing (including remote sensing), Internet of Things (IoT), automation, robotics and drone technologies hold much promise in meeting these challenges.

The objective of the proposed Minor in Smart Agricultural Systems is to prepare engineering majors in Applied Engineering Sciences, Biosystems Engineering, Computational Data Science, Computer Engineering, Computer Science, Electrical Engineering, and Mechanical Engineering for the rapidly evolving smart ag industry.

b. **Academic Programs Catalog Text:**

The Minor in Smart Agricultural Systems, which is administered by the Department of Biosystems and Agricultural Engineering, is designed to serve students with majors in Applied Engineering Sciences, Biosystems Engineering, Computational Data Science, Computer Engineering, Computer Science, Electrical Engineering, and Mechanical Engineering who are interested in smart technology for management decision support and who plan to pursue careers in agriculture or natural resources. The minor will provide an opportunity for students to gain a working knowledge of digital technologies necessary to monitor and manage aspects of agriculture, food, natural resources, and bioenergy systems.

With the approval of the department and college that administer the student’s degree program, the courses that are used to satisfy the minor may also be used to satisfy the requirements for the bachelor’s degree. At least 10 unique credits counted towards the requirements for a student’s minor must not be used to fulfill the requirements for that student’s major.

Students who plan to complete the requirements of the minor should consult the Smart Agricultural Systems minor program coordinator in the Department of Biosystems Engineering and have their program of study approved in advance and in writing.

**Requirements for the Minor in Smart Agricultural Systems**

Students must complete a minimum of 16 credits from the following:

<table>
<thead>
<tr>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All of the following courses (10 credits):</td>
</tr>
<tr>
<td>BE' 221 Introduction to Smart Agriculture 1</td>
</tr>
<tr>
<td>BE 321 Principles of Precision Agriculture 3</td>
</tr>
<tr>
<td>BE 421 Sensors and Robotics for Agricultural Systems 3</td>
</tr>
<tr>
<td>BE 422 Crop Modeling and Optimization 3</td>
</tr>
<tr>
<td>2. Two of the following courses (6 or 7 credits):</td>
</tr>
<tr>
<td>BE 449 Human Health Risk Analysis for Engineering Controls 3</td>
</tr>
<tr>
<td>BE 456 Electric Power and Control 3</td>
</tr>
<tr>
<td>BE 481 Water Resources Systems Analysis and Modeling 3</td>
</tr>
<tr>
<td>BE 482 Engineering Ecological Treatment Systems 3</td>
</tr>
<tr>
<td>CSE 404 Introduction to Machine Learning 3</td>
</tr>
<tr>
<td>CSE 440 Introduction to Artificial Intelligence 3</td>
</tr>
<tr>
<td>CSE 480 Database Systems 3</td>
</tr>
<tr>
<td>CSE 482 Big Data Analysis 3</td>
</tr>
</tbody>
</table>
PART I - NEW ACADEMIC PROGRAMS AND PROGRAM CHANGES – continued - 3
April 16, 2024

Effective Fall 2024.

2. Request to change the requirements in the Master of Science degree in Computer Science in the Department of Computer Science and Engineering. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2024 meeting.

   a. Under the heading Requirements for the Master of Science Degree in Computer Science make the following changes:

      (1) Under the heading System Design and Analysis, add the following courses:

          CSE 834 Advanced Topics in Automated Vehicles 3
          CSE 893 Selected Topics in System Design and Analysis 3

      (2) Under the heading Theory and Algorithms add the following course:

          CSE 894 Selected Topics in Theory and Algorithms 3

      Delete the following course:

          CSE 836 Probabilistic Models and Algorithms in Computational Biology 3

      (3) Under the heading Data Analysis and Applications add the following courses:

          CSE 850 Advanced Topics in Adversarial Machine Learning 3
          CSE 851 Genetic Programming 3
          CSE 895 Selected Topics in Data Analysis and Applications 3

      Delete the following courses:

          CSE 843 Language and Interaction 3
          CSE 872 Advanced Computer Graphics 3

Effective Spring 2025.

3. Request to change the requirements in the Doctor of Philosophy degree in Computer Science in the Department of Computer Science and Engineering. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2024 meeting.

   a. Under the heading Requirements for the Doctor of Philosophy Degree in Computer Science make the following changes:

      (1) Under the heading System Design and Analysis, add the following courses:

          CSE 834 Advanced Topics in Automated Vehicles 3
          CSE 893 Selected Topics in System Design and Analysis 3

      (2) Under the heading Theory and Algorithms add the following course:

          CSE 894 Selected Topics in Theory and Algorithms 3
Delete the following course:

CSE 836 Probabilistic Models and Algorithms in Computational Biology 3

(3) Under the heading Data Analysis and Applications add the following courses:

CSE 850 Advanced Topics in Adversarial Machine Learning 3
CSE 851 Genetic Programming 3
CSE 895 Selected Topics in Data Analysis and Applications 3

Delete the following courses:

CSE 843 Language and Interaction 3
CSE 872 Advanced Computer Graphics 3

Effective Spring 2025.

**COLLEGE OF HUMAN MEDICINE**

1. Request to change the requirements for the Master of Public Health degree in Public Health in the College of Human Medicine. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2024 meeting.

The concentrations in the Master of Public Health degree in Public Health are noted on the student's academic record when the requirements for the degree have been completed.

a. Under the heading Requirements for the Master of Public Health Degree in Public Health make the following change:

(1) Change all ‘HM’ required courses to ‘PH’.

(2) Add the following concentrations:

**Data Management and Analytics Concentration**
Provides students with the data management and analytic skillset needed to effectively utilize a variety of public health and health care data sources for applied public health practice and research purposes, while integrating a data equity framework into all aspects of this work. Students completing this concentration will possess the skills to access, manage, assess, analyze, and report findings from a myriad of data sources commonly used in public health such as, vital records, surveys, surveillance, and in the healthcare delivery setting such as, administrative claims data, electronic medical records data. These concentration courses will prepare MPH students with the applied skills needed to pursue careers in public health positions which require skills in data management and analyses.

All the following courses (9 credits):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 826</td>
<td>Data Management in Public Health Practice</td>
<td>3</td>
</tr>
<tr>
<td>PH 878</td>
<td>Applied Biostatistics for Public Health Practitioners</td>
<td>3</td>
</tr>
<tr>
<td>PH 829</td>
<td>Public Health and Healthcare Delivery Data</td>
<td>3</td>
</tr>
</tbody>
</table>

**Rural Public Health Concentration**
Provides students with sufficient skills and knowledge to effectively work as public health leaders and practitioners in rural communities, both globally and domestically. Students completing this concentration will develop an understanding of how unique social, cultural, political, and environmental characteristics of rural communities, as well as structural, systemic, and historical influences, affect everything from rural health and well-being to public health and health care delivery, policy development, collaborative opportunities, and advocacy strategies. Courses in the concentration will prepare MPH students with a unique set of applied skills needed to pursue careers in rural public health.
All the following courses (9 credits):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH 830</td>
<td>Foundations of Rural Public Health</td>
<td>3</td>
</tr>
<tr>
<td>PH 834</td>
<td>Drivers of Rural Health</td>
<td>3</td>
</tr>
<tr>
<td>PH 839</td>
<td>Rural Public Health Policy and Advocacy</td>
<td>3</td>
</tr>
</tbody>
</table>

Effective Fall 2024.

**COLLEGE OF NATURAL SCIENCE**

1. Request to change the requirements for the Bachelor of Science degree in Neuroscience in the College of Natural Science.

   a. Under the heading Requirements for the Bachelor of Science Degree in Neuroscience replace item 3. with the following:

      a. One of the following groups of courses (8 or 9 credits):

         (1) BS 161 Cell and Molecular Biology 3
         BS 162 Organismal and Population Biology 3
         BS 171 Cell and Molecular Biology Laboratory 2
         (2) BS 181H Honors Cell and Molecular Biology 3
         BS 182H Honors Organismal and Population Biology 3
         BS 191H Honors Cell and Molecular Biology Laboratory 2
         (3) LB 144 Biology I: Organismal Biology 4
         LB 145 Biology II: Cellular and Molecular Biology 5

      b. One of the following groups of courses (7 or 8 credits):

         (1) CEM 141 General Chemistry 4
         CEM 142 General and Inorganic Chemistry 3
         (2) CEM 151 General and Descriptive Chemistry 4
         CEM 152 Principles of Chemistry 3
         (3) CEM 181H Honors Chemistry I 4
         CEM 182H Honors Chemistry II 4
         (4) LB 171 Principles of Chemistry I 4
         LB 172 Principles of Chemistry II 3

      c. One of the following courses (1 credit):

         CEM 161L Chemistry Laboratory I 1
         LB 171L Introductory Chemistry Laboratory 1
         CEM 185H Honors Chemistry Laboratory I 2

      d. Both of the following courses (6 credits):

         CEM 251 Organic Chemistry I 3
         CEM 252 Organic Chemistry II 3

      e. One of the following groups of courses (6 or 8 credits):

         (1) PHY 221 Studio Physics for Life Scientists I 4
         PHY 222 Studio Physics for Life Scientists II 4
         (2) PHY 231 Introductory Physics I 3
         PHY 232 Introductory Physics II 3
         (3) PHY 183 Physics for Scientists and Engineers I 4
         PHY 184 Physics for Scientists and Engineers II 4
         (4) PHY 193H Honors Physics I-Mechanics 4
         PHY 294H Honors Physics II-Electromagnetism 4
         (5) LB 273 Physics I 4
         LB 274 Physics II 4

      f. One of the following courses (3 or 4 credits):

         MTH 124 Survey of Calculus I 3
         MTH 132 Calculus I 3
         MTH 152H Honors Calculus I 3
         LB 118 Calculus I 4

      g. One of the following courses (3 or 4 credits):

         STT 201 Statistical Methods 4
         STT 231 Statistics for Scientists 3
         STT 421 Statistics I 3
         STT 464 Statistics for Biologists 3
2. Request to change the name of the Bachelor of Arts degree in Computational Mathematics to Computational Mathematics and Applied Mathematics in the Department of Mathematics.

No new students are to be admitted to the Bachelor of Arts degree in Computational Mathematics effective Fall 2024. No students are to be readmitted to Bachelor of Arts degree in Computational Mathematics effective Fall 2024. Effective Fall 2029, coding for the Bachelor of Arts degree in Computational Mathematics will be discontinued and the program will no longer be available in the Department of Mathematics. Students admitted to the bachelor’s degree prior to Fall 2024 will be awarded a Bachelor of Arts degree in Computational Mathematics in the Department of Mathematics. Students admitted to the bachelor’s degree Fall 2024 and forward will be awarded a Bachelor of Arts degree in Computational Mathematics and Applied Mathematics in the Department of Mathematics.

3. Request to change the requirements for the Bachelor of Arts degree in Computational Mathematics and Applied Mathematics in the Department of Mathematics.

a. Under the heading Computational Mathematics and Applied Mathematics make the following changes:

(1) In item 1., delete the following statement:

Students who are in the teacher certification program are required to complete Mathematics 330 or 432 and Statistics and Probability 430.

(2) Replace item 3. with the following:

a. The following courses outside the Department of Mathematics (27 credits):

(1) One course of at least 3 credits in biological science, entomology, microbiology, physiology, plant biology, or integrative biology.

(2) One of the following courses (4 credits):
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEM 141</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CEM 151</td>
<td>General and Descriptive Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>CEM 181H</td>
<td>Honors Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>LB 171</td>
<td>Principles of Chemistry I</td>
<td>4</td>
</tr>
</tbody>
</table>

(3) One of the following courses (4 or 5 credits):
- PHY 183  Physics for Scientists and Engineers I  4
- LB 273   Physics I                 4
- PHY 173  Studio Physics for Scientists and Engineers I  5
- PHY 193H Honors Physics I – Mechanics  4

(4) At least 2 credits in laboratory in biological science, chemistry, entomology, microbiology, physiology, plant biology, or integrative biology from the following:

(5) A minimum of 6 credits beyond the university requirements in courses from the College of Arts and Letters or the College of Social Science approved by the student’s academic advisor.

(6) One of the following groups of courses (8 credits):

(a) CSE 231 Introduction to Programming I  4
(b) CSE 232 Introduction to Programming II  4
(c) CMSE 201 Computational Modelling and Data Analysis I  4
(d) CMSE 202 Computational Modelling and Data Analysis II  4

b. The following courses from the Department of Mathematics:

(1) One course from each of the following groups (11 or 12 credits):

(a) MTH 132 Calculus I  3
(b) MTH 152H Honors Calculus I  3
(c) LB 118 Calculus I  4

(b) MTH 153H Honors Calculus II  4
(c) LB 119 Calculus II  4

(2) One of the following groups (4 or 7 credits):

(a) MTH 299 Transitions  4
(b) MTH 314 Matrix Algebra with Computational Applications  3
(c) MTH 317H Honors Linear Algebra  4

(3) Completion of one of the following groups of courses (12 credits):

(a) **Differential Equations and Numerical Methods**
   (i) One of the following courses:
   - MTH 235 Differential Equations  3
   - MTH 340 Ordinary Differential Equations I  3
   - MTH 347H Honors Ordinary Differential Equations  3

   (ii) One of the following courses:
   - MTH 320 Analysis I  3
   - MTH 327H Honors Introduction to Analysis  3

   (iii) The following course:
   - MTH 451 Numerical Analysis I  3

   (iv) One of the following courses:
   - MTH 441 Ordinary Differential Equations II  3
   - MTH 442 Partial Differential Equations  3
   - MTH 452 Numerical Analysis II  3

(b) **Probability and Discrete Mathematics**
   (i) The following course:
   - STT 441 Probability and Statistics I: Probability  3
(ii) One of the following courses:
MTH 320 Analysis I 3
MTH 327H Honors Introduction to Analysis 3

(iii) Both of the following courses:
MTH 481 Discrete Mathematics I 3
MTH 482 Discrete Mathematics II 3

(c) Applied Algebra and Discrete Mathematics
(i) One of the following courses:
MTH 310 Abstract Algebra I and Number Theory 3
MTH 418H Honors Algebra I 3

(ii) All of the following courses:
MTH 416 Introduction to Algebraic Coding 3
MTH 481 Discrete Mathematics I 3
MTH 482 Discrete Mathematics II 3

(d) Mathematical Machine Learning
(i) One of the following courses:
MTH 320 Analysis I 3
MTH 327H Honors Introduction to Analysis 3

(ii) All of the following courses:
MTH 483 Mathematical Machine Learning 3
STT 441 Probability and Statistics I: Probability 3
STT 442 Probability and Statistics II: Statistics 3

(4) Both of the following courses (6 credits):
MTH 415 Applied Linear Algebra 3
MTH 496 Capstone in Mathematics (W) 3

(5) Complete five elective courses from the following lists of electives with at least two from the **Mathematics Electives** list. All courses listed may only be used if not being used to meet a course requirement in requirement (3) above (15 to 20 credits):

**Mathematics Electives**
MTH 310 Abstract Algebra 3
Or
MTH 418H Honors Algebra I 3
MTH 320 Analysis I 3
or
MTH 327H Honors Introduction to Analysis 3
MTH 411 Abstract Algebra II 3
or
MTH 419H Honors Algebra II 3
MTH 416 Introduction to Algebraic Coding 3
MTH 417 Topics in Number Theory 3
MTH 421 Analysis II 3
or
MTH 429H Honors Real Analysis 3
MTH 425 Complex Analysis 3
MTH 441 Ordinary Differential Equations II 3
MTH 442 Partial Differential Equations 3
MTH 451 Numerical Analysis I 3
MTH 452 Numerical Analysis II 3
MTH 457 Introduction to Financial Mathematics 3
MTH 461 Metric and Topological Spaces 3
MTH 481 Discrete Mathematics I 3
MTH 482 Discrete Mathematics II 3
MTH 483 Mathematical Machine Learning 3

Other 400-level or above MTH courses approved by the Department of Mathematics.
Other Electives
Approval of the College of Engineering is required to enroll in all CSE or ECE courses listed.

CMSE 404  Introduction to Machine Learning  3
CSE  402  Biometrics and Pattern Recognition  3
CSE  404  Introduction to Machine Learning  3
CSE  425  Introduction to Computer Security  3
CSE  450  Translation of Programming Languages  3
CSE  460  Computability and Formal Language Theory  3
CSE  472  Computer Graphics  3
CSE  482  Big Data Analysis  3
ECE  305  Electromagnetic Fields and Waves I  4
ECE  366  Introduction to Signal Processing  3
ECE  405  Electromagnetic Fields and Waves II  4
ECE  446  Biomedical Signal Processing  3
ECE  447  Introduction to Biomedical Imaging  3
ECE  449  Fundamentals of Acoustics  3
ECE  457  Communication Systems  3
PHY  410  Thermal and Statistical Physics  3
PHY  415  Methods of Theoretical Physics  4
PHY  422  Classical Mechanics II  3
PHY  471  Quantum Physics I  3
PHY  472  Quantum Physics II  3
PHY  480  Computational Physics  3
PHY  481  Electricity and Magnetism I  3
PHY  482  Electricity and Magnetism II  3
STT  381  Fundamentals of Data Science Methods  4
STT  441  Probability and Statistics I: Probability  3
STT  442  Probability and Statistics II: Statistics  3
STT  455  Actuarial Models I  3
STT  461  Computations in Probability and Statistics  3
STT  465  Bayesian Statistical Methods  3
Other 400-level or above courses approved by the Department of Mathematics.

Effective Fall 2024.

4. Request to change the name of the Bachelor of Science degree in Computational Mathematics to Computational Mathematics and Applied Mathematics in the Department of Mathematics.

No new students are to be admitted to the Bachelor of Science degree in Computational Mathematics effective Fall 2024. No students are to be readmitted to Bachelor of Science degree in Computational Mathematics effective Fall 2024. Effective Fall 2029, coding for the Bachelor of Science degree in Computational Mathematics will be discontinued and the program will no longer be available in the Department of Mathematics. Students admitted to the bachelor’s degree prior to Fall 2024 will be awarded a Bachelor of Science degree in Computational Mathematics in the Department of Mathematics. Students admitted to the bachelor’s degree Fall 2024 and forward will be awarded a Bachelor of Science degree in Computational Mathematics and Applied Mathematics in the Department of Mathematics.

5. Request to change the requirements for the Bachelor of Science degree in Computational Mathematics and Applied Mathematics in the Department of Mathematics.

   a. Under the heading Computational Mathematics and Applied Mathematics make the following changes:

      (1) In item 1., delete the following statement:

      Students who are in the teacher certification program are required to complete Mathematics 330 or 432 and Statistics and Probability 430.

      (2) Replace item 3. with the following:

     a. The following courses outside the Department of Mathematics (28 credits):
(1) One course of at least 3 credits in biological science, entomology, microbiology, physiology, plant biology, or integrative biology.

(2) One course from each of the following groups (8 or 10 credits):
   (a) CEM 141 General Chemistry 4
       CEM 151 General and Descriptive Chemistry 4
       CEM 181H Honors Chemistry I 4
       LB 171 Principles of Chemistry I 4
   (b) CEM 142 General and Inorganic Chemistry 3
       CEM 152 Principles of Chemistry 3
       CEM 182H Honors Chemistry II 4
       LB 172 Principles of Chemistry II 3
   (c) CEM 161 Chemistry Laboratory I 1
       CEM 185H Honors Chemistry Laboratory 2
       LB 171L Introductory Chemistry Laboratory I 1

(3) One course from each of the following groups (8 or 10 credits):
   (a) PHY 183 Physics for Scientists and Engineers I 4
       LB 273 Physics I 4
       PHY 173 Studio Physics for Scientists and Engineers I 5
       PHY 193H Honors Physics I – Mechanics 4
   (b) LB 274 Physics II 4
       PHY 184 Physics for Scientists and Engineers I 4
       PHY 174 Physics II 5
       PHY 294H Honors Physics II – Electromagnetism 4

(4) At least 1 credit in laboratory in biological science, chemistry, entomology, microbiology, physiology, plant biology, or integrative biology from the following:

(5) One of the following groups of courses (8 credits):
   (a) CSE 231 Introduction to Programming I 4
       CSE 232 Introduction to Programming II 4
   (b) CMSE 201 Computational Modelling and Data Analysis I 4
       CMSE 202 Computational Modelling and Data Analysis II 4

b. The following courses from the Department of Mathematics:
   (1) One course from each of the following groups (11 or 12 credits):
       (a) MTH 132 Calculus I 3
           MTH 152H Honors Calculus I 3
           LB 118 Calculus I 4
       (b) MTH 133 Calculus II 4
           MTH 153H Honors Calculus II 4
           LB 119 Calculus II 4
       (c) MTH 234 Multivariable Calculus 4
           MTH 254H Honors Multivariable Calculus 4
           LB 220 Calculus III 4
   (2) One of the following groups (4 or 7 credits):
       (a) MTH 299 Transitions 4
           MTH 309 Linear Algebra I 3
       (b) MTH 299 Transitions 4
           MTH 314 Matrix Algebra with Computational Applications 3
       (c) MTH 317H Honors Linear Algebra 4
   (3) Completion of one of the following groups of courses (12 credits):
       (a) **Differential Equations and Numerical Methods**
           (i) One of the following courses:
               MTH 235 Differential Equations 3
               MTH 340 Ordinary Differential Equations I 3
               MTH 347H Honors Ordinary Differential Equations 3

           (ii) One of the following courses:
MTH 320 Analysis I 3
MTH 327H Honors Introduction to Analysis 3

(iii) The following course:
MTH 451 Numerical Analysis I 3

(iv) One of the following courses:
MTH 441 Ordinary Differential Equations II 3
MTH 442 Partial Differential Equations 3
MTH 452 Numerical Analysis II 3

(b) Probability and Discrete Mathematics
   (i) The following course:
   STT 441 Probability and Statistics I: Probability 3

   (ii) One of the following courses:
   MTH 320 Analysis I 3
   MTH 327H Honors Introduction to Analysis 3

   (iii) Both of the following courses:
   MTH 481 Discrete Mathematics I 3
   MTH 482 Discrete Mathematics II 3

(c) Applied Algebra and Discrete Mathematics
   (i) One of the following courses:
   MTH 310 Abstract Algebra I and Number Theory 3
   MTH 418H Honors Algebra I 3

   (ii) All of the following courses:
   MTH 416 Introduction to Algebraic Coding 3
   MTH 481 Discrete Mathematics I 3
   MTH 482 Discrete Mathematics II 3

(d) Mathematical Machine Learning
   (i) One of the following courses:
   MTH 320 Analysis I 3
   MTH 327H Honors Introduction to Analysis 3

   (ii) All of the following courses:
   MTH 483 Mathematical Machine Learning 3
   STT 441 Probability and Statistics I: Probability 3
   STT 442 Probability and Statistics II: Statistics 3

(4) Both of the following courses (6 credits):
MTH 415 Applied Linear Algebra 3
MTH 496 Capstone in Mathematics (W) 3

(5) Complete five elective courses from the following lists of electives with at least two from the Mathematics Electives list. All courses listed may only be used if not being used to meet a course requirement in requirement (3) above (15 to 20 credits):

Mathematics Electives
MTH 310 Abstract Algebra 3

Or
MTH 418H Honors Algebra I 3
MTH 320 Analysis I 3

or
MTH 327H Honors Introduction to Analysis 3
MTH 411 Abstract Algebra II 3

or
MTH 419H Honors Algebra II 3
MTH 416 Introduction to Algebraic Coding 3
MTH 417 Topics in Number Theory 3
MTH 421 Analysis II 3

or
### MTH Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 429H</td>
<td>Honors Real Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MTH 425</td>
<td>Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MTH 441</td>
<td>Ordinary Differential Equations II</td>
<td>3</td>
</tr>
<tr>
<td>MTH 442</td>
<td>Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MTH 451</td>
<td>Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MTH 452</td>
<td>Numerical Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MTH 457</td>
<td>Introduction to Financial Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>MTH 461</td>
<td>Metric and Topological Spaces</td>
<td>3</td>
</tr>
<tr>
<td>MTH 481</td>
<td>Discrete Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>MTH 482</td>
<td>Discrete Mathematics II</td>
<td>3</td>
</tr>
<tr>
<td>MTH 483</td>
<td>Mathematical Machine Learning</td>
<td>3</td>
</tr>
</tbody>
</table>

Other 400-level or above MTH courses approved by the Department of Mathematics.

### Other Electives

Approval of the College of Engineering is required to enroll in all CSE or ECE courses listed.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMSE 404</td>
<td>Introduction to Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>CSE 402</td>
<td>Biometrics and Pattern Recognition</td>
<td>3</td>
</tr>
<tr>
<td>CSE 404</td>
<td>Introduction to Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>CSE 425</td>
<td>Introduction to Computer Security</td>
<td>3</td>
</tr>
<tr>
<td>CSE 450</td>
<td>Translation of Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td>CSE 460</td>
<td>Computability and Formal Language Theory</td>
<td>3</td>
</tr>
<tr>
<td>CSE 472</td>
<td>Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>CSE 482</td>
<td>Big Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ECE 305</td>
<td>Electromagnetic Fields and Waves I</td>
<td>4</td>
</tr>
<tr>
<td>ECE 386</td>
<td>Introduction to Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 405</td>
<td>Electromagnetic Fields and Waves II</td>
<td>4</td>
</tr>
<tr>
<td>ECE 446</td>
<td>Biomedical Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 447</td>
<td>Introduction to Biomedical Imaging</td>
<td>3</td>
</tr>
<tr>
<td>ECE 449</td>
<td>Fundamentals of Acoustics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 457</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>PHY 410</td>
<td>Thermal and Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHY 415</td>
<td>Methods of Theoretical Physics</td>
<td>4</td>
</tr>
<tr>
<td>PHY 422</td>
<td>Classical Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>PHY 471</td>
<td>Quantum Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PHY 472</td>
<td>Quantum Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHY 480</td>
<td>Computational Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHY 481</td>
<td>Electricity and Magnetism I</td>
<td>3</td>
</tr>
<tr>
<td>PHY 482</td>
<td>Electricity and Magnetism II</td>
<td>3</td>
</tr>
<tr>
<td>STT 381</td>
<td>Fundamentals of Data Science Methods</td>
<td>4</td>
</tr>
<tr>
<td>STT 441</td>
<td>Probability and Statistics I: Probability</td>
<td>3</td>
</tr>
<tr>
<td>STT 442</td>
<td>Probability and Statistics II: Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STT 455</td>
<td>Actuarial Models I</td>
<td>3</td>
</tr>
<tr>
<td>STT 461</td>
<td>Computations in Probability and Statistics</td>
<td>3</td>
</tr>
<tr>
<td>STT 465</td>
<td>Bayesian Statistical Methods</td>
<td>3</td>
</tr>
</tbody>
</table>

Other 400-level or above courses approved by the Department of Mathematics.

Effective Fall 2024.
6. Request to change the requirements for the **Bachelor of Arts** degree in **Mathematics, Advanced** in the Department of Mathematics.

   a. Under the heading **Requirements for the Bachelor of Arts Degree in Mathematics, Advanced** make the following changes:

   (1) Replace item 3. a. (1) with the following:

   One of the following courses (3 or 4 credits):
   - BS 161  Cell and Molecular Biology 3
   - IBIO 150  Integrating Biology: From DNA to Populations 3
   - PLB 105  Plant Biology 3
   - ENT 205  Pests, Society, and Environment 3
   - PSL 250  Introductory Physiology 4

   (3) Delete item 3. b.

   (4) Reletter item 3. c. to item 3. b. and make the following change in item (4):

   (a) Change the total credits from ‘25’ to ‘22’.

   (b) Delete the following course:

   - MTH 428H  Honors Complex Analysis 3

   (5) Reletter item 3. d. to item 3. c. and replace with the following:

   A total of 15 credits in electives.

   Three of the courses (9 credits) are to be selected from any MTH course at the 800-level or above, or any course approved by the Mathematics Advanced program for satisfying this requirement, or any course from the following list:

   - MTH 416  Introduction to Algebraic Coding 3
   - MTH 417  Topics in Number Theory 3
   - MTH 425  Complex Analysis 3
   - MTH 441  Ordinary Differential Equations II 3
   - MTH 442  Partial Differential Equations 3
   - MTH 451  Numerical Analysis I 3
   - MTH 452  Numerical Analysis II 3
   - MTH 461  Metric and Topological Spaces 3
   - MTH 481  Discrete Mathematics I 3
   - MTH 482  Discrete Mathematics II 3
   - MTH 492H  Undergraduate Thesis (W) 3

   Two of the courses (6 credits) are to be selected from any MTH course at the 400 level or above (excluding MTH 411 and 421), or any course approved by the Mathematics Advanced program for satisfying this requirement, or any course from the following list:

   - CMSE 820  Mathematical Foundations of Data Science 3
   - CMSE 821  Numerical Methods for Differential Equations 3
   - CMSE 823  Numerical Linear Algebra 3
   - CSE 425  Introduction to Computer Security 3
   - CSE 450  Translation of Programming Languages 3
   - CSE 460  Computability and Formal Language Theory 3
   - CSE 472  Computer Graphics 3
   - CSE 802  Pattern Recognition and Analysis 3
   - CSE 803  Computer Vision 3
   - CSE 814  Computer Aided Verification 3
   - CSE 830  Design and Theory of Algorithms 3
   - CSE 835  Algorithmic Graph Theory 3
   - CSE 847  Machine Learning 3
   - CSE 860  Foundations of Computing 3
   - CSE 881  Data Mining 3
   - PHL 432  Logic and its Metatheory 4
   - PHY 410  Thermal and Statistical Physics 3
7. Request to change the requirements for the Bachelor of Science degree in Mathematics, Advanced in the Department of Mathematics.

a. Under the heading Requirements for the Bachelor of Science Degree in Mathematics, Advanced make the following changes:

   (1) In item 3. a., change the total credits from '21 to 25' to '20 to 25'.

   (2) Replace item 3. a. (1) with the following:
       
       One of the following courses (3 or 4 credits):
       - BS 161       Cell and Molecular Biology             3
       - IBIO 150     Integrating Biology: From DNA to Populations      3
       - PLB 105      Plant Biology             3
       - ENT 205       Pests, Society, and Environment         3
       - PSL 250     Introductory Physiology                  4

   (3) In item 3. a. (4) change the credits from '2' to '1'.

   (4) Delete item 3. b.

   (5) Reletter item 3. c. to item 3. b. and make the following change in item (4):

       (a) Change the total credits from '25' to '22'.

       (b) Delete the following course:

       MTH 428H  Honors Complex Analysis     3

   (6) Reletter item 3. d. to item 3. c. and replace with the following:

       A total of 15 credits in electives.

       Three of the courses (9 credits) are to be selected from any MTH course at the 800-level or above, or any course approved by the Mathematics Advanced program for satisfying this requirement, or any course from the following list:

       MTH 416  Introduction to Algebraic Coding     3
       MTH 417  Topics in Number Theory            3
       MTH 425  Complex Analysis                   3
       MTH 441  Ordinary Differential Equations II     3
       MTH 442  Partial Differential Equations      3
       MTH 451  Numerical Analysis I              3
       MTH 452  Numerical Analysis II             3
       MTH 461  Metric and Topological Spaces      3
       MTH 481  Discrete Mathematics I            3
       MTH 482  Discrete Mathematics II          3
       MTH 492H Undergraduate Thesis (W)         3
Two of the courses (6 credits) are to be selected from any MTH course at the 400 level or above (excluding MTH 411 and 421), or any course approved by the Mathematics Advanced program for satisfying this requirement, or any course from the following list:

- CMSE 820 Mathematical Foundations of Data Science 3
- CMSE 821 Numerical Methods for Differential Equations 3
- CMSE 823 Numerical Linear Algebra 3
- CSE 425 Introduction to Computer Security 3
- CSE 450 Translation of Programming Languages 3
- CSE 460 Computability and Formal Language Theory 3
- CSE 472 Computer Graphics 3
- CSE 802 Pattern Recognition and Analysis 3
- CSE 803 Computer Vision 3
- CSE 814 Computer Aided Verification 3
- CSE 830 Design and Theory of Algorithms 3
- CSE 835 Algorithmic Graph Theory 3
- CSE 847 Machine Learning 3
- CSE 860 Foundations of Computing 3
- CSE 881 Data Mining 3
- PHL 432 Logic and its Metatheory 4
- PHY 410 Thermal and Statistical Physics 3
- PHY 415 Methods of Theoretical Physics 4
- PHY 422 Classical Mechanics I 3
- PHY 471 Quantum Physics I 3
- PHY 472 Quantum Physics II 3
- PHY 480 Computational Physics 3
- PHY 481 Electricity and Magnetism I 3
- PHY 482 Electricity and Magnetism II 3
- STT 861 Theory of Probability and Statistics I 3
- STT 862 Theory of Probability and Statistics II 3
- STT 881 Theory of Probability I 3
- STT 882 Theory of Probability II 3
- STT 886 Stochastic Processes and Applications 3

Effective Fall 2024.

COLLEGE OF OSTEOPATHIC MEDICINE

1. Request to change the requirement for the Master of Science degree in Basic Medical Science in the College of Osteopathic Medicine. The University Committee on Graduate Studies (UCGS) will consider this request at its April 15, 2024 meeting.

   a. Under the heading Requirements for the Master of Science Degree in Basic Medical Science make the following changes:

      (1) Add the option of Plan B (without thesis).

      (2) Delete item 3. and 4. and replace with the following:

      **Additional Requirements for Plan A**

         1. Complete the following course:

            | Course | Title | Credits |
            |--------|-------|---------|
            | OST 899 | Master’s Thesis Research | 4 |

            This requirement must be completed within one full semester of entry into the program.


      **Additional Requirements for Plan B**

         1. Completion of a final examination or evaluation.

Effective Fall 2024.
PART II - NEW COURSES AND CHANGES

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

AT 215   Agriculture Employee Management
On Demand. 3(3-0) R: Open to students in the Institute of Agricultural Technology.
NEW   Key concepts, techniques, and issues in agricultural employee management and their impact on agricultural operations
Effective Summer Semester 2024

AT 221   Unmanned Aircraft Systems (UAS) in Agriculture
Spring of every year. 4(2-4) R: Open to students in the Institute of Agricultural Technology and open to undergraduate students in the College of Agriculture and Natural Resources. Approval of department; application required.
NEW   Concepts and field work necessary to conduct safe operations with unmanned aerial systems used in agricultural operations. Field trips required. Field trips required. Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 1 semester after the end of the semester of enrollment.
Effective Spring Semester 2025

CSS 860   Soil Health Concepts and Methodology
Fall of every year. 1(0-2) RB: One course in soil science and one course in plant science or ecosystem science
NEW   A rigorous and quantitative assessment of chemical, physical, and biological components of soils in agroecosystems. Advanced techniques in field and laboratory settings. Soil health data verification and validation for informed interpretations and management recommendations. Field trip required. Offered first ten weeks of semester.
Effective Fall Semester 2024

COLLEGE OF ENGINEERING

BE 221   Introduction to Smart Agriculture
Spring of every year. 1(1-1) Interdepartmental with Engineering P: (MTH 114 or MTH 116 or LB 117) or ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently))
Effective Fall Semester 2024

BE 321   Principles of Precision Agriculture
Fall of every year. 3(2-2) P: BE 221 or concurrently or approval of department
NEW   Principles of precision agriculture utilizing GPS, GIS, data acquisition, analysis, and prescriptive application. Mapping, prescriptive software, and informed decision making for sustainable and resilient agriculture.
SA: TSM 343
Effective Fall Semester 2024

BE 421   Sensors & Robotics for Agricultural Systems
Fall of every year. 3(2-2) P: BE 321 or concurrently R: Open to juniors or seniors in the College of Engineering or approval of department.
NEW   Comprehensive introduction to the fundamentals and applications of sensing and robotics technologies in agricultural systems.
Effective Fall Semester 2024
BE 422   Crop Modeling and Optimization
Spring of every year. 3(2-2) P: BE 321 or concurrently R: Open to juniors or seniors in the College of Engineering or approval of department.

NEW  An in-depth exploration of the theory and practical applications of crop modeling in agriculture and agroecosystems.
Effective Fall Semester 2024

CSE 834   Advanced Topics in Automated Vehicles
Spring of every year. 3(3-0) Interdepartmental with Electrical and Computer Engineering RB: Algorithms, programming in Python or equivalent, basic knowledge of probability and statistics. R: Open to graduate students in the Department of Computer Science and Engineering or in the Department of Electrical and Computer Engineering or approval of department.

NEW  This course will serve as an advanced course for graduate students interested in conducting hands-on research into automated and connected vehicles. It is a standalone course or may be considered a follow-on course to CSE434.
Effective Spring Semester 2025

CSE 850   Advanced Topics in Adversarial Machine Learning
Spring of every year. 3(3-0) P: CSE 840 R: Open to graduate students in the Department of Computer Science and Engineering.

NEW  This course will serve as an advanced course for graduate students interested in conducting foundational and applied research regarding the robustness and trustworthiness of today’s deep learning systems. It is a standalone course but with a preference to have certain backgrounds on Machine Learning (CSE 847), Deep Learning (CSE 849), or Computer Vision (CSE 803).
Effective Spring Semester 2025

CSE 851   Genetic Programming
Fall of every year. 3(3-0) R: Open to graduate students in the Department of Computer Science and Engineering or approval of department.

NEW  Genetic Programming was originally conceptualized as a method to approach automatic programming of computers, by a method akin to breeding computer programs. It then developed a large body of work related to Machine Learning. This course will give an overview of current techniques and applications of genetic programming, with occasional excursions into the history of fields like Artificial Intelligence, Machine Learning and automatic programming in general. Students will learn to create their own genetic programming systems and apply them in projects of their choice.
Effective Spring Semester 2025

CSE 893   Selected Topics in System design and analysis
On Demand. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open to graduate students in the Department of Computer Science and Engineering or approval of department. A student may earn a maximum of 9 credits in 891, 893, 894 and 895 combined

NEW  Selected topics in System design and analysis of current interest and importance but not covered in a regular course.
Effective Spring Semester 2025

CSE 894   Selected Topics in Theory and Algorithms
On Demand. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. R: Open to graduate students in the Department of Computer Science and Engineering or approval of department. A student may earn a maximum of 9 credits in 891, 893, 894 and 895 combined

NEW  Selected topics in theory and algorithms of current interest and importance but not covered in a regular course.
Effective Spring Semester 2025
CSE 895   Selected Topics in Data Analysis and Applications
On Demand. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this
course. P: CSE 840 R: Open to graduate students in the Department of Computer Science and
Engineering or approval of department. A student may earn a maximum of 9 credits Student may
earn a maximum of 9 credits in 891, 893, 894 and 895 combined

NEW Selected topics in data analysis and applications of current interest and importance but
not covered in a regular course.
Effective Spring Semester 2025

COLLEGE OF HUMAN MEDICINE

PH 826   Data Management in Public Health Practice
Fall of every year. Spring of every year. Summer of every year. 3(3-0) R: Open to students in the
Public Health Major or approval of department.

NEW Data management skills for using large data sets for public health related practice and
research activities.
Effective Fall Semester 2024

PH 829   Public Health and Healthcare Delivery Data
Fall of every year. Spring of every year. Summer of every year. 3(3-0) P: PH 826 and PH 878 R:
Open to students in the Public Health Major or approval of department.

NEW Public health and healthcare data sources, data systems and use requirements.
Common data sources and data sets in public health and healthcare delivery. Application
of data management, project management, study design, research methods, and
statistical analysis skills.
Effective Fall Semester 2024

PH 830   Foundations of Rural Public Health
Fall of every year. Spring of every year. Summer of every year. 3(3-0) R: Open to students in the
Public Health Major or approval of department.

NEW Unique historical, political, and social influences of rural health. Rural determinants of
health, public health systems, health outcomes and disparities. Comparisons of domestic
and global rural health.
Effective Fall Semester 2024

PH 834   Drivers of Rural Health
Fall of every year. Spring of every year. Summer of every year. 3(3-0) R: Open to students in the
Public Health Major or approval of department.

NEW Analysis of social, cultural, commercial, and political systems, resource availability and
their interactions that can be changed to improve domestic and global health outcomes.
Effective Fall Semester 2024

PH 839   Rural Public Health Policy and Advocacy
Fall of every year. Spring of every year. Summer of every year. 3(3-0) P: PH 830 and PH 834 R:
Open to students in the Public Health Major or approval of department.

NEW Leadership and advocacy skills necessary for rural public health systems and policy-level
change. Leadership theories, skills, and policy development processes. Exploration of
political, social, and cultural drivers/determinants that influence policy, advocacy, and
coalition building in rural communities. Advocacy plan creation specific to rural public
health issues.
Effective Fall Semester 2024
COLLEGE OF NATURAL SCIENCE

BMB 470   Advanced Molecular Biology Laboratory
Fall of every year. 4(2-4) P: BMB 370 and BMB 461 RB: BMB 462 R: Open to students in the Biochemistry and Molecular Biology/Biotechnology Major or in the Biochemistry and Molecular Biology major or in the Lyman Briggs Biochemistry and Molecular Biology Coordinate Major or in the Lyman Briggs-Biochemistry/Biotechnology Coordinate Major or approval of department. R: Open to students or approval of department.
Methods of molecular biology and the underlying principles on which these methods are based.
SA: BCH 472, BMB 472
Effective Spring Semester 2024

BMB 825   Cell Structure and Function
Spring of every year. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics, Microbiology and Molecular Genetics, Physiology
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrative information transfer. Original investigations in all five kingdoms.
SA: BCH 825
Effective Fall Semester 2025

MTH 116   College Algebra and Trigonometry
Fall of every year. Spring of every year. Summer of every year. 5(5-0) P: Designated score on Mathematics Placement test Not open to students with credit in MTH 103. Not open to students with credit in LB 117 or MTH 103.
SA: LBS 117
Effective Summer Semester 2023

MTH 362   Mathematics of Contract Pricing in Sports Analytics
Fall of every year. Spring of every year. 3(3-0) A student may earn a maximum of 3 credits in all enrollments for this course. P: MTH 360 RB: MTH 361
NEW Employ tools from mathematics finance to value sports contracts in sports analytics. Connections with utility theory and constrained optimality. Analysis of sports organizations and the leagues they play in.
Effective Spring Semester 2025

MTH 481   Discrete Mathematics I
Fall of every year. Spring of every year. Fall of every year. Spring of every year. Summer of every year. 3(3-0) P: MTH 309
Effective Fall Semester 2020

MTH 810   Error-Correcting Codes
Spring of every year. 3(3-0) RB: MTH 411 or MTH 414 or MTH 415 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Block codes, maximum likelihood decoding. Shannon's theorem. Generalized Reed-Solomon codes, modification of codes, subfield codes. Alterant and Goppa codes, cyclic codes and BCH codes.
Effective Spring Semester 2024
MTH 819  
Algebra II  
Spring of every year. 3(3-0)  
RB: MTH 818  
RB: (MTH 818) and MTH 818  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or approval of department.  
Modules and vector spaces, projectives modules, tensor algebra. Fields and Galois groups, algebraic and transcendental numbers, non-commutative rings. The Jacobson radical, the structure of semisimple rings with the descending chain condition.  
Effective Fall Semester 2024  

MTH 828  
Real Analysis I  
Fall of every year. 3(3-0)  
RB: MTH 421 and MTH 461  
RB: (MTH 421 and MTH 461) or MTH 421 and MTH 461  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Effective Fall Semester 2024  

MTH 829  
Complex Analysis I  
Spring of every year. 3(3-0)  
RB: MTH 421 and MTH 425  
RB: (MTH 421 and MTH 425) and MTH 421 and MTH 425  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Effective Fall Semester 2024  

MTH 841  
Boundary Value Problems I  
Fall of every year. 3(3-0)  
RB: MTH 414 and MTH 421  
RB: (MTH 414 and MTH 421) and MTH 414 and MTH 421  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Methods for solving boundary and initial value problems for ordinary and partial differential equations.  
Effective Fall Semester 2024  

MTH 842  
Boundary Value Problems II  
Spring of every year. 3(3-0)  
RB: MTH 841  
RB: (MTH 841) and MTH 841  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Continuation of MTH 841.  
Effective Fall Semester 2024  

MTH 843  
Survey of Industrial Mathematics  
Fall of every year. 3(3-0)  
RB: (MTH 414 or MTH 415) or Some familiarity with mathematical software such as Mathematica, Matlab, etc. and (MTH 421 and MTH 442).  
R: Open only to master's students in the Industrial Mathematics major or approval of department.  
R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Fundamentals of mathematical modeling in government and industry, including modes of industrial communication.  
Effective Fall Semester 2024
MTH 844  Projects in Industrial Mathematics
Spring of every year. 3(3-0) RB: ((MTH 414 or MTH 415) or some familiarity with mathematical software such as Mathematica or Matlab.) and (MTH 421 and MTH 442 and MTH 843) R: Open only to master’s students in the Industrial Mathematics major or approval of department. R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Participation as a member of a 3-4 person team on a significant industrial problem, with participation of an industrial liaison, including project report generation and reporting. Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 1 semester after the end of the semester of enrollment.
Effective Fall Semester 2024

MTH 849  Partial Differential Equations
Spring of every year. 3(3-0) P: MTH 847 or approval of department RB: MTH 828 R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Sobolev spaces and embedding theorems, weak solutions of second order elliptic equations in divergence form (existence, uniqueness, and regularity), Fredholm alternative, maximum principle, calculus of variations, Euler-Lagrange equations.
Effective Fall Semester 2024

MTH 850  Numerical Analysis I
Fall of every year. 3(3-0) RB: MTH 414 and MTH 421 RB: (MTH 414 and MTH 421) and MTH 414 and MTH 421 R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Convergence and error analysis of numerical methods in applied mathematics.
Effective Fall Semester 2024

MTH 852  Numerical Methods for Ordinary Differential Equations
Spring of every year. 3(3-0) RB: MTH 850 R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Effective Fall Semester 2024

MTH 868  Geometry and Topology I
Fall of every year. 3(3-0) RB: (MTH 411 and MTH 421) or approval of department. R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Effective Fall Semester 2024

MTH 869  Geometry and Topology II
Spring of every year. 3(3-0) RB: MTH 868 RB: (MTH 868) and MTH 868 R: Open to graduate students or master’s students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Continuation of MTH 868.
Effective Fall Semester 2024
MTH 880   Combinatorics I  
Fall of every year. 3(3-0) RB: MTH 411 or MTH 482 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Enumerative combinatorics, recurrence relations, generating functions, asymptotics, applications to graphs, partially ordered sets, generalized Moebius inversions, combinatorial algorithms. Effective Fall Semester 2024

MTH 881   Graph Theory  
Spring of even years. 3(3-0) RB: MTH 880 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Basic concepts in graph theory, connectivity, algebraic and topological methods. Networks, graph algorithms, Hamiltonian and Eulerian graphs, extremal graph theory, random graphs. Effective Fall Semester 2024

MTH 882   Combinatorics II  
Spring of every year. 3(3-0) P: MTH 880 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Algebraic combinatorics including symmetric functions, group actions, and cluster algebra, geometric combinatorics including shellability, discrete Morse functions, and polytopes. Extremal combinatorics including Ramsey Theory and Sperner Theory. Effective Fall Semester 2024

MTH 890   Readings in Mathematics  
Fall of every year. Spring of every year. Summer of every year. Fall of every year. Spring of every year. Summer of every year. 1 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Individualized study for Master’s level students. Effective Fall Semester 2024

MTH 910   Commutative Algebra  
Fall of odd years. 3(3-0) RB: MTH 819 RB: (MTH 819) and MTH 819 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Noetherian rings and modules, localization and tensor products, primary decomposition, Krull dimensions, graded rings and modules, Hilbert's Nullstellensatz, integral extensions, discrete valuation rings, Dedekind domains. Effective Fall Semester 2024

MTH 912   Group Theory I  
Fall of even years. 3(3-0) RB: MTH 819 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Permutation groups, solvable and nilpotent groups, simple groups. Representation and character theory. Extension theory and cohomology groups. Effective Fall Semester 2024

MTH 914   Lie Groups and Algebras  
Fall of odd years. 3(3-0) RB: MTH 819 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Nilpotent and semisimple algebras, the ad joint representation, root spaces, Weyl groups, Dynkin diagrams, classification of simple algebras. Effective Fall Semester 2024
MTH 916   Introduction to Algebraic Geometry I  
Fall of even years. 3(3-0) RB: MTH 818 and MTH 819 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or approval of department. 
Affine and projective algebraic varieties and their properties. Morphisms and singularities. Schemes and coherent sheaves. Sheaf cohomology and other related topics. 
Effective Fall Semester 2024

MTH 917   Introduction to Algebraic Geometry II  
Spring of odd years. 3(3-0) RB: MTH 916 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department. 
Continuation of MTH 916. 
Effective Fall Semester 2024

MTH 918   Number Theory I  
Fall of even years. 3(3-0) P: MTH 819 or approval of department R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department. 
Number fields and algebraic integers, prime ideals and factorization, cyclotomic fields, the class group, the Dirichlet unit theorem, different, discriminant, decomposition and inertia groups, local fields. 
Effective Fall Semester 2024

MTH 919   Number Theory II  
Spring of odd years. 3(3-0) P: MTH 918 or approval of department R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department. 
Topics from: class field theory, zeta and L-functions, modular forms, theory of elliptic curves, diophantine approximation, diophantine geometry. 
Effective Fall Semester 2024

MTH 920   Functional Analysis  
Spring of every year. 3(3-0) RB: MTH 828 R: Open to graduate students in the College of Natural Science or approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department. 
Effective Fall Semester 2024

MTH 921   Operator Theory  
Fall of even years. 3(3-0) RB: MTH 829 and MTH 920 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department. 
Introduction to operator and spectral theory. Topics include Banach algebras, bounded and unbounded operators on Banach spaces, spectral theory for normal operators on a Hilbert space, C*-algebras, Schatten - von Neumann classes, the theory of Fredholm operators, semigroup theory. 
Effective Fall Semester 2024
MTH 922  Harmonic Analysis
Fall of odd years. 3(3-0) RB: MTH 829 and MTH 920 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
- Fourier series, mean and pointwise convergence, conjugate functions, Fourier transform, Plancherel theorem, Paley-Wiener theorem, interpolation of operators, Hausdorff-Young theorem.
Effective Fall Semester 2024

MTH 925  Random Variables and Stochastic Processes
Fall of every year. 3(3-0) R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
- Introduction to measure-theoretic probability theory. Topics include infinite product spaces, Kolomogorov extension theorem, Borel Cantelli Lemma, law of large numbers, central limit theorem, conditioning, filtrations, martingales, Markov chains, Wiener process.
Effective Fall Semester 2024

MTH 928  Real Analysis II
Spring of odd years. 3(3-0) RB: MTH 828 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
- Continuation of MTH 828. Topics include Borel measures on locally compact spaces, complex measures, differentiable transformations and changes of variables in Rn.
Effective Fall Semester 2024

MTH 930  Riemannian Geometry I
Fall of even years. 3(3-0) RB: MTH 869 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
- Riemannian metrics, connections, curvature, geodesics. First and second variation, Jacobi fields, conjugate points. Rauch comparison theorems, Hodge theorem, Bochner technique, spinors. Further topics on curvature or submanifold theory.
Effective Fall Semester 2024

MTH 931  Riemannian Geometry II
Spring of odd years. 3(3-0) RB: MTH 930 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
- Continuation of MTH 930.
Effective Fall Semester 2024

MTH 935  Complex Manifolds I
Spring of even years. 3(3-0) RB: MTH 829 and MTH 869 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Effective Fall Semester 2024
MTH 940  Topics in Partial Differential Equations for Applied Math  
Fall of odd years. 3(3-0) RB: MTH 828 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the College of Natural Science or in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Partial differential equation techniques for applied mathematics, including, bifurcation theory, partial differential equations as dynamical systems, boundary layers, asymptotic analysis, matched asymptotic and singular perturbations, and homogenization.  
Effective Fall Semester 2024

MTH 941  Linear and Nonlinear Parabolic Equations  
Spring of even years. 3(3-0) RB: MTH 940 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the College of Natural Science or in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Evolution equations with a comparison principle, including parabolic equations and Hamilton-Jacobi-Bellman equations, with an emphasis on existence and uniqueness of both classical and weak solutions. Linear and nonlinear cases, including quasi-linear parabolic equations related to geometric flows.  
Effective Fall Semester 2024

MTH 942  Regularity for Second Order Elliptic Equations  
Fall of even years. 3(3-0) RB: MTH 848 and MTH 849 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the College of Natural Science or in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Review of classical regularity results, such as Schauder theory and L-p theory. Elliptic equations with coefficients of low regularity (bounded and measurable) and nonlinear elliptic equations. The Harnack inequality and Holder regularity in the context of both weak solutions of divergence form equations and viscosity solutions of equations in non-divergence form. Higher regularity and applications to minimization problems.  
Effective Fall Semester 2024

MTH 943  Hyperbolic and Dispersive Equations  
Spring of odd years. 3(3-0) RB: MTH 942 R: Open to doctoral students in the College of Natural Science or approval of department. R: Open to doctoral students or graduate students or master's students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Classical and modern techniques for higher dimensional hyperbolic and dispersive partial differential equations. Space-time integral estimates, including the classical Strichartz estimate for Schrodinger, Klein-Gordon, and Wave equations, and modern (multi)linear estimates using Fourier, physical-space, and microlocal techniques.  
Effective Fall Semester 2024

MTH 950  Numerical Methods for Partial Differential Equations I  
Spring of odd years. 3(3-0) RB: MTH 852 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Finite difference methods for ordinary and partial differential equations.  
Effective Fall Semester 2024

MTH 951  Numerical Methods for Partial Differential Equations II  
Spring of even years. Fall of every year. Spring of every year. 3(3-0) R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Bachelor of Science in Mathematics or in the Mathematics Major or approval of department.  
Finite element methods for ordinary and partial differential equations.  
Effective Fall Semester 2024
MTH 960   Algebraic Topology I  
Fall of every year. 3(3-0) RB: MTH 869 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Cohomology, products, duality, basic homotopy theory, bundles, obstruction theory, spectral sequences, characteristic classes, and other related topics.  
Effective Fall Semester 2024

MTH 961   Algebraic Topology II  
Spring of every year. 3(3-0) RB: MTH 960 R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Continuation of MTH 960.  
Effective Fall Semester 2024

MTH 988   Representation Theory I  
Fall of odd years. 3(3-0) P: MTH 819 or approval of department R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Representations of finite groups, unitary representations, tensor products and character tables, further theory (Frobenius-Schur indicator, Burnside's theorem, Mackey formula, Frobenius reciprocity), representations of GL(2; Fq), representations of symmetric groups (Young diagrams, Schur-Weyl duality), fundamental theorem of invariant theory, introduction to representations of compact groups  
Effective Fall Semester 2024

MTH 990   Reading in Mathematics  
Fall of every year. Spring of every year. Summer of every year. Fall of every year. Spring of every year. Summer of every year. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Individualized study for doctoral level students.  
Effective Fall Semester 2024

MTH 991   Special Topics in Algebra  
Fall of every year. Spring of every year. Fall of every year. Spring of every year. 3 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Advanced topics in algebra.  
Effective Fall Semester 2024

MTH 992   Special Topics in Analysis  
Fall of every year. Spring of every year. Fall of every year. Spring of every year. 3 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Advanced topics in analysis.  
Effective Fall Semester 2024

MTH 993   Special Topics in Geometry  
Fall of every year. Spring of every year. Fall of every year. Spring of every year. 3 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.  
Advanced topics in geometry.  
Effective Fall Semester 2024
MTH 994  
Special Topics in Applied Mathematics
Fall of every year. Spring of every year. Fall of every year. Spring of every year. 3 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Advanced topics in applied mathematics.
Effective Fall Semester 2024

MTH 996  
Special Topics in Topology
Fall of every year. Spring of every year. Fall of every year. Spring of every year. 3 to 6 credits. A student may earn a maximum of 18 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or master's students or doctoral students in the Applied Mathematics Major or in the Industrial Mathematics Major or in the Mathematics Major or approval of department.
Advanced topics in topology.
Effective Fall Semester 2024

MTH 999  
Doctoral Dissertation Research
Fall of every year. Spring of every year. Summer of every year. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Approval of department. R: Open to graduate students or doctoral students in the Applied Mathematics Major or in the Mathematics Major. Approval of department.
Doctoral dissertation research.
Request the use of the Pass-No Grade (P-N) system.
Effective Fall Semester 2024

PHY 183  
Physics for Scientists and Engineers I
Fall of every year. Spring of every year. 4(5-0) P: (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently) Not open to students with credit in LB 273 or PHY 193H or PHY 231 or PHY 231C or PHY 233B. Not open to students with credit in LB 273 or PHY 193H or PHY 231 or PHY 231C or PHY 183B.
Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, and waves.
Effective Summer Semester 2021

PHY 232  
Introductory Physics II
Fall of every year. Spring of every year. 3(4-0) P: PHY 231 or PHY 231C or PHY 183 or PHY 183B or PHY 193H or LB 273 Not open to students with credit in LB 274 or PHY 184 or PHY 184B or PHY 232 or PHY 234B. Not open to students with credit in LB 274 or PHY 184 or PHY 184B or PHY 232C or PHY 294H.
Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.
Effective Spring Semester 2024

PHY 234B  
Calculus Concepts in Physics II
Spring of every year. Summer of every year. 2 credits. P: (PHY 232 or PHY 232C) and ((MTH 133 or concurrently) or (MTH 153H or concurrently) or (LB 119 or concurrently)) Not open to students with credit in LB 274 or PHY 184 or PHY 184B. Not open to students with credit in LB 274 or PHY 184 or PHY 184B or PHY 232C or PHY 294H.
Electricity and magnetism. This course is given in the competency based instruction format.
Effective Spring Semester 2024

PHY 480  
Computational Physics
Spring of every year. 3(3-0) P: CMSE 201 RB: CSE 131 or CSE 230
Applications of scientific computational techniques to solutions of differential equations, matrix methods, and Monte Carlo methods used in physics.
Effective Fall Semester 2024
PHY 864  Accelerator Technology  
Spring of every year. 3(3-0) RB: PHY 422 and PHY 482 R: Open to graduate students in the College of Engineering or in the College of Natural Science.

REINSTATEMENT  Key technologies for modern accelerators such as magnets, the normal conducting and super conducting radio frequency cavities, charged particle sources, diagnostic instruments.  
Effective Spring Semester 2024

COLLEGE OF NURSING

NUR 861  Curriculum Design in Nursing Education  
Summer of every year. Fall of every year. 3(3-0) P: NUR 802 RB: Open only to master's students in Clinical Nurse Specialist-Nurse Education concentration. R: Open to graduate students in the Master of Science in Nursing.  
Analysis and application of theories, principles, and concepts associated with curriculum development, design, and evaluation.  
Effective Spring Semester 2024

NUR 866  Academic and Clinical Teaching Internship  
Spring of every year. Summer of every year. 3(1-6) P: NUR 861 RB: Open only to masters students in Clinical Nurse Specialist-Nurse Education concentration. R: Open to graduate students in the Master of Science in Nursing.  
Guided field internship within an academic or health care setting. Synthesis and application of concepts to facilitate development of the advanced practice nurse as scholar, teacher, and collaborator.  
Effective Spring Semester 2024

NUR 903  Healthcare Informatics  
Fall of every year. Spring of every year. 3(3-0) R: Open to graduate students in the College of Nursing or in the Master of Science in Nursing or in the Nursing Practice Major.  
Health information systems and technologies in relationship to the delivery of efficient, high quality healthcare.  
Effective Spring Semester 2024

NUR 914  Biostatistics for the APRN  
Fall of every year. Spring of every year. Fall of every year. 3(3-0)  
The application of descriptive statistics, bivariable and multivariable inferential statistics (parametric and non-parametric), and essential epidemiological concepts  
Effective Spring Semester 2024

COLLEGE OF OSTEOPATHIC MEDICINE

OMM 501  Student Coordinator for Osteopathic Manipulative Medicine Practical Laboratory  
Fall of every year. Spring of every year. Summer of every year. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course. P: OMM 511 C: OMM 500 concurrently

NEW  Student Coordinator for elective course of didactic and clinical sessions which apply osteopathic principles and techniques on patients.  
Request the use of the Pass-No Grade (P-N) system.  
Effective Summer Semester 2024

OMM 520  Sports OMT  
Fall of every year. Spring of every year. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to graduate-professional students. Approval of department.

NEW  Provide the student with an opportunity to actively treat MSU Division I athletes using OMT under the guidance of ONMM residents.  
Request the use of the Pass-No Grade (P-N) system.  
Effective Fall Semester 2024
OMM 521  Student Coordinator for Sports OMT
Fall of every year. Spring of every year. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to graduate-professional students. Approval of department. C: OMM 520 concurrently
NEW  Student coordinators will help to coordinate the clinic functions that are able to provide the other student participants with an opportunity to actively treat MSU Division I athletes using OMT under the guidance of ONMM residents.
Request the use of the Pass-No Grade (P-N) system.
Effective Fall Semester 2024

OMM 590  Special Problems in Biomechanics
Fall of every year. Spring of every year. Summer of every year. Fall of every year. Spring of every year. Summer of every year. 1 to 24 credits. A student may earn a maximum of 48 credits in all enrollments for this course. R: Open only to graduate and graduate-professional students in the College of Osteopathic Medicine. Approval of department. R: Open to graduate-professional students. Approval of department.
Each student works under faculty direction on an experimental, theoretical, or applied problem.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
SA: BIM 590
Effective Fall Semester 2024

OMM 591  Osteopathic Manipulative Medicine Teaching Assistant Elective
Fall of every year. Spring of every year. Summer of every year. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. P: OMM 512 R: Open to graduate-professional students. Approval of department.
NEW  Provides students with experience in teaching OMM diagnosis and treatment in a small group setting. This is an unpaid TA experience.
Request the use of the Pass-No Grade (P-N) system.
Effective Fall Semester 2024

OST 585  Intro to Community-Based Service
Fall of every year. 1(1-0) A student may earn a maximum of 1 credit in all enrollments for this course.
NEW  Preparation for medically relevant service experience in local communities
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
Effective Fall Semester 2024

OST 586  Community-Based Service Learning
Spring of every year. 1(1-0) A student may earn a maximum of 1 credit in all enrollments for this course. P: OST 585 or concurrently or approval of college
NEW  Capstone for community-based service learning
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
Effective Spring Semester 2025
OST 601  Transitions II: Classroom to Bedside
Transitions: Classroom to Bedside
Summer of every year. 5 credits. A student may earn a maximum of 10 credits in all enrollments for this course. R: Open to graduate-professional students in the College of Osteopathic Medicine.
Selected topics designed to assist the COM student in transitioning from the classroom to the clinical learning environment.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 1 semester after the end of the semester of enrollment.
Effective Summer Semester 2024

OST 696  Global Health: SPAIN- Pre-Clinical Observation, Culture and Medicine
Summer of every year. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department; application required.

NEW
International Clinical Immersion
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
Effective Summer Semester 2024

OSS 644  ORT 644  Sports Medicine Clerkship
Fall of every year. Spring of every year. Summer of every year. 1 to 20 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open to graduate-professional students in the College of Osteopathic Medicine.
Sports Medicine management and treatment. Proficiency in motor skills, aptitude, comprehension of concepts and principles, patient evaluations, diagnosis, management, therapy.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 4 semesters after the end of the semester of enrollment.
Effective Fall Semester 2024

OSS 656  ORT 656  Orthopedic Clerkship
Fall of every year. Spring of every year. Summer of every year. Fall of every year. Spring of every year. Summer of every year. 1 to 20 credits. A student may earn a maximum of 30 credits in all enrollments for this course. RB: Completion of Units I and II. R: Open only to graduate-professional students or osteopathic medicine students in the College of Osteopathic Medicine.
Program developed to achieve proficiency in motor skills, aptitudes, comprehension of concepts and principles, patient evaluation, diagnosis, management, and therapy.
Request the use of the Pass-No Grade (P-N) system.
Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 4 semesters after the end of the semester of enrollment. Request the use of ET-Extension to postpone grading.
The work for the course must be completed and the final grade reported within 2 semesters after the end of the semester of enrollment.
SA: OM 656
Effective Fall Semester 2024