MECHANICAL ENGINEERING

Faculty

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The discipline of mechanical engineering is the branch of engineering that deals predominantly with the conversion, transmission and storage of mechanical and thermal energy; the generation, transmission and control of forces; the production and regulation of mechanical motion; and the optimal use of materials in the design and fabrication of the requisite machines and mechanisms.

Mission Statement

The Department of Mechanical Engineering is committed to providing the best undergraduate mechanical engineering education possible within the constraints of a four-year curriculum. In accord with the College of Engineering Mission Statement, the mechanical engineering department strives to nurture the intellectual, professional and personal development of its students. The mechanism for achieving the department's educational mission is the curriculum in mechanical engineering designed to satisfy its Program Educational Objectives. The department strives to achieve a process of continuous improvement of the curricula, to provide a faculty who are professionally current in their field and to maintain state-of-the-art facilities.

Program Educational Objectives

The Department of Mechanical Engineering seeks to prepare students to be successful in engineering or other careers and to be recognized for qualities associated with their Bucknell educational experiences. Graduates of our program will:

- Develop innovative solutions to challenging problems consistent with professional expectations.
- Pursue advanced studies that supplement their Bucknell education and further their career.
- Demonstrate effective communication and an ability to contribute successfully to a multidisciplinary team.
- Make decisions by considering multiple factors including ethics, sustainability and societal impact.
- Advance professionally by accepting new responsibilities and demonstrating leadership potential.

It is our expectation that our graduates will have demonstrated significant progress toward a subset of these objectives within five years of graduation from Bucknell.

Student Outcomes

Graduates of the program shall demonstrate the following at the time of graduation:

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies.

The mechanical engineering program at Bucknell University is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (https://www.abet.org/).

Bachelor of Science in Mechanical Engineering

The **Bachelor of Science** in Mechanical Engineering requirements are:

First Year

First Semester	Credits	Second Semester	Credits
ENGR 099	0	ENGR 214	1
ENGR 100	1	MATH 202	1
MATH 201	1	MECH 202	.5
PHYS 211	1	MECH 220	1
Foundation Seminar (W1)	1	Elective	1
	4		**4.5**

Sophomore

First Semester	Credits	Second Semester	Credits
CHEM 203[1]	1	ENGR 240	1
MATH 211	1	MATH 212[3]	1
MECH 213	1	MATH 227	1
MECH 353 or 252[2]	1	MECH 252 or 353[2]	1
	4		**4**

Junior

First Semester	Credits	Second Semester	Credits
ECEG 205	1	MECH 222	.5
MECH 313	1	MECH 312	1
MECH 355	1	MECH 392[4]	1
Elective	1	Two electives	2
	4		**4.5**

Senior

First Semester	Credits	Second Semester	Credits
MECH 401	1	MECH 402	.5
MECH 403	1	Four electives	4
MECH 405	1		
Elective	1		
Elective	.5		
	4.5		**4.5**

Total Credits: 34

1 CHEM 203 General Chemistry for Engineers must be taken within the first two years.

2 Simultaneous enrollment in both MECH 353 Solid Mechanics and MECH 252 Dynamics is only permitted by the department chair.

3 MATH 212 Differential Equations and its prerequisite courses must be completed prior to the start of the junior year.

4 MECH 392 Mechanical Design must be completed before the start of senior year.

The 10.5 elective courses shown above are distributed as follows:

- A student must choose five electives that meet engineering college requirements for general education (https://coursecatalog.bucknell.edu/collegeofengineeringcurricula/curriculaoverview/). Note that this includes the foundation seminar taken in the first semester.
- At a minimum, one course must also fulfill the college's global perspectives requirement. It is expected that this course is one of the five electives noted previously.
- One full-credit science or math elective selected from any of the following:
  - any full-credit, 200-level or 300-level courses in physics, astronomy, biology, chemistry or geology for which prerequisites have been satisfied;
  - any of the following 100-level geology courses (must be taken within the first three years):GEOL 108 When Rocks Attack, GEOL 109 Energy and Natural Resources, GEOL 117 Environmental Geohazards;
  - MATH 245 Linear Algebra, MATH 280 Logic, Sets, and Proofs, or any 300-level MATH course for which prerequisites have been satisfied;
- 2.5 credits of 400-level MECH elective courses. Up to 1.0 credit may be replaced with a) a course needed to fulfill a minor if the minor is otherwise not possible without an overload in the senior year, or b) an approved 400-level course in any department within the College of Engineering, for which the prerequisites have been met. The 400-level MECH elective courses may also count toward other University majors and minors.
- Two courses in any department or program of the University.

Three courses in each student's program must fulfill the University's writing requirement that includes a W1 (FOUN or RESC) course taken in the first semester of the first year and two subsequent W2 courses.

Bachelor of Arts/Management for Engineers - Bachelor of Science in Mechanical Engineering

The **Bachelor of Arts/Management for Engineers - Bachelor of Science in Mechanical Engineering** requirements are:

First Year

First Semester	Credits	Second Semester	Credits
ENGR 099	0	ENGR 214	1
ENGR 100	1	MATH 202	1
MATH 201	1	MECH 202	.5
PHYS 211	1	MECH 220	1
Foundation Seminar (W1)	1	Elective	1
	4		**4.5**

Sophomore

First Semester	Credits	Second Semester	Credits
CHEM 203[1]	1	MATH 212[2]	1
MATH 211	1	MATH 227	1
MECH 213	1	MECH 353 or 252[3]	1
Elective	1	Elective (UNIV 200)	1
	4		**4**

Junior

First Semester	Credits	Second Semester	Credits
ECEG 205[5]	1	ENGR 240	1
MECH 252 or 353[3]	1	MECH 222[5]	.5
Two Electives	2	MECH 392[4]	1
		Two electives	2
	4		**4.5**

Senior

First Semester	Credits	Second Semester	Credits
MECH 313	1	MECH 312	1
MECH 355	1	Three electives	3
Two electives	2		
	4		**4**

Five Year

First Semester	Credits	Second Semester	Credits
MECH 401	1	MECH 402	.5
MECH 403	1	Four Electives	4
MECH 405	1		
Elective	1		
Elective	.5		
	4.5		**4.5**

Total Credits: 42

1. CHEM 203 General Chemistry for Engineers must be taken before or concurrently with ENGR 240 Science of Materials, and is to be completed before the start of the fourth year (before semester 7).
2. MATH 212 Differential Equations and its prerequisite courses must be completed prior to the start of the junior year.
3. Simultaneous enrollment in both MECH 353 Solid Mechanics and MECH 252 Dynamics is only permitted by the department chair.
4. MECH 392 Mechanical Design must be completed before the start of the fifth year.
5. These courses may be delayed by one year, based on consultation with the academic adviser, if needed to complete the degree and if possible with regard to prerequisite courses.

The 18.5 elective courses shown above are distributed as follows:

- One full-credit science or math elective selected from any of the following:
  - Any full-credit, 200-level or 300-level courses in physics, astronomy, biology, chemistry or geology for which prerequisites have been satisfied;
  - Any of the following 100-level geology courses (must be taken within the first three years):GEOL 108 When Rocks Attack, GEOL 109 Energy and Natural Resources, GEOL 117 Environmental Geohazards;
  - MATH 245 Linear Algebra, MATH 280 Logic, Sets, and Proofs or any 300-level MATH course for which prerequisites have been satisfied;
- Eight courses to satisfy requirements for the Bachelor of Arts (BA) or Bachelor of Management for Engineers (BME) major.
- Courses used to fulfill the General Education (https://coursecatalog.bucknell.edu/collegeofengineeringcurricula/curriculaoverview/) requirements for engineering students should also fulfill the College of Arts & Sciences Core Curriculum (CASCC) (https://coursecatalog.bucknell.edu/collegeofartsandsciencescurricula/curriculaoverview/collegecorecurriculum/) requirements for those in the 5-year Engineering & Liberal Arts dual degree program or the Freeman College of Management General Education Curriculum (https://coursecatalog.bucknell.edu/collegeofmanagementcurricula/curriculaoverview/gened/) requirements for those in the 5-year Engineering & Management dual degree program.
- One Integrated Perspectives course (UNIV 200).
- One foreign language course.
- 2.5 credits of 400-level MECH elective courses. Up to 1.0 credit of these courses may be replaced with a) a course needed to fulfill a minor if the minor is otherwise not possible without an overload in the senior year, or b) an approved 400-level course in any department within the College of Engineering, for which the prerequisites have been met.
- Three courses in each student's program must fulfill the University's writing requirement that includes a W1 (FOUN or RESC) course taken in the first semester of the first year and two subsequent W2 courses.
- Two elective or required courses must also fulfill the Diversity in the U.S., Environmental Connections, and Global Connections components of the College Core Curriculum or Management General Education Curriculum.
- See the following link for the Freeman College of Management curricular information: https://coursecatalog.bucknell.edu/collegeofmanagementcurricula/areasofstudy/bme (https://coursecatalog.bucknell.edu/collegeofmanagementcurricula/areasofstudy/bme/)

Graduates of the program shall demonstrate the following student outcomes at the time of graduation:

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Courses

MECH 151. Machining for Manufacturing Technology. 0 Credits.
Offered Fall Semester Only; Lecture hours:1,Other:2
Develop an understanding of the processes needed to produce manufactured parts. Emphasis on hands-on machining and fabrication.

MECH 202. Graphics for Design and Manufacture. .5 Credits.
Offered Spring Semester Only; Lecture hours:1,Lab:2
Graphical representation techniques for visualization and communication of mechanical engineering designs and concepts. Creation, storage, and manipulation of production drawings and 3-D geometric representations using state-of-the-art software. Introduction to fabrication through rapid prototyping tools. Co-Requisite: MECH 202L.

MECH 213. Thermodynamics. 1 Credit.
Offered Fall Semester Only; Lecture hours:4
Thermodynamic principles including properties of substances, the first and second laws of thermodynamics, efficiencies, power and refrigeration cycles. Prerequisites: MATH 201 and ENGR 214 or permission of the department. Not open to students who have taken ENGR 200 or CHEG 310.

MECH 220. Mechanics. 1 Credit.
Offered Spring Semester Only; Lecture hours:4
Equilibrium of two-and three-dimensional rigid bodies and systems. Trusses, frames, and machines. Friction. Distributed forces and equivalent systems. Internal loads. Prerequisite: PHYS 211 and MATH 201 or permission of the instructor. Not open to students who have taken ENGR 221 or ENGR 229.

MECH 222. Introduction to Mechanical Engineering Lab Practice. .5 Credits.
Offered Spring Semester Only; Lecture hours:1,Lab:2
Sensors, measurement techniques for static and dynamic measurements, data processing, statistical data analysis, propagation of error, actuators and motors. Corequisite: MECH 222L. Prerequisites: MATH 202, ECEG 205, and ENGR 214.

MECH 230. Aircraft Design Competition. .25 Credits.
Offered Both Fall and Spring; Lecture hours:Varies,Other:2; Repeatable
The AIAA Design/Build/Fly (DBF) competition tasks teams each year to design, build and then fly an aircraft that performs certain missions such as flying the fastest around a preset course. Through this competition, teams will learn how to design, engineer, manufacture and operate an aircraft.

MECH 231. Off-road Racing Design. .25 Credits.
Offered Both Fall and Spring; Lecture hours:Varies,Other:2; Repeatable
The SAE Baja Competition challenges teams to design, build, and compete with an off-road vehicle that will be tested in events that stress various aspects of vehicle performance, concluding with a four-hour endurance race. Teams also build a business case and present their engineering design to a panel of judges.

MECH 252. Dynamics. 1 Credit.
Offered Both Fall and Spring; Lecture hours:4
Kinematic and kinetic analysis of rigid bodies in planar motion. Absolute and relative analysis of displacements, velocities, and accelerations; force, energy, and momentum methods; analysis of mechanical vibrations; analytical and computer-simulated solution techniques. Prerequisites: MECH 220 and MATH 202 or permission of the instructor.

MECH 285. Independent Study for Sophomores. .5-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:4; Repeatable
Independent investigation under the direction of a faculty member for students who have completed their first year. Sophomore standing in mechanical engineering and permission of the instructor.

MECH 288. Intro topics in Mechanical Engineering. .5-1 Credits.
Offered Fall Semester Only; Lecture hours:2; Repeatable
Topic is specific to the semester offered. Course description will be available in Banner prior to registration.

MECH 302. Finite Elements in Analysis and Design. 1 Credit.
Offered Occasionally; Lecture hours:3,Lab:2
Introduction to finite element method (FEM) and commercial FEM software for design and analysis of mechanical components and thermal problems. Applications in mechanical and thermal component/system design. Co-Requisites: MECH 302L. Prerequisites: MECH 202 and MECH 353.

MECH 312. Heat Transfer. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Lab:2
Principles and engineering applications of heat transfer by conduction, convection, and radiation. Co-Requisites: MECH 312L. Prerequisite: MECH 313 or permission of the instructor.

MECH 313. Fluid Dynamics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:2
Fundamentals of fluid dynamics including integral and differential control volume analysis, conservation equations, dimensional analysis, incompressible inviscid flows, internal and external viscous flows. Prerequisites: MATH 212, MECH 213, or permission of the department. Not open to students who have taken ENGR 222 or ENGR 233.

MECH 353. Solid Mechanics. 1 Credit.
Offered Both Fall and Spring; Lecture hours:3,Lab:2
Analysis of stress, strain, and failure of engineering components under axial, torsional, flexural, and combined loading conditions. Introduction to stability of compression members, energy methods, and failure theory. Bridge to computational methods in solid mechanics. Prerequisites: MECH 220 and MATH 202 or permission of the instructor.

MECH 355. Manufacturing Processes. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:2
Analytical and technological study of materials processing including deformation, solidification, material removal, plastics forming, and additive manufacturing methods. Laboratory fabrication projects and introduction to numerical control and CAD/CAM. Co-Requisite: MECH 355L. Prerequisites: ENGR 240 and MECH 202, or permission of instructor.

MECH 385. Independent Study for Juniors. .5-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:4; Repeatable
Independent investigation under the direction of a faculty member for students who have completed two years of study. Junior standing in mechanical engineering and permission of the instructor.

MECH 392. Mechanical Design. 1 Credit.
Offered Spring Semester Only; Lecture hours:3,Lab:2
Principles and techniques for creative design of machines in relation to specifications and user requirements. Design using a solid modeling CAD package. Co-Requisites: MECH 392L. Prerequisites: MECH 252 and MECH 353, or permission of the instructor.

MECH 401. Senior Design I. 1 Credit.
Offered Fall Semester Only; Lecture hours:2,Common Hour:2
Student teams design systems to solve open-ended problems with consideration of broad perspectives through the use of the design process, modeling and analysis, resource management, and documentation. Co-Requisite: MECH 401C. Prerequisites: MECH 312 and MECH 392, or permission of the instructor.

MECH 402. Senior Design II. .5 Credits.
Offered Spring Semester Only; Lecture hours:2,Common Hour:2
Student teams validate systems designed in MECH 401 with consideration of broad perspectives through modeling and analysis, fabrication, instrumentation, and testing. Professional practice in engineering and ethics. Design of experiments for design validation. Co-requisite: MECH 402C. Prerequisite: MECH 401.

MECH 403. Thermal Design. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:2
Design of thermal-fluid energy conversion systems; equipment selection; codes and standards; and economic analysis. Mini-design laboratories and design projects. Co-Requisites: MECH 403L. Prerequisites: MECH 312.

MECH 405. System Dynamics. 1 Credit.
Offered Fall Semester Only; Lecture hours:3,Lab:2
Modeling and analysis of dynamic systems consisting of mechanical, electrical, and fluid elements. Frequency response methods. Sampled data systems. Experimental system identification. Co-Requisites: MECH 405L. Prerequisites: MATH 212, MECH 222, MECH 252, and ECEG 205.

MECH 420. Solar Energy Conversion. 1 Credit.
Offered Occasionally; Lecture hours:4
Fundamental aspects of the design and operation of solar energy conversion systems including photovoltaics, solar thermal power, solar heating and chemical fuel production. Prerequisite: MECH 312 or permission of the instructor. Crosslisted as MECH 620.

MECH 422. Renewable Energy Conversion. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Current energy demands, environmental effects, renewable energy resources, includes solar, wind, tidal, ocean thermal, wave energies; clean coal, nuclear energy, smart grid technology. Prerequisites: CHEG 200 or ENGR 200 or MECH 213 or permission of instructor. Crosslisted as MECH 622.

MECH 424. Internal Combustion Engines. 1 Credit.
Offered Occasionally; Lecture hours:4
Description of internal combustion engines, methods of evaluating performance, the thermodynamics of combustion, engine testing, and design. Prerequisite: MECH 312 or permission of instructor. Crosslisted as MECH 624.

MECH 428. HVAC System & Smart Building. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Explores the key mechanical aspects in designing an efficient, intelligent, and healthy built environment. Topics include building energy load estimate, psychrometric analysis, typical cooling and heating production (steam, chilled water, air conditioning), air distribution systems and smart buildings in the context of grid decarbonization. Prerequisites: MECH 312, concurrency allowed. Crosslisted as MECH 628.

MECH 429. Applied Thermodynamics. 1 Credit.
Offered Occasionally; Lecture hours:4
Application of Thermodynamic principles for Energy, Refrigeration and Air-Conditioning, Psychrometrics, Combustion, Compressible Flow, Exergy Analysis. Prerequisite: MECH 213 or equivalent Crosslisted as MECH 629.

MECH 433. Advanced Fluid Mechanics. 1 Credit.
Offered Occasionally; Lecture hours:4
Kinematics of fluid flow. Conservation equations. Viscous flow. Turbulent flow (description, statistics, equations, physics, modeling, boundary layers, analyses). Selected applied topic(s) e.g. design applications of computational fluid dynamics, reservoir flow. Selected laboratory projects. Prerequisite: MECH 313 or equivalent, or permission of the instructor. Crosslisted as MECH 633.

MECH 435. Aerodynamics. 1 Credit.
Offered Occasionally; Lecture hours:4
Two-dimensional flow theory; vortex and momentum theories of finite wings; viscous flows, boundary layers and drag; high lift devices. Prerequisites: MECH 313 or equivalent and permission of the instructor. Crosslisted as MECH 635.

MECH 438. Fundamentals of Aircraft Dsgn. 1 Credit.
Offered Occasionally; Lecture hours:4
Introduction to aircraft design elements and theory. Develop computer models to design, analyze, simulate, and evaluate commercial and electric aircraft designs and their performance. Design, build, and fly a small-scale aircraft. Prerequisites: ENGR 214 and MECH 202. Crosslisted as MECH 638.

MECH 448. Advanced Materials Science. 1 Credit.
Offered Occasionally; Lecture hours:4
The course will start with a survey of different materials - metals and alloys, ceramics, polymers, composites, carbon, and biomaterials. Next, thin-film deposition methods and their characterization (microscopy and spectroscopy) will be discussed. Finally, the course will delve into tribology: the science of wear, friction, and lubrication. Prerequisite: ENGR 240. Crosslisted as MECH 648.

MECH 451. Vibration Analysis. .5-1 Credits.
Offered Occasionally; Lecture hours:4
Damped and undamped vibrations in free and forced systems. Resonance conditions. Vibration measuring equipment. Multi-degree of freedom discrete systems. Continuous systems. Prerequisites: MECH 252 or MATH 212 or permission of the instructor. Crosslisted as MECH 651.

MECH 453. Robotics. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
History, evolution, capabilities, and applications of robotic devices. Introduction to robot kinematics, dynamics, and control via mathematical and computational modeling approaches. Research into current topics in robotics. Prerequisites: MECH 252 or permission of the instructor. Crosslisted as MECH 653.

MECH 454. Vehicle Dynamics and Control. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Introduction to modeling of vehicles for analysis and control. Topics include tire models, handling response, stability control, suspension design, race tuning. Prerequisites: MECH 252 and MECH 353 and MECH 405 or permission of the instructor. Crosslisted as MECH 654.

MECH 457. Accident Analysis. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Analysis of vehicle design and performance as it pertains to crashworthiness. Vehicle materials and structure, how vehicles are regulated with an emphasis on occupant safety. Studying the evolution of modern designs to minimize injuries includes reviewing many relevant biomechanics research studies. Crosslisted as BMEG 457 and MECH 657.

MECH 460. Engineering Optimization. 1 Credit.
Offered Occasionally; Lecture hours:4
Mathematical representation and modeling of engineering decision-making problems. Applied methods of linear, nonlinear, discrete and global optimization. Numerical techniques for solving constrained and unconstrained problems. Prerequisites: ENGR 214, MATH 212, and MATH 245 or permission of the instructor. Crosslisted as MECH 660.

MECH 462. Computer Integrated Manufacturing. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Issues of integrated information and advanced machinery in modern manufacturing systems. In-depth study of solid modeling. Study of the effects of the integration of computers in manufacturing, via topics such as control of manufacturing processes, quality control, process planning, assembly, additive manufacturing, etc. Prerequisite: MECH 355 or permission of instructor. Crosslisted as MECH 662.

MECH 467. Finite Element Methods. 1 Credit.
Offered Occasionally; Lecture hours:3,Other:2
Fundamental theory and applications for civil and mechanical engineering. Multidimensional elements, and axisymmetric elements, and their formulations; stress recovery techniques; modeling considerations; convergence criteria and error estimates, includes use of commercial and developmental finite element analysis programs. Prerequisite: MECH 353 or permission of the instructor. Crosslisted as CEEG 408 and CEEG 608 and MECH 667.

MECH 468. Human Movement Biomechanics. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Principles of mechanics applied to human movement. Background in anatomy and physiology, physics, and statistics will be presented. Topics include human movement biomechanics, kinematics and kinetics, electromyography, gait, clinical/atypical movement, and other applications of biomechanics. Prerequisites: MECH 220. Crosslisted as MECH 668.

MECH 473. Materials Characterization. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Theory and practice of materials characterization techniques including phase identification, mechanical testing, and various forms of microscopy. Prerequisite: ENGR 240 or permission of instructor. Crosslisted as MECH 673.

MECH 475. Finite Element Modeling. .5-1 Credits.
Offered Occasionally; Lecture hours:Varies
Introduction to finite element modeling with commercial software. Brief overview of the finite element method and approximation techniques. Modeling of three dimensional solids, including structural and multiphysics analyses. Emphasis of modeling considerations such as boundary conditions, material properties, mesh convergence, sensitivity studies, and other common modeling assumptions. Crosslisted as MECH 675.

MECH 476. Biomechanics. 1 Credit.
Offered Occasionally; Lecture hours:4
Principles of mechanics applied to biological systems. Background in anatomy, physiology, and cell biology will be presented. Mechanical behavior of hard and soft biological materials. Topics in cellular, cardiovascular, musculoskeletal, implant, and sport/motion biomechanics. Prerequisite: MECH 353 or permission of the instructor. Crosslisted as MECH 676.

MECH 478. Biomimetic Materials. 1 Credit.
Offered Occasionally; Lecture hours:3,Recitation:1
Introduction to topics in biomimetics, studying nature as an inspiration for engineering design. Topics include relationships between microstructure and physical properties of natural materials and tissue engineering approaches to biomaterials design. Crosslisted as BMEG 431, BMEG 631 and MECH 678.

MECH 484. Machine Learning for Engineering Systems. 1 Credit.
Offered Occasionally; Lecture hours:4
Machine Learning is a branch of Artificial Intelligence (AI). This course focuses on system modeling and optimization using established machine learning tools such as neural networks and genetic algorithms. MATLAB based. Prerequisite: ENGR 214 or equivalent, or permission of the instructor. Crosslisted as MECH 684.

MECH 485. Advanced Engineering Problems. .25-1 Credits.
Offered Either Fall or Spring; Lecture hours:Varies,Other:4; Repeatable
An investigation under the direction of a faculty member. Senior-level topics not covered in other courses may be studied in this course. Prerequisites: Senior standing in mechanical engineering and permission of the instructor.

MECH 488. Advanced Topics in Mechanical Engineering. .5-1 Credits.
Offered Occasionally; Lecture hours:4; Repeatable
Advanced, in-depth course developed from areas of mechanical engineering. Topics will vary. Crosslisted as MECH 688.

MECH 495. Advanced Topics in Engineering Mathematics. 1 Credit.
Offered Fall Semester Only; Lecture hours:4
Linear algebra and analytical/computational techniques for solving ordinary and partial differential equations relevant to engineering applications. Crosslisted as CEEG 495 and CHEG 495 and MECH 495 and ENGR 695 and ECEG 495 and ECEG 695. Prerequisite: permission of the instructor.