BMEG 101: Survey of Biomedical Engineering

Catalog Data :	**BMEG-101: Biomedical Engineering Seminar, Credits: 3** The course covers basic concepts tied to biomedical engineering and their applications. Further, it serves as an introduction to the fundamental science and engineering on which biomedical engineering is based. Further, the course provides a survey of various areas tied to biomedical engineering (e.g., assistive technologies, biomechanics, additive manufacturing, and bioimaging). Hands-on projects and case studies are designed engage the students and to provide baseline knowledge. The course is designed for science and non-science majors but is a mandatory requirement for students majoring in biomedical engineering.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 1 hour, 20minutes lectures per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	None
Co-requisites Course:	None
Required Texts:	Readings and assignments provided by instructor
Course Coordinator:	Dr. Lara A. Thompson
Course Objectives:	The objective of this course is to expose students to an array of topics related to biomedical engineering, or BME, via for example: lectures, readings, field trips, interactive small group discussions, projects and an end of term poster presentation. Topics covered throughout the course will include medical ethics & research conduct, rehabilitation engineering, biomechanics (biomaterials & biomedical imaging), additive manufacturing and bioinstrumentation. Knowledgeable professionals in the above areas will be invited to present interactive and informative sessions to expose and engage the students. Further, students will develop professionally in terms of their written and oral communication skills. Following successful completion of this course, students will be able to: have a general understanding of the above BME areas and meaningfully disseminate their ideas in both written and oral technical formats. The objectives are to develop a student's capacity to gain: • To develop an understanding of professional and ethical responsibility • To gain new knowledge of contemporary issues in human health and medicine • To gain an understanding of the impact of biomedical engineering solutions in a global, economic, environmental,

	and societal context • To gain an ability to communicate effectively (both oral and written)
Topics Covered:	• Medical & Research Ethics • Rehabilitation Engineering • Biomechanics • Advanced Manufacturing/3D printing for Biomedical Engineering applications • Bioinstrumentation • Big Data/Data Analytics in Biomedical Engineering • BME guest speaker presentations • Technical writing & oral presentations • Field Trips
Lab Experiment and Activities	1. Guest speaker presentations 2. Student essays & discussions 3. Project 4. Poster Presentation
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO2, SO3, SO4, SO7
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to: **Assessed for Student Outcomes** **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Biomedical Engineering) **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (BMES, ASME), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.

Prepared by:	Dr. Lara Thompson
Approved by DCC:	By Biomedical Engineering Curriculum Committee

BMEG 235: Engineering Software & Programming

Catalog Data :	**BMEG-235: Engineering Software & Programming, Credits: 3** This course introduces students to an array of software packages and applications applicable to the biomedical engineering curriculum and discipline. Course content includes mathematical programming software and applications (e.g., MATLAB, Python, COMSOL, and ANSYS), data acquisition and analysis software (e.g., LabVIEW).
Credits and Requirements:	3 Cr. and required course
Class Schedule	1 hour and 20 minutes lecture per week for one semester
Laboratory Schedule:	1 hour and 20 minutes lab per week for one semester
Pre-requisites by Course:	None
Co-requisites Course:	None
Required Texts:	MATLAB Programming for Biomedical Engineers and Scientists, 1st Edition. Andrew King and Paul Aljabar. ISBN: 9780128122037 Engineering Analysis with ANSYS Software, 2nd Edition. Tadeusz Stolarski, Y. Nakasone, S. Yoshimoto. ISBN: 978-0-08-102164-4 Additional notes provided by instructor
Course Coordinator:	Dr. Ji Chen (instructor); Dr. Lara A. Thompson (owner)
Course Objectives:	The objective of this course is to expose students to an array of software packages and applications to engineering, in particular, towards the biomedical engineering field. The goal is for students to become knowledgeable on how to use mathematical programming and modeling software, as well as become exposed to data acquisition and analysis software. An introduction to various tools will take place as a well as guided, integrated project assignments which display examples of how the software could be used and applied. The student learning outcomes are: • To prepare students for engineering practice via introduction of various software towards biomedical engineering applications • To develop an understanding of the importance of programming and analysis in science, medicine, and engineering • To develop an understanding of the importance of simulation in science, medicine, and engineering • To gain hands-on experience in order to meet demands of the biomedical engineering workforce • To gain new knowledge of contemporary software and to develop skills
Topics Covered:	1. An introduction to Excel 2. An introduction to mathematical programming and analysis:

	MATLAB and Python 3. Brief overview of data acquisition: Labview 4. Project #1: Acquisition and analysis body kinetic and kinematic data a. Exposure to LabView and data acquisition b. Guided analysis of data using Excel and MATLAB 5. An introduction to modeling and analysis: COMSOL and ANSYS 6. Project #2: Stress and strain on bone a. Analysis of data i. Simple plotting, regression and calculations via Excel and MATLAB b. Exposure to simulation software environments via ANSYS i. Importing geometry, setting boundary conditions, specifying the physics, setting material properties, meshing, simulation, and visualization
Lab Experiment and Activities	5. Assignments 6. Project #1 7. Project #2
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: **SO1, SO2**
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO2-B** Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions **SO2-C** Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Biomedical Engineering)
Prepared by:	Dr. Lara Thompson	
Approved by DCC:	By Biomedical Engineering Curriculum Committee	

BMEG 300: Bioinstrumentation Lab

Catalog Data:	**BMEG-300 Bioinstrumentation Lab. Credits 1.** The course will introduce biomedical devices, their components and background of their use, as well as cover basic concepts for analog signal amplification and filters, digital acquisition, digital filtering and processing. Students may gain the opportunity to do the following: explore different types of (biomedical-related) sensors; explore hands-on implementation of instrumentation; record physiologic signals.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 140-minute laboratory session per week for one semester
Pre-requisites by Course:	ELEC 225 Electronic Circuits Lec.; ELEC 226 Electronics Circuits Lab.
Co-requisites Course:	BMEG-301
Required Texts:	Webster, John G. (ed.), *Medical Instrumentation: Application and Design*, Fourth Edition, Wiley
Course Co-coordinator:	Dr. Max Denis
Course Objectives:	After successful completion of this class, students will be able to: • Demonstrate an understanding of physics and engineering in biosensor and electrodes • Demonstrate an understanding of the biomedical instrumentation principles in aspects of device design and applications • Apply these principles in the context of bioinstrumentation interactions with tissues, organs and human body to explain the measurement results and to develop the instrumentations.
Topics Covered:	• Basics Sensors • Signal conditioning basics: amplifier and filter built from operational amplifier • Data acquisition using Arduino • Data analysis using MATLAB • Biopotential, biopotential electrodes, biopotential amplifier • Electronic safety • Hands-on projects
Lab Experiment and Activities	Yes
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO3 and SO6
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods. **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

BMEG 301: Bioinstrumentation Lec

Catalog Data :	**BMEG-301 Bioinstrumentation Lec. Credits 3.** The course will introduce biomedical devices, their components and background of their use, as well as cover basic concepts for analog signal amplification and filters, digital acquisition, digital filtering and processing. Students may gain the opportunity to do the following: explore different types of (biomedical-related) sensors; explore hands-on implementation of instrumentation; record physiologic signals.
Credits and Requirements:	3 Cr. and required course
Class Schedule	One 90-minute combine lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	ELEC 225 Electronic Circuits Lec.; ELEC 226 Electronics Circuits Lab.
Co-requisites Course:	None
Required Texts:	Webster, John G. (ed.), *Medical Instrumentation: Application and Design*, Fourth Edition, Wiley
Course Co-coordinator:	Dr. Max Denis
Course Objectives:	To expose and develop student-understanding of instrumentation for measuring various physiological variables: • Understanding of engineering concepts and physiology as related to medical-engineering needs. • Ability to apply knowledge of advanced mathematics, sciences, and engineering to solve problems at the interface of engineering and biology and to model biological systems • Ability to conduct experiments, including making measurements and interpreting experimental data from physiological systems Ability to calculate centers of mass of composite structures
Topics Covered:	• Overview of Experimental Measurement Systems • Analysis of Molecules in Clinical Medicine • Cellular Measurements and Biopotentials • Bioimaging Techniques • Measurements related to Central Nervous System functions
Lab Experiment and Activities	Yes
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1 and SO3
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

BMEG 302: Professional Issues in Biomedical Engineering/Biomedical Engineering Seminar

Catalog Data :	**BMEG-302: Professional Issues in Biomedical Engineering/Biomedical Engineering Seminar, Credits: 3** The purpose of the seminar course is to expose students to an array of topics related to BME (e.g., via guest speaker lectures, case studies, paper-readings, and interactive small group discussions). Topics covered include medical ethics, research conduct, written and oral technical communication, and other BME-related topics and issues. Knowledgeable professionals in the field of BME may be invited to present interactive and informative sessions to expose and engage the students.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 1 hour, 20minutes lectures per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	Junior standing, or by permission of instructor
Co-requisites Course:	None
Required Texts:	Journal papers and readings provided by instructor
Course Coordinator:	Dr. Lara A. Thompson
Course Objectives:	This objective of this course is to expose students to an array of topics related to biomedical engineering research (including medical ethics, additive manufacturing, biomechanics, genetic engineering, etc.). The course will include guest speakers, case studies, paper-readings and small group discussions. Further, students will develop professionally in terms of their written and oral communication skills. Following successful completion of this course, students will be able to: conduct and interpret literature research; meaningfully disseminate their conclusions in both written and oral technical formats. The objectives are to develop a student's capacity to gain: • An understanding of professional and ethical responsibility • The ability to communicate effectively (both oral and written) • An understanding of the impact of biomedical engineering solutions in a global, economic, environmental, and societal context • New knowledge of contemporary issues in human health and medicine
Topics Covered:	• Medical & Research Ethics, including exposure to Institutional Review Board (IRB) Processes & Human Studies Applications • Professional development (e.g., discussion on internships and fellowship opportunities, as well as pursuit of advanced degrees) • Technical writing & oral presentations and developing a research plan

<table>
<tr><td></td><td colspan="2">• Advanced Manufacturing/3D printing for Biomedical Engineering applications
• Rehabilitation Engineering and Biomechanics
• Sensory Substitution and Big Data/Data Analytics in Biomedical Engineering
• Medical Imaging</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">8. Guest speaker presentations and Theme papers & Presentations
9. Personal Statement & Research Plan Documents
10. Personal Statement & Research Plan Presentation</td></tr>
<tr><td>Relationship of course to BME Curriculum:</td><td colspan="2">Meets Educations Objectives through Student Outcomes
Student Outcomes: SO2, SO3, SO4, SO7</td></tr>
<tr><td rowspan="2">Course Student Outcomes through Performance Indicators:</td><td colspan="2">Students will demonstrate ability to</td></tr>
<tr><td>Assessed for Student Outcomes</td><td>SO2-C Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline (i.e., Biomedical Engineering)
SO3 - A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO3 - B Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences
SO4-A Demonstrate knowledge of Professional Code of Ethics in general as well as major specific society specific codes (BMES, ASME), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements
SO4-B Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities
SO4-C Ability to recognize ethical and professional responsibilities of engineering solutions and their impacts in global, economic, environmental and societal contexts and incorporate their sensitivities into the design process appropriately
SO7-A Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning)
SO7-B Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession</td></tr>
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Prepared by:	Dr. Lara Thompson
Approved by DCC:	By Biomedical Engineering Curriculum Committee

BMEG 304: Biomechanics

Catalog Data :	**BMEG-304 Biomechanics Credits 3.** This course provides a foundation of mechanics formulated towards addressing biomedical engineering problems. Here, the basic concepts and methods of mechanics (statics, dynamics, and mechanics) are applied to study the forces on the human body & biological tissues. For example, biomechanics of movement, cardiovascular biomechanics, and soft tissue mechanics will be explored.
Credits and Requirements:	3 Cr. and elective course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN 201, CVEN 202
Co-requisites Course:	None
Required Texts:	Knudson, D. V. (2003). ***Fundamentals of biomechanics***. New York: Kluwer Academic/Plenum Publishers. ISBN: 978-0-387-49312-1
Course Co-coordinator:	Dr. Ji Chen (instructor), Dr. Lara Thompson (owner)
Course Objectives:	• Ability to utilize nine key nine fundamental biomechanics principles to generally explain various types of human movement. • Ability to use nine biomechanics principles as a basis to provide ideas on enhancing certain movements. • Ability to perform linear and angular kinematic analysis on joints and segments in typical human movement (walking, jumping, running, reaching and grasping objects). • Ability to perform linear and angular kinetic analysis on joints and segments in static setting (postural control) and dynamic setting of human movement. • Ability to use a few tools (hardware and software) to perform biomechanics analysis for human movement rehabilitation. • Ability to use techniques and principles learned from this course to design a simple research experiment to study a particular human movement.
Topics Covered:	• Fundamentals of Biomechanics and Qualitative Analysis • Anatomical Description and Its Limitations • Mechanics of the Musculoskeletal System • Linear and Angular Kinematics • Linear and Angular Kinetics • Applications of Biomechanics in Qualitative Analysis including in Sports Medicine, Rehabilitation, Strength and Conditioning.

	• Fundamentals of Engineering Mechanics (Statics and Dynamics)	
Lab Experiment and Activities	None	
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO6	
Course Student Outcomes through Performance Indicators:	Students will be able to:	
	Assessed for Student Outcomes	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions **SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO1-D** Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Ji Chen	
Approved by DCC:	By Biomedical Engineering Program Curriculum Committee and Mechnical Engineering Department Curriculum Committee	

BMEG 371: Analysis of Physiological Systems Lec.

Catalog Data :	**BMEG-371 Analysis of Physiological Systems Lec. Credits 3.** This course provides an overview of systems theory with applications and case studies from bioengineering and physiology (e.g., nerve function, muscle dynamics, cardiovascular regulation, physiologic feedback control systems, properties of muscle, cardiovascular function). Analyses within the course includes: differential equations, linear and nonlinear systems, stability, time and frequency domain methods, feedback control, and biological oscillations. Case studies readings and analysis of actual physiologic data will comprise a portion of this course.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH-254; CVEN-308
Co-requisites Course:	BMEG-373
Required Texts:	Nise, N., Control Systems Engineering. 7th edition
Course Co-coordinator:	Dr. Max Denis
Course Objectives:	After completing the course, students should be able to: • Build on a basic understanding of physiology to develop a more in-depth level of understanding that will enable engineering analysis of selected physiological systems • Translate the understanding of physiological function into an engineering model based on block-diagram analysis of a dynamic system whose function is based on a differential equation. • Develop skill in applying a high-level engineering tools for block diagram modeling (SIMULINK). • Be able to apply engineering models of physiological systems to answer questions relevant to the design of biomedical engineering devices or processes. • Recognize the difference between the roles of variables and parameters in a model.
Topics Covered:	• Introduction to Physiological Systems Modeling • Linear systems • Laplace Transforms • Transfer functions • Physiological Modeling • Block Diagram Analysis • Analysis and Design in State-Space • Linearization

Lab Experiment and Activities	None	
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO6	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	Addressed for Student Outcomes	**SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods. **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

BMEG 373: Analysis of Physiological Systems Lab.

Catalog Data :	**BMEG-373 Analysis of Physiological Systems Lab. Credits 1.** This course provides an overview of systems theory with applications and case studies from bioengineering and physiology (e.g., nerve function, muscle dynamics, cardiovascular regulation, physiologic feedback control systems, properties of muscle, cardiovascular function). Analyses within the course includes: differential equations, linear and nonlinear systems, stability, time and frequency domain methods, feedback control, and biological oscillations. Case studies readings and analysis of actual physiologic data will comprise a portion of this course.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	Two 80-minute laboratory sessions per week for one semester
Pre-requisites by Course:	ELEC 226
Co-requisites Course:	BMEG-371
Required Texts:	Nise, N., Control Systems Engineering. 7th edition
Course Co-coordinator:	Dr. Max Denis
Course Objectives:	After completing the course, students should be able to: • Build on a basic understanding of physiology to develop a more in-depth level of understanding that will enable engineering analysis of selected physiological systems • Translate the understanding of physiological function into an engineering model based on block-diagram analysis of a dynamic system whose function is based on a differential equation. • Develop skill in applying a high-level engineering tools for block diagram modeling (SIMULINK). • Be able to apply engineering models of physiological systems to answer questions relevant to the design of biomedical engineering devices or processes. • Recognize the difference between the roles of variables and parameters in a model.
Topics Covered:	• Laplace transforms • Block diagrams modeling of systems using Simulink • Pole-zero modeling and analysis • Transfer function of systems • Open loop and close-loop analysis • Transient, steady-state error, and stability analysis of firs-order and second-order electrical and mechanical systems • Analysis of negative feedback systems • Designing of Proportional, PI, PD, and PID controllers • Frequency responses (Bode Diagram)

	• Arduino projects
Lab Experiment and Activities	Yes, the theory covered with BMEG-371
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO6
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to: **Assessed for Student Outcomes** **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods. **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Max Denis
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee

BMEG 402: Biological Imaging

Catalog Data:	**BMEG-402 Biological Imaging Credits 3.** An overview of biomedical signals and images including imaging modalities such as Xray, computerized axial tomography (CT), positron emission tomography (PET), and magnetic resonance imaging (MRI) will be covered. Fundamentals of signal and image processing including data acquisition, filtering, 2D signals and systems, noise reduction methods and homomorphic filtering for image enhancement will be discussed. An overview of random signals and linear systems and power spectra will also be discussed.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	BIOL-101; BIOL 103; PHYS 201; PHYS 205, PHYS 202; PHYS 206
Co-requisites Course:	BMEG-491
Required Texts:	Prince, J.L. and Links, J.M. Medical Imaging: Signals and Systems. 2nd Edition, Prentice Hall, 2006
Course Co-coordinator:	Dr. Max Denis
Course Objectives:	After completing the course, students should be able to:: • Explain methods of image acquisition and formation. • Describe the types of energy used for each modality and how the energy is generated. • Derive the spatial and temporal limitations, and resolution of each modality. • Identify what improves or degrades resolution. • Determine which imaging modalities would be best to determine molecular, anatomical, or physiological information. • Compare and contrast the possible bioeffects of each modality. Describe the FDA limits if they exist. • Differentiate how biomedical imaging is used clinically and in biomedical research. Differentiate the advantages of each method for a range of industrial, clinical, and research applications.
Topics Covered:	• Linear systems • Fourier analysis and signal processing • Image quality and performance • Ultrasound • MRI • Nuclear imaging • X-ray imaging • Computed Tomography (CT)

Lab Experiment and Activities	None	
Relationship of course to BME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO6	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	Addressed for Student Outcomes	**SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods. **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

CCEN 101: Introduction to Engineering

Catalog Data :	**CCEN101 Introduction to Engineering Credits 2.** Introduces freshmen interested in engineering disciplines to basic scientific principles and engineering concepts through hands-on experiments. These experiments enable students to acquire the knowledge, skills and attitudes necessary to be successful in the pursuit of engineering disciplines. In addition, students in this course will learn how to analyze, interpret and present data. Emphasis on guided design and problem-solving methodologies. Students undertake practice-oriented group design projects. Formal written reports and oral presentations will be required.
Credits and Requirements:	2 Cr. and required course
Class Schedule	Two 150-minute lecture sessions per week for one semester
Laboratory Schedule:	Tuesday, Thursday after lecture session
Pre-requisites by Course:	No
Co-requisites Course:	None
Required Texts:	Strategies for Creative Problem Solving, Scott Fogler and Steven LeBlanc 3rd edition, Prentice Hall, 2014 (ISBN 978-0-13-309166-3)
Course Co-coordinator:	Dr. Kate Klein
Course Objectives:	Emphasis will be placed on critical thinking and problem solving skills. The purpose of the course is to expose the student to concepts, research, and projects across various engineering disciplines so as to enable the student to choose the engineering career-path most suitable. There will be guest lectures to give students an overview of a wide variety of engineering applications, research, and technology. The students will work on a group project that involves design constraints, fabrication, and presentation. The ability to work synergistically within small groups is a major goal of this course
Topics Covered:	Engineering and Design cannot be neatly separated, though they both involve problem solving. Engineering is associated with an emphasis on the inter-relationship between predictions and experimentation, while design will be associated with more of an intuitive approach. In either case, the primary purpose of the course is to introduce students to a systematic method of problem solving. The methodology is applicable to both individual and group problems or projects. There will be a series of experimental problems encountered during this course. There will also be a robotics final project that will require each team to complete a series of challenges and then develop their own problem statement to solve for their final

	project. Reports and presentations will be required for all projects.	
Lab Experiment and Activities	(description of lab activities)	
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO5, SO6, SO7	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	Assessed for Student Outcomes	1. Understand complex problems by examining the issues and points of view [SO1] 2. Apply the engineering heuristic (define, generate, decide, implement, evaluate) to produce solutions to engineering design problems [SO2] 3. Communicate technical information in written, oral and graphical form in a professional manner [SO3] 4. Demonstrate the ability to plan collaborative tasks, share responsibility, and execute team goals [SO5] 5. Gather, analyze, and evaluate data from a variety of sources [SO6] 6. Ability to continuously adapt to new information and situations and appreciate the need for life-long learning [SO7]
Prepared by:	Dr. Kate Klein	
Approved by DCC:	By Mechnical Engineering Department Curriculum Committee	

CVEN 201: Engineering Mechanics I

Catalog Data :	**CVEN-201 Engineering Mechanics I. Credits 3.** Covers statics of particles and rigid bodies; equilibrium, distributed forces; centroids; center of gravity; structuretrusses, frames, machines; forces in beams and cable; friction; moments of inertia.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS 201 Physics I
Co-requisites Course:	None
Required Texts:	Engineering Mechanics: Statics, by R.C. Hibbler ISBN 9780136077909, 13th Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to engineering centered around the mechanics of static bodies: • To familiarize students with the concept of static equilibrium utilizing Newton's second law • To familiarize students with concept of a free-body diagram • To familiarize students with the concept of internal and external reaction forces • Ability to add forces and resolve them into components • Ability to use free-body diagrams to analyze rigid bodies • Ability to develop equations of equilibrium for rigid bodies • Ability to analyze trusses by finding the force in each member • Ability to calculate the internal forces of a beam and draw shear and moment diagrams • Ability to calculate friction forces and the limits before slipping • Ability to calculate centers of mass of composite structures
Topics Covered:	• Introduction and general principles • Equilibrium of Particles • Force Systems and Equilibrium of Rigid Bodies • Internal Forces and Moments • Structures • Friction • Method of Virtual Work • Centroids, centers of gravity, and moments of inertia
Lab Experiment and	None

Activities		
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1	
Course Outcomes	Students will demonstrate ability to:	
	ssed for Student Outcomes Performance Indicators	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	Civil Engineering Department Curriculum Committee	

CVEN 202: Engineering Mechanics II

Catalog Data :	**CVEN-202 Engineering Mechanics II. Credits 3.** Covers kinematics and kinetics of a particle. Planar kinematics of a rigid body; planar kinetics of a rigid body including force and acceleration; work and acceleration; work and energy; impulse and momentum, and vibrations.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN 201
Co-requisites Course:	None
Required Texts:	Engineering Mechanics: Dynamics, by R.C. Hibbler ISBN 9780136077916, 13th Edition, Prentice Hall
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to engineering centered around rigid body kinematics: • Ability to utilize principles of particle and rigid body kinematics. • Ability to form mathematical models of engineering mechanisms and machines. • Ability to determine the motion caused by applied forces. • Ability to apply the principle of conservation of momentum • Ability to analyze dependent motion of particles • Ability to define relationships of position, velocity, and acceleration of rigid bodies • Ability to solve kinematic problems with rectilinear and curvilinear motion of particles • Ability to apply principles of work and energy • Ability to solve kinematic problems of rotating rigid bodies • Ability to calculate moments of inertia for systems of particles and rigid bodies • Ability to solve problems with impact of particles
Topics Covered:	• Kinematics of Particles and Rigid Bodies • Projectile Motion • Principles of Impulse and Momentum • Conservation of Energy • Principles of Force and Acceleration • Relative Motion Analysis • Rigid Body Equations of Motion

Lab Experiment and Activities	None	
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1	
Course Outcomes	Students will demonstrate ability to:	
	Performance Indicators Assessed for Student Outcomes	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	Civil Engineering Department Curriculum Committee	

CVEN 308: Applied Numerical Analysis

Catalog Data :	**CVEN-308 Applied Numerical Analysis. Credits 3.** Covers modeling and error analysis, roots of equations; systems of linear algebraic equations, curve fitting; numerical differentiation and integration; ordinary differential equations; partial differential equations.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH 254
Co-requisites Course:	None
Required Texts:	Applied Numerical Methods with MATLAB: for Engineers and Scientists, by Steven Chapra ISBN-13: 978-0073397962, 4th Edition, McGraw-Hill
Course Co-coordinator:	Dr. Bryan Higgs
Course Objectives:	The purpose of this course is to develop an understanding of key concepts to numerical analysis: • Ability to find the roots of equations • Ability to apply numerical methods to solve systems of equations • Ability to apply methods for differentiation and integration • Ability to apply the process of numerical optimization • Ability to conduct numerical analyses in MATLAB • Ability to create equations from input data through curve fitting • Ability to interpret mathematical models
Topics Covered:	• Mathematical Modeling • MATLAB Fundamentals • Methods for finding roots • Optimization and Linear Algebra • Linear regression • Interpolation • Integration and Differentiation • Ordinary Differential Equations
Lab Experiment and Activities	None
Relationship of course to CE Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO6
Course Student Outcomes through	Students will demonstrate ability to:

Performance Indicators:	**Assessed for Student Outcomes**	**SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints **SO6-B** Able to analyze and interpret data, validate experimental results including the use of statistics to account for possible experimental error and compares using alternate tools for or methods
Prepared by:	Dr. Bryan Higgs	
Approved by DCC:	Civil Engineering Department Curriculum Committee	

ELEC 225: Electrical Circuits

Catalog Data:	**ELEC-225 Electrical Ciruits. Credits 3.** Description, analysis, simulation, and Design, of electric circuits. Basic concepts and laws of electrical circuits such as Ohm's and Kirchhoff's laws, Thevenin and Norton theorems and equivalents, DC and AC steady-state analysis of simple circuits, transient analysis of first and second-order circuits, frequency response and transfer functions of first and second-order circuits, and ideal op-amp circuits and diode circuits.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-201, PHYS-205
Co-requisites Course:	ELEC-226
Required Texts:	Engineering Circuit Analysis by William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, 8th Edition, Mc Graw Hill Publishing company.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	ourse covers Voltage and Current Laws, Handy circuit analysis techniques, The Operational Amplifier (Op-Amp), Capacitors and Inductors, RC, RL and RLC circuits, Sinusoidal Steady State analysis, AC circuit power analysis, Polyphase circuits. • Ability to design, and analysis, of purely resistive circuits • Ability to design, analysis, and evaluation of AC and DC circuits using Ohm's Law • Ability to design, analysis, and evaluation of AC and DC circuits using KVL and KCL • Ability to design, analysis, and evaluation of AC and DC circuits using Voltage and Current dividers • Ability to design, analysis, and evaluation of AC and DC circuits including Operational Amplifiers • Ability to design, analysis, and evaluation of AC circuits using frequency domain (phasor analyses) • Ability to design, analysis, and evaluation of AC poly phase circuits
Topics Covered:	• Circuit Variables: Voltage, Current, Power and Energy • Circuit Elements and Experimental Laws (Ohm's Law, KCL, KVL) • Voltage and Current Laws • Nodal and Mesh analysis

<table>
<tr><td></td><td colspan="2">

- Handy circuit analysis techniques
- The Operational Amplifier (Op-Amp)
- Capacitors and Inductors
- RC, RL and RLC circuits
- Sinusoidal Steady State analysis
- AC circuit power analysis
- Polyphase circuits
- Magnetically coupled circuits

</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO1, SO2</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will demonstrate ability to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-A Identify complex problems by examining and understanding the issues and necessity of engineering solutions
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Amir Shahirinia</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering curriculum committee.</td></tr>
</table>

ELEC 226: Electrical Circuits Laboratory

Catalog Data:	**ELEC-226 Electrical Circuits Laboratory. Credits 1.** A laboratory course to accompany Electrical Circuits. This course is the first in a sequence of laboratory courses intended to develop a strong foundation in designing, assembling, and testing electrical circuits.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minutes laboratory session per week for one semester
Pre-requisites by Course:	PHYS-201 University Physics I, PHYS-205 University Physics I laboratory
Co-requisites Course:	ELEC-225 Electrical Circuit
Required Texts:	Engineering Circuit Analysis by William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, 8th Edition, Mc Graw Hill Publishing company.
Course Co-coordinator:	Dr. Amir Shahirinia
Course Objectives:	This lab offers experiments on Voltage and Current Laws, Handy circuit analysis techniques, The Operational Amplifier, Capacitors and Inductors charge and discharge, RC, RL and RLC circuits, Sinusoidal Steady State analysis, and AC circuit power analysis • The students gain a broad overview of the engineering concepts associated with analysis, design, and evaluation of circuits • The students gain an in-depth emphasis which is placed on selected topics in circuits analysis • The students evaluate an "off-the-shelf" design and determine if it could meet a specification • The students demonstrate and ability to simulate, and analyze circuits using software packages such as MATLAB/Simulink, OrCAD, and PSpice and compare them with experimental results to strengthen concepts in DC and AC circuits analysis
Topics Covered:	None
Lab Experiment and Activities	• Ohm's Law • Designing Series Circuits • Designing Series Parallel Circuits • Kirchhoff's Voltage and Current Laws • Designing Voltage and Current-Divider Circuits. • Maximum Power Transfer • Balanced Bridge Circuit • Superposition Theorem • Thevenin's Theorem

<table>
<tr><td></td><td colspan="2">• Oscilloscope Operations
• Peak, RMS, and Average Values of AC
• RC Time Constant
• Inductors and Capacitors in Series and Parallel
• Impedance of RC, RL, and RLC Circuits
• Power in AC Circuits
• Transformers Characteristics
• Selected PSpice Projects</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes: SO2, SO3, SO5</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will demonstrate ability to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO3-A Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience
SO5-B Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Amir Shahirinia</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Electrical and Computer Engineering Department Curriculum Committee</td></tr>
</table>

MECH-107: ME Computer Graphics

Catalog Data:	**MECH-107: ME Computer Graphics Credits 3.** This course provides students with hands-on, practical application of graphical modeling to create 3D parts for product design and manufacturing. The main objective is to familiarize students with the CREO software so that they may demonstrate competency in generating 3D models of both existing and new components. Finally they will produce a physical rendering of their model using 3D printing. This course will lay the foundation for the Advanced Manufacturing course.
Credits and Requirements:	3 Credits and required course
Class Schedule	One 150-minute lecture/ lab session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	None
Co-requisites Course:	None
Required Texts:	Creo Parametric 5.0, by Louis Gary Lamit ISBN 1985387530, CreateSpace Independent Publishing Platform, 2018
Course Co-coordinator:	Dr. Paul Witherell
Course Objectives:	This lab provides students with hands-on, practical application of graphical modeling to create 3D parts for product design and manufacturing. The main objective is to familiarize students with the CREO software so that they may demonstrate competency in generating 3D models of both existing and new components. Finally, they will lean to create and produce a physical rendering of their model using 3D printing. This course will lay the foundation for the Advanced Manufacturing course. Upon completion of the course the student will be able to: • Demonstrate the familiarity with different features and functions of CREO 5.0 • Demonstrate competence in making 3D models of engineering components • Make 3D models as per the suggested specifications • Modify engineering components and 3D models • Build 3D model for use in a 3D printer based on the CREO model
Topics Covered:	• Technical drawing basics, views and parent-child relationships, etc. • Modeling Theory - Sketching and Base Feature Geometry Creation, Dimensioning

<table>
<tr><td></td><td colspan="2">• Part Modeling & Secondary Features. Fillets, Chamfers, Draft, Revolves, Mirrors, Patterns, and Circular Patterns
• 3D Curves and Sweeps; Swept Blends/Lofting
• Building Assemblies (Bottom-Up method “BU” and Top-Down method “TD”)
• Creating Part Drawings and Assembly Drawings
• Importing/reusing models; Tessellated Geometries and Manifold Volumes
• Using different modeling software (ANSYS, SOLIDWORKS); Understanding Different File Formats & Interoperability
• Preparing model for 3D printing and creating</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2, SO3</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will demonstrate ability to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-D Select and effectively utilize appropriate techniques, tools, and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques
SO2-A Analyze the design problem, develop a clear and unambiguous needs statement, formulate design objectives, identify constraints, and establish criteria for acceptability and desirability of the design solution
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions
SO3-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Paul Witherell</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Mechanical Engineering Department Curriculum Committee</td></tr>
</table>

MECH 208: Thermodynamics

Catalog Data :	**MECH-208 Theromdynamics Credits 3.** Covers thermodynamic concepts, zeroth law, thermodynamic properties, first law and second law analysis of closed and open systems; availability and irreversibility analysis; power and refrigeration cycles; mixture of gases and psychometrics.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	PHYS-201
Co-requisites Course:	None
Required Texts:	Borgnakke, C. and Sonntag, R.E., Fundamentals of Thermodynamics. 8th edition
Course Co-coordinator:	Dr. Rufus Elemo (adjunct), Dr. Kate Klein (owner)
Course Objectives:	After completing the course, students should be able to: • Articulate the fundamental concepts of Thermodynamics • Determine and articulate the properties of a pure substance • Apply the 1st Law of Thermodynamics to open and closed system problems • Apply the 2nd Law of Thermodynamics to systems and evaluate efficiency • Analyze power and refrigeration cycles using the concept of entropy and the 2nd Law • Read and understand thermodynamic tables and charts and utilize software programs in order to solve engineering problems • Understand modern applications and challenges of thermodynamics
Topics Covered:	• Properties of (pure) substances • Conservation of mass and energy (1st Law of Thermodynamics) • Entropy and the 2nd Law of Thermodynamics • Vapor and gas power cycles and refrigeration cycles
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions. **SO1-B** Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes. **SO1-C** Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints. **SO1-D** Select and effectively utilize appropriate techniques, tools and computer-based resources, for a specific engineering task, project or assignment; demonstrate competency comparing results from alternative tools or techniques.
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

MECH 302: Research Experience & Technical Communication

Catalog Data :	**MECH-302 Research Experience & Technical Communication Credits 3.** This course will provide understanding of basic elements of research in the context of science and engineering and will involve the student in hands-on, cutting edge research not possible through regular courses in the curriculum. Students will also gain valuable skills in communicating technical results.
Credits and Requirements:	3 Cr. and required course
Class Schedule	One 170-minute in-class lecture and seminar session per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	CVEN-101, Sophomore or Junior standing; permission of instructor
Co-requisites Course:	None
Required Texts:	Journal articles and handouts
Course Co-coordinator:	Drs. Kate Klein and Max Denis
Course Objectives:	Upon completion of this course the student will be able to: • Conduct a literature review • Develop logical plan to investigate a new research topic • Understand a cutting-edge research field and conduct research • Demonstrate the mastery of using research equipment, tools, and specialized computer programs • Understand safe, responsible, ethical research practices • Write a research paper in the format of a peer reviewed publication • Create a poster and/or PowerPoint presentation to communicate results
Topics Covered:	• Literature Review • Reference Citation and Bibliography • Responsible Conduct of Research • Design of Experiments • Technical Presentations • Technical Writing • Research Proposal • Data Management
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO3, SO4, SO5, SO6 and SO7
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO3-A** Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience. **SO3-B** Communicate effectively orally in a variety of professional contexts such as well-organized, logical oral presentations, including good explanations when questioned to a range of audiences **SO3-C** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner. **SO4-A** Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements **SO5-A** Demonstrate ability to participate as a team member in developing and selecting ideas, establishing team goals and objectives, willingness to take on leadership responsibility and communicate with team members. **SO5-B** Demonstrate ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals. **SO6-A** Able to develop and conduct appropriate experimentation (identify the assumptions, constraints, models for the experiment, equipment, laboratory procedure and safety protocols) **SO6-C** Able to draw conclusions that are supported by the analysis and interpretation of data with respect to assumptions, constraints and theory. **SO7-A** Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).
Prepared by:	Dr. Max Denis	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

MECH 321: Fluid Mechanics

Catalog Data :	**MECH 321 Fluid Mechanics Credits 3.** Covers fluid properties and definitions, fluid statics, Archimedes principles, kinematics of fluids, control volume equations and analysis, Bernoulli equation, Euler equation, ideal flow equations, velocity potential and stream function, dimensional analysis, and viscous flows in pipes
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisites by Course:	MATH-254 Differential Equations; MECH-208 Thermodynamics
Co-requisites Course:	None
Required Texts:	*Fluid Mechanics: Fundamentals and Applications*, Cengel, Yunus A.; Cimbala, John M., First Edition, McGraw-Hill (2018). ISBN 0–07–247236–7
Course Co-coordinator:	Dr. Ludwig Carlos Nitsche
Course Objectives:	The main objectives of this course are to provide students with the skills and ability to understand, analyze, and solve fluid mechanic problems in a logical manner with emphasis on fluid statics and Archimedes principles; fluid kinematics and Reynolds Transport Theorem; inviscid and viscous flows; and dimensional analysis.
Topics Covered:	• Basic concepts and fluid properties: introduction and definitions. (1 week) • Basic equation of fluid statics. Pressure in a static fluid. (1 weeks) • Hydrostatic forces on submerged surfaces. Center of pressure. (1 weeks) • Buoyancy, stability of flotation, metacentric center (1 week) • Kinematics. Eulerian and Lagrangian approaches. Flow patterns and data plots. (2 week) • Other kinematic descriptions. Vorticity. Reynolds transport theorem. (1 week) • Conservation equations (mass, energy). Bernoulli's law. (2 weeks) • Momentum analysis of flow systems. (1 week). • Dimensional analysis and similarity. Non-dimensionalization. Pi theorem. (1 week). • Internal flows – laminar vs turbulent flow. Frictional losses, pumps. (1 week). • Differential analysis of fluid flow. Stream function. Navier-stokes equation (1 week).

<table>
<tr><td></td><td colspan="2">• Tests and Examinations (2 weeks)</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">None</td></tr>
<tr><td>Relationship of course to ME Curriculum:</td><td colspan="2">Meets Educations Objectives through Student Outcomes
Student Outcomes: SO 1-B, SO 1-C, SO 2-C, SO 3-A, SO 4-A, SO 4-B</td></tr>
<tr><td rowspan="2">Course Student Outcomes through Performance Indicators:</td><td colspan="2">Students will demonstrate ability to:</td></tr>
<tr><td>Assessed for Student Outcomes</td><td>SO1-B: Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes.
SO1-C: Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints.
SO2-C: Explain impact of engineering solution with respect to public health, safety, and welfare, as well as global, cultural, social, environmental, economic and contemporary critical issues confronting the discipline
SO3-A: Communicate effectively in writing in a variety of professional contexts such as lab reports, design reports using appropriate formats and grammar with discipline-specific conventions including citations appropriate to the audience.
SO4-A: Demonstrate knowledge of Professional Code of Ethics in general as well as major/society specific codes (ASCE), recognize ethical dilemma, evaluate ethical dimensions of a problem in the discipline, and professional responsibilities in engineering situations to make informed judgements
SO4-B: Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Ludwig Carlos Nitsche</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Mechnical Engineering Department Curriculum Committee</td></tr>
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MECH 351: Heat Transfer

Catalog Data:	**3511-351 Heat Transfer. Credits 3.** Examines heat conduction equations, steady and unsteady state heat conduction problems; principles of heat convection, forced, free and phase-change convective heat transfer; and radiative physics and heat transfer.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	N/A
Pre-requisites by Course:	3511 208 Thermodynamics 3511 321 Fluid Mechanics 1535 260 Differential Equations with Linear Algebra
Co-requisites Course:	N/A
Required Texts:	Fundamentals of Heat and Mass Transfer, 7th Edition Authors: Theodore L. Bergman, Adrienne S. Lavine, Frank P Incropera, David P. DeWitt Publisher: John Wiley & Sons, Inc
Course Co-coordinator:	Dr. Simpson Chen (instructor), Dr. Jiajun Xu (owner)
Course Objectives:	The objective of this course is to equip mechanical engineering students with a fundamental understanding of the mechanism and mathematics of heat transfer, ability to formulate, analyze, and solve problems involving heat transfer (a) Heat Conduction and Numerical Methods for 1&2D Problems (b) Convective Heat Transfer, Heat Transfer Coefficient (c) Boiling Heat Transfer (d) Radiative Heat Transfer. Upon completion of the course the student will be able to: • Articulate key processes of various heat transfer mechanisms and explain how these mechanisms work and their application in solving the engineering problems • Perform engineering analysis and design of different heat transfer modes with proficient mathematical: o 1) An ability to apply knowledge of ordinary and partial differential equations o 2) The ability to solve ordinary differential equations. o 3) The ability to some special partial difference equations and engineering skills: o 1) Internalize the meaning of the terminology and physical principles associated with heat transfer subject

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2) Delineate pertinent transport phenomena for any process or system involving heat transfer
3) Use requisite inputs for computing heat transfer rates and/or material temperatures

4) Develop representative models of real processes and systems and draw conclusions concerning process/system design or performance from attendant analysis

</td></tr>
<tr><td>Topics Covered:</td><td>
1. Introduction, Basic Concepts
2. Introduction to Conduction
3. 1-D Steady State Conduction
4. 2-D Steady State Conduction
5. Transient Conduction
6. Introduction to Convection
7. External Flow
8. Internal Flow
9. Free Convection
10. Boiling and Condensation
11. Radiation, Processes and Properties
12. Radiation Exchange
</td></tr>
<tr><td>Lab Experiment and Activities</td><td>N/A</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td>Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO2</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will demonstrate the ability to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</td><td>SO1-A Identify complex problems by examining and understanding the issues and necessity of engineering solutions.
SO1-B Apply mathematical principles (from calculus and differential equations), demonstrate competency of performing analytical and numerical solutions, and appropriately apply scientific principles to model a system or processes.
SO1-C Develop solution procedures and methods to solve complex engineering problems and identify solutions that are appropriate and within reasonable required accuracy and constraints.
SO2-B Integrate prior knowledge into design process (such as concept, alternative solution generation, mathematical modeling, computer modeling, evaluation, iteration etc.) to develop engineering solutions.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Jiajun Xu, PE</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Mechanical Engineering Department Curriculum Committee</td></tr>
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