CCEN 101: Introduction to Engineering

Catalog Data:	**CCEN 101: 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 credits, required course for all freshmen engineering students
Class Schedule	Two 150-minute lecture/lab sessions per week for one semester
Laboratory Schedule:	Lec/lab combined
Pre-requisite Course:	None
Co-requisite 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 Coordinator:	Dr. Kate Klein
Course Objectives:	Emphasis will be placed on critical thinking and problem-solving skills.
Topics Covered:	Engineering and Design cannot be neatly separated, though they both involve problem solving.
Lab Experiment and Activities:	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 final projects.
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO4, SO5, SO7
	Students will demonstrate ability to:

Course Student Outcomes through Performance Indicators:	**Assessed for Student Outcomes**	**SO 1-A:** Identify complex problems by examining and understanding the issues and necessity of engineering solutions. **SO 1-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. **SO 2-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. **SO 3-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. **SO 3-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. **SO 3-C:** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner. **SO 4-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. **SO 5-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. **SO 5-C:** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance). **SO 7-B:** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Kate Klein	
Approved by DCC:	Mechanical 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-requisite 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 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:	1. Introduction and general principles 2. Equilibrium of Particles 3. Force Systems and Equilibrium of Rigid Bodies 4. Internal Forces and Moments 5. Structures 6. Friction 7. Method of Virtual Work 8. Centroids, centers of gravity, and moments of inertia
Lab Experiment and Activities	None

<table>
<tr><td>Relationship of course to ME Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1</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-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</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Bryan Higgs</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Civil Engineering Department Curriculum Committee</td></tr>
</table>

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-requisite Course:	None
Required Texts:	Engineering Mechanics: Dynamics, by R.C. Hibbler ISBN 9780136077916, 13th Edition, Prentice Hall
Course 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:	1. Kinematics of Particles and Rigid Bodies 2. Projectile Motion 3. Principles of Impulse and Momentum 4. Conservation of Energy 5. Principles of Force and Acceleration 6. Relative Motion Analysis 7. Rigid Body Equations of Motion
Lab Experiment and Activities	None

<table>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1</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-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</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Bryan Higgs</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Civil Engineering Department Curriculum Committee</td></tr>
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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-requisite 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 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:	1. Mathematical Modeling 2. MATLAB Fundamentals 3. Methods for finding roots 4. Optimization and Linear Algebra 5. Linear regression 6. Interpolation 7. Integration and Differentiation 8. Ordinary Differential Equations
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1
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
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-requisite Course:	PHYS-201, PHYS-205
Co-requisite 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 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:	1. Circuit Variables: Voltage, Current, Power and Energy 2. Circuit Elements and Experimental Laws (Ohm's Law, KCL, KVL) 3. Voltage and Current Laws 4. Nodal and Mesh analysis 5. Handy circuit analysis techniques

	6. The Operational Amplifier (Op-Amp) 7. Capacitors and Inductors 8. RC, RL and RLC circuits 9. Sinusoidal Steady State analysis 10. AC circuit power analysis 11. Polyphase circuits 12. Magnetically coupled circuits	
Lab Experiment and Activities	None	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2	
Course Outcomes	Students will demonstrate ability to:	
	Assessed for Student Outcomes Performance Indicators	**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
Prepared by:	Dr. Amir Shahirinia	
Approved by DCC:	By Electrical and Computer Engineering curriculum committee.	

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-requisite Course:	PHYS-201 University Physics I, PHYS-205 University Physics I laboratory
Co-requisite 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 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	1. Ohm’s Law 2. Designing Series Circuits 3. Designing Series Parallel Circuits 4. Kirchhoff’s Voltage and Current Laws 5. Designing Voltage and Current-Divider Circuits. 6. Maximum Power Transfer 7. Balanced Bridge Circuit 8. Superposition Theorem 9. Thevenin’s Theorem 10. Oscilloscope Operations 11. Peak, RMS, and Average Values of AC

<table>
<tr><td></td><td colspan="2">12. RC Time Constant
13. Inductors and Capacitors in Series and Parallel
14. Impedance of RC, RL, and RLC Circuits
15. Power in AC Circuits
16. Transformers Characteristics
17. Selected PSpice Projects</td></tr>
<tr><td>Relationship of course to ME 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-C Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner.
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>
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MECH-107: ME COMPUTER GRAPHICS LAB

Catalog Data:	**MECH-107: ME COMPUTER GRAPHICS LAB 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-requisite Course:	None
Co-requisite Course:	None
Required Texts:	Creo Parametric 5.0, by Louis Gary Lamit ISBN 1985387530, CreateSpace Independent Publishing Platform, 2018
Course Coordinator:	Dr. Paul Witherell (adjunct), Dr. Kate Klein (owner)
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:	1. Technical drawing basics, views and parent-child relationships, etc. 2. Modeling Theory - Sketching and Base Feature Geometry Creation, Dimensioning 3. Part Modeling & Secondary Features. Fillets, Chamfers, Draft, Revolves, Mirrors, Patterns, and Circular Patterns 4. 3D Curves and Sweeps; Swept Blends/Lofting

	5. Building Assemblies (Bottom-Up method "BU" and Top-Down method "TD") 6. Creating Part Drawings and Assembly Drawings 7. Importing/reusing models; Tessellated Geometries and Manifold Volumes 8. Using different modeling software (ANSYS, SOLIDWORKS); Understanding Different File Formats & Interoperability 9. Preparing model for 3D printing and creating	
Lab Experiment and Activities	None	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3	
Course Outcomes	Students will demonstrate ability to:	
	Assessed for Student Outcomes Performance Indicators	**SO1-A** Identify complex problems by examining and understanding the issues and necessity of engineering solutions. **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-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
Prepared by:	Dr. Paul Witherell	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 108: Programming for Engineers

Catalog Data:	**MECH-108 Programming for Engineers Credits 1.** Introduction to programming for engineers and scientists. This course introduces the fundamental techniques for software development for solving engineering problems using high-level programming languages that are widely used within the engineering discipline. Topics include fundamental data and control structures and I/O functions with focus on engineering applications. Emphasis on modern engineering principles including object-oriented design, design decomposition, encapsulation, abstraction, modularity, testing, debugging and reuse.
Credits and Requirements:	1 Cr. and required course
Class Schedule	Two 75-minutes laboratory sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Freshman/Sophomore Standing
Co-requisite Course:	None
Required Texts:	Python Crash course A hands-on, project-based introduction to programming by Eric Matthews
Course Coordinator:	Uzma Amir (adjunct), Dr. Pawan Tyagi (owner)
Course Objectives:	The purpose of this course is: • To make student realize the importance of knowing python like generic programming language to automate complex operations for wide range of areas. • To familiarize students with basic structures of python programming language. • To facilitate project-based learning to enhance knowledge and skills in applying programming language in different context.
Topics Covered:	Module 1: Getting Started with the discussion on use of Python Programming language. Module 2: Variables and Simple Data Types. Module 3: Introducing Lists. Module 4: Working with Lists. Module 5: if Statements. Module 6: Dictionaries. Module 7: User Input and while Loops. Module 8: Functions. Module 9: Classes. Module 10: Files and Exceptions. Module 11: Testing Your Code.
Lab Experiment and Activities	Writing computer programs
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1 and SO6
Course Outcomes	Students will demonstrate ability to:

	Assessed for Student Outcomes Performance Indicators	**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-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. Pawan Tyagi, PhD	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

MECH-205: MATERIALS SCIENCE LEC

Catalog Data :	**MECH205- MATERIALS SCIENCE LEC. Credits 3.** This course provides an introduction to engineering materials with an emphasis on how atomic and molecular bonding, crystal structure, composition and processing influence material properties. This course covers the topics of electronic structure, crystal structure, and imperfections in metals, ceramics and polymers; elastic and plastic deformation; deformation processes and mechanical failure; diffusion, phase diagrams and transformations.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	CHEM-111
Co-requisite Course:	None
Required Texts:	Fundamentals of Materials Science and Engineering, An Integrated Approach by W.D. Callister, Jr. and David Rethwisch 5th Ed., Wiley, 2015 (ISBN 978-1-119-17548-3)
Course Coordinator:	Jose Febres (adjunct), Kate L. Klein (owner)
Course Objectives:	Mechanical Engineers utilize materials which have been selected based on their properties. Therefore, ME students are well served in their careers by an understanding of the scientific foundations of materials that govern these properties. This objective of this course is to provide an introduction to engineering materials with an emphasis on how atomic and molecular bonding, crystal structure, composition and processing influence material properties.
Topics Covered:	1. Introduction to Materials Science and Engineering 2. Atomic Structure and Bonding 3. Crystal Structure of Solids 4. Polymer Structures 5. Imperfections (defects) in Solids 6. Diffusion 7. Mechanical Properties of Metals: Elastic and Plastic Deformation 8. Mechanical Properties of Metals: Dislocations & Strengthening Mechanisms 9. Mechanical Properties of Metals: Failure 10. Phase Diagrams and Phase Transformations 11. Properties, and Applications of Ceramics & Polymers 12. Electrical and/or Thermal Properties 13. Special Topics (Nanomaterials, Composites, Semiconductors) 14. Microscopy Techniques

<table>
<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 Program Educations Objectives through Student Outcomes
Student Outcomes: SO2, SO7</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.
SO7-A: Explain the need for additional knowledge, skills and attitudes to be acquired independently (self-learning).</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Kate Klein</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">By Mechanical Engineering Department Curriculum Committee</td></tr>
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MECH-206: MECHANICS OF MATERIALS LEC

Catalog Data :	**MECH-206 MECHANICS OF MATERIALS LEC I. Credits 3.** This course provides students with an understanding of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. Topics covered include: axial forces, shear and moment, stress and axial loads, strain and axial deformation, torsion of shafts, stress in beams, columns, deflection of beams, and elemental indeterminate problems. This course lays foundation for engineering design.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 80-minute lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	CVEN-201, MECH-205
Co-requisite Course:	MECH-207 Lab
Required Texts:	Mechanics of Materials, Brief Edition By James M. Gere and Barry Goodno ISBN 1-111-13602-5 First Edition, Cengage Learning, 2012
Course Coordinator:	Kate L. Klein, Ph.D
Course Objectives:	This course provides students with an understanding of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. This course lays foundation for engineering design.
Topics Covered:	• Mechanical properties of materials and Hooke's Law • Axial Loading, Shear Loading, Torsion, and Bending • Stress and Strain Transformations, Mohr's Circle • Design of Beams and Shafts, Deflections of Beams • Combined Loading and Statically Indeterminate Structures
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO4
Course Outcomes	Students will demonstrate ability to:

	Assessed for Student Outcomes Performance Indicators	**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. **SO4-B**: Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities.
Prepared by:	Dr. Kate Klein	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

MECH-207: MECHANICS OF MATERIALS LAB

Catalog Data:	**MECH-207 MECHANICS OF MATERIALS LAB. Credits 1.** Covers introduction, purpose, scope, equipment/apparatus, interpreting results, uncertainty and error analysis, and writing reports. Experiments include physical properties and mechanical response of engineering materials, stress and strain measurement, thermal expansion, torque, bending moment, and deflection of beams.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 150-minute lecture sessions per week for one semester
Pre-requisite Course:	None
Co-requisite Course:	MECH-206
Required Texts:	Mechanics of Materials, Brief SI Edition (Reference only) By James M. Gere and Barry Goodno ISBN 1-111-13603-3 First Edition, Cengage Learning, 2012
Course Coordinator:	Dr. Kate Klein
Course Objectives:	This lab provides students with hands-on testing of engineering materials and observation of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. Students will learn to collect data and write comprehensive lab reports. This course supplements the Mechanics of Materials Lecture (MECH-206) and lays foundation for engineering design.
Topics Covered:	1. Measurement Lab • Data collection, measurement, statistical analysis, and error/uncertainty 2. Virtual Tensile Testing of Metals and Polymers 3. Hooke's Law • Fracture strength of pastas • Springs under tension • Tensile Testing of Elastic bands and Poisson's Ratio • Excel Plotting & Data Analysis 4. Tensile Testing of Metals and Polymers 5. Thermal Expansion 6. Torsion and Shear Modulus 7. Deflection of Beams under 3-Point Loading • Centroids and Moments of Inertia, Design of Beams
Lab Experiment and Activities	Lab report(s), Lab Worksheets

Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO3, SO5, SO6	
Course Outcomes	Students will demonstrate ability to:	
	Assessed for Student Outcomes Performance Indicators	**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. **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-C:** Produce engineering drawings and documents with appropriate graphics such as figures, tables in written and oral communications in a professional manner. **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-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. Kate Klein	
Approved by DCC:	By Mechanical Engineering Department Curriculum Committee	

MECH 208: THERMODYNAMICS

Catalog Data:	**MECH-208 THERMODYNAMICS 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-requisite Course:	PHYS-201
Co-requisite Course:	None
Required Texts:	Borgnakke, C. and Sonntag, R.E., Fundamentals of Thermodynamics. 8th edition
Course 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:	1. Properties of (pure) substances 2. Conservation of mass and energy (1st Law of Thermodynamics) 3. Entropy and the 2nd Law of Thermodynamics 4. 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
Course Student Outcomes through	Students will demonstrate ability to:

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.
Prepared by:	Dr. Max Denis	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 222: Engineering Measurement

Catalog Data:	**3511-222 Engineering Measurement. Credits 3.** Covers statistical data and error analysis; measuring systems, transducers; property measurements; signal conditioning; data output and analysis; analog and digital circuits; computer applications.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	Refer to Engineering Measurement Lab
Pre-requisite Course:	3511-221 Engineering Circuits I
Co-requisite Course:	3511-224 Engineering Measurement Lab
Required Texts:	J. M. Dally W. F. Riley and K. G. McConnel, "Instrumentation for Engineering Measurements",2nd Ed, Wiley 1993 Instructor will supplement with course notes.
Course Coordinator:	Dr. Simpson Chen (adjunct), Dr. Jiajun Xu (owner)
Course Objectives:	The objective of this course is to introduce students to important elements of engineering measurements and analysis of experimental data. The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course 3511 224. It prepares students to design and conduct experiments objectively to examine analytical findings and development of products. After the course students will be able to: • Articulate key processes of various engineering measurement techniques and explain how these measurement techniques work and their application in solving the engineering problems • Perform engineering analysis and design of different engineering measurement systems modes with proficient mathematical and engineering skills. • Solve practical applications through homework, exams, projects involving engineering measurement system designs and analysis • Use state-of-the-art engineering measurement instrumentation and software
Topics Covered:	1. Introduction, Basic Concepts 2. Review of DC Circuits, AC Circuits 3. Analog Recording Instruments 4. Digital Recording Instruments 5. Digital codes DA and AD converters 6. Sensors for transducers 7. Signal Conditioning Circuits 8. Statistical Data Analysis 9. Temperature Measurements

	10. Strain Measurements 11. Force, Torque, and Pressure Measurements	
Lab Experiment and Activities	Refer to Engineering Measurement Lab	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2	
Course Outcomes	Students will demonstrate ability to:	
	Assessed 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. **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
Prepared by:	Dr. Jiajun Xu, PE	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 224: Engineering Measurement Laboratory

Catalog Data:	**3511-224 Engineering Measurement Laboratory. Credits 1.** Involves experimentation in the measurements of different mechanical properties using analog and digital systems; use of sensors and transducers, and modern instrumentation technology.
Credits and Requirements:	1 Cr. and required course
Class Schedule	Two 75-minutes laboratory sessions per week for one semester
Laboratory Schedule:	Refer to Engineering Measurement Lab
Pre-requisites Course:	3511-221 Engineering Circuits I
Co-requisite Course:	3511-222 Engineering Measurement Lecture
Required Texts:	J. M. Dally W. F. Riley and K. G. McConnel, "Instrumentation for Engineering Measurements",2nd Ed, Wiley 1993 Instructor will supplement with course notes.
Course Coordinator:	Dr. Simpson Chen (adjunct), Dr. Jiajun Xu, PE
Course Objectives:	The objective of this course is to introduce students to important elements of engineering measurements and analysis of experimental data. The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course 3511 224. It prepares students to design and conduct experiments objectively to examine analytical findings and development of products. After the course students will be able to: • Articulate key processes of various engineering measurement techniques and explain how these measurement techniques work and their application in solving the engineering problems • Perform engineering analysis and design of different engineering measurement systems modes with proficient mathematical and engineering skills. • Solve practical applications through homework, exams, projects involving engineering measurement system designs and analysis • Use state-of-the-art engineering measurement instrumentation and software
Lab Experiment and Activities	1. Calibration of a resistance position transducer 2. Effect of circuit loading on the output voltage of a potentiometer 3. Measurement of voltage and resistance using a Wheatstone bridge circuit 4. Temperature measurements using an RTD and a thermistor 5. Statistical analysis of temperature fluctuations in a room over a period of time

<table>
<tr><td></td><td colspan="2">6. Characteristics of a Strain Gauge Transducer
7. Signal analysis using an oscilloscope
8. Electronic data acquisition and data analysis using LabVIEW</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="2">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO3, SO6</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>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</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">Mechanical Engineering Department Curriculum Committee</td></tr>
</table>

MECH 302: Research Experience for Undergraduates

Catalog Data:	**MECH-302 Research Experience 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-requisite Course:	CVEN-101, Sophomore or Junior standing; permission of instructor
Co-requisite Course:	None
Required Texts:	Journal articles and handouts
Course 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:	5. Literature Review 6. Reference Citation and Bibliography 7. Responsible Conduct of Research 8. Design of Experiments 9. Technical Presentations 10. Technical Writing 11. Research Proposal 12. 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:	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-requisite Course:	MATH-254 Differential Equations; MECH-208 Thermodynamics
Co-requisite 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 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:	1. Basic concepts and fluid properties: introduction and definitions. (1 week) 2. Basic equation of fluid statics. Pressure in a static fluid. (1 weeks) 3. Hydrostatic forces on submerged surfaces. Center of pressure. (1 weeks) 4. Buoyancy, stability of flotation, metacentric center (1 week) 5. Kinematics. Eulerian and Lagrangian approaches. Flow patterns and data plots. (2 week) 6. Other kinematic descriptions. Vorticity. Reynolds transport theorem. (1 week) 7. Conservation equations (mass, energy). Bernoulli's law. (2 weeks) 8. Momentum analysis of flow systems. (1 week). 9. Dimensional analysis and similarity. Non-dimensionalization. Pi theorem. (1 week). 10. Internal flows – laminar vs turbulent flow. Frictional losses, pumps. (1 week). 11. Differential analysis of fluid flow. Stream function. Navier-stokes equation (1 week). 12. Tests and Examinations (2 weeks)

<table>
<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: SO1, SO2, SO3</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.</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">Mechnical Engineering Department Curriculum Committee</td></tr>
</table>

MECH 322: Thermo/Fluid Laboratory

Catalog Data:	**MECH 322 Thermo/Fluid Laboratory Credits 1.** This course examines methods of experimental fluid mechanics and covers laboratory experiments in thermodynamics and fluid mechanics.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	One 2 hour 40-minutes laboratory session per week for one semester
Pre-requisite Course:	MECH-208 Thermodynamics
Co-requisite Course:	MECH-321 Mechanics
Required Texts:	Instrumentation for Engineering Measurements, by James W. Dally, William F. Riley, and Kenneth G. McConnel ISBN 0471045489 Second Edition, John Wiley; Fluid Mechanics, By Frank M. White ISBN978-0-07-352934-9 Seventh Edition, McGraw-Hill
Course Coordinator:	Dr. Ludwig Carlos Nitsche
Course Objectives:	The main objectives of this course are to explore and familiarize engineering students with: sensors and instrumentations used in thermodynamics and fluid measurements; application of probability and statistics methods in data and error analysis; and hands-on experience in data measurements and processing. Upon completion of the course the student will be able to: • Articulate sources of errors and different types of errors in experimentation • Apply methods of probability and statistics to estimate errors • Use experiments to verify certain theories and principles of thermodynamics and fluids • Articulate different classes of pressure and velocity/flow measurements • Use different instruments to measure temperature • Perform various experiments • Write laboratory reports with data analysis and conclusion
Topics Covered:	1. Introduction to methods of experimentation (1.0 week) 2. Review of fundamental properties of fluid (1.0 week) 3. Errors and use of probability and statistics in error analysis (2.0 week) 4. Pressure measurement using manometers and transducers (1.0 week) 5. Measurement of temperature using thermocouples and thermistors (1.0 weeks) 6. Verification of Bernoulli Principle (1.0 week)

	7. Force on a plane submerged surface; center of pressure (1.0 week) 8. Forced vortex free surface profile (1.0 weeks) 9. Fluid friction and losses in pipe flows (1.0 weeks) 10. Archimedes principle and metacentric center (1.0 week)	
Lab Experiment and Activities	None	
Relationship of course to ME Curriculum:	Meets: Educational Objectives through Student Outcomes Student Outcomes: **SO1, SO3, SO5, SO6**	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	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. **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-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-C:** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance). **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. Ludwig Carlos Nitsche	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 341: Analysis and Synthesis of Mechanisms

Catalog Data:	**MECH 341 Analysis and Synthesis of Mechanisms. Credits 3.** Covers kinematics and dynamics of mechanisms, analysis of mechanisms, including linkage, cam, gear, synthesis of mechanism for prescribed performances; and computer-aided design of mechanisms.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	CVEN 202 Engineering Mechanics II (Dynamics)
Co-requisite Course:	None
Required Texts:	C. E. Wilson and J. P. Sadler, Kinematics and Dynamics of Machinery, Harper Collins 2003 ISBN 0-201-35099-8 Third Edition, Pearson Education, New Jersey
Course Coordinator:	Dr. Jiajun Xu, PE

Course Objectives:	The objective of this course is to familiarize the students with various mechanisms used in machines. The static and dynamic characteristics and design of mechanisms are discussed. It enables students to (a) analyze position velocity acceleration and jerk in mechanisms (b) design mechanisms with given performance characteristic and (c) use of computers in analysis and design. Upon completion of the course the student will be able to:
	• Articulate key processes of various mechanisms and explain how these mechanisms work and their application in solving the engineering problems
	• Perform statistical and dynamic analysis and design of different mechanisms with proficient mathematical:
	  o 1) An ability to apply knowledge of Linear Algebra
	  o 2) The ability to complete standard matrix manipulations.
	  o 3) The ability to use matrices for solving systems of linear equations
	  and engineering skills:
	  o 1) Analysis of position, velocity and acceleration kinematics of mechanisms
	  o 2) Analysis of inverse dynamics of mechanisms
	  o 3) Basic analysis of cams and gears
	• Solve practical applications through homework, exams, projects involving engineering designs and analysis
	• Use engineering software, mathematics software and user-written programs to solve problem and to present the results in plotted or tabulated form

Topics Covered:	1. Introduction, Basic Concepts 2. Different types of mechanism 3. Displacement analysis and synthesis 4. Velocity analysis of mechanisms 5. Acceleration analysis of mechanisms 6. Cam analysis and design 7. Spur gears analysis and design 8. Helical worm and bevel gears 9. Drive trains analysis and design 10. Static force analysis 11. Dynamic force analysis
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: **SO1, SO2**
Course Outcomes	Students will demonstrate ability to: **Assessed for Student Outcomes Performance Indicators** **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-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.
Prepared by:	Dr. Jiajun Xu, PE
Approved by DCC:	Mechanical Engineering Department Curriculum Committee

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-requisite Course:	3511 208 Thermodynamics 3511 321 Fluid Mechanics 1535 260 Differential Equations with Linear Algebra
Co-requisite 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 Coordinator:	Dr. Simpson Chen (adjunct), 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 o 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	
Topics Covered:	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	
Lab Experiment and Activities	N/A	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2	
Course Outcomes	Students will demonstrate the ability to:	
	Assessed 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. **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.
Prepared by:	Dr. Jiajun Xu, PE	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 361: Machine Design

Catalog Data:	**MECH-361 Machine Design Lec. Credits 3.** Examines engineering design process; theories of failure; fundamentals of mechanical design; and computer-aided design of machine elements, bearings, gears, shafts, brakes and couplings; design projects
Credits and Requirements:	3 Cr. and required course
Class Schedule	A 2-hour 40 minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	MECH-206 Mechanics of Materials
Co-requisite Course:	None
Required Texts:	Machine Elements in Mechanical Design, by Robert L. Mott ISBN 0-13-841446-7 Fourth Edition, Prentice Hall
Course Coordinator:	Dr. José R. Febres (adjunct); Dr. Kate Klein (owner)
Course Objectives:	The main objectives of this course are to introduce students of mechanical engineering to the engineering design process including design constraints, design requirements, material selection and manufacturing considerations, and the application of design theories in the design of basic machine elements. Upon completion of the course the student will be able to: • Formulate the engineering design process and specify design constraints and requirements • Conduct case study in stress and deflection analysis • Articulate the basis for the use of different design theories – static and fatigue theories of failure • Select appropriate fatigue theory of failure in the design of specific machine element for different stress cycles • Study and make oral presentation on assigned Case Study • Design of various machine elements • Implement a project on the design of a speed reducer
Topics Covered:	1. Review of stress and deflection analysis, and materials properties (1.0 week) 2. Machine design methodology, design codes and standards (1.0 week) 3. Introduction to static and fatigue theories of failure (2.0 week) 4. Design of machine elements, flexible drives, gears, shafts, bearings, brakes and clutches, power screw, bolts, rivets, welding, etc (2.0 week) 5. Tolerances and Fits

	6. Springs (1.0 week) 7. Design of speed reducers (1.0 week) 8. Project (2.0 weeks) 9. Case Studies (1 week)	
Lab Experiment and Activities	3 Cr. and required course	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO5	
Course Outcomes	Students will demonstrate ability to:	
	Assessed for Student Outcomes Performance Indicators	**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-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. **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.
Prepared by:	Dr. Kate Klein, PhD	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 371: Design of Control Systems Lec.

Catalog Data:	**MECH-371 Design of Control Systems Lec. Credits 3.** Identifies and examines models of mechanical, electrical, fluid, thermal, electro-mechanical, thermofluid systems, transducers, digital devices, types of controllers, performance of feedback systems; simulation, root locus and frequency response methods for design of automatic control.
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 Course:	MATH-254; CVEN-308
Co-requisite Course:	MECH-373
Required Texts:	Nise, N., Control Systems Engineering. 7th edition
Course 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:	1. Introduction to Physiological Systems Modeling 2. Linear systems 3. Laplace Transforms 4. Transfer functions 5. Physiological Modeling 6. Block Diagram Analysis 7. Analysis and Design in State-Space 8. Linearization
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1, SO3, SO5, and SO6
	Students will demonstrate the 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-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. **SO5-C** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance). **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:	Mechanical Engineering Department Curriculum Committee	

MECH 373: Design of Control Systems Lab.

Catalog Data:	**MECH-373 Design of Control Systems Lab. Credits 1.** Experiments illustrating the basic principles of three term (PID) thermal process control, multivariable systems and the basics of multivariable dynamics and control under steady state and transient conditions.
Credits and Requirements:	1 Cr. and required course
Class Schedule	None
Laboratory Schedule:	Two 80-minute laboratory sessions per week for one semester
Pre-requisite Course:	ELEC 226
Co-requisite Course:	MECH-371
Required Texts:	Nise, N., Control Systems Engineering. 7th edition
Course 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:	1. Laplace transforms 2. Block diagrams modeling of systems using Simulink 3. Pole-zero modeling and analysis 4. Transfer function of systems 5. Open loop and close-loop analysis 6. Transient, steady-state error, and stability analysis of firs-order and second-order electrical and mechanical systems 7. Analysis of negative feedback systems 8. Designing of Proportional, PI, PD, and PID controllers 9. Frequency responses (Bode Diagram) 10. Physioex virtual labs
Lab Experiment and Activities	Yes, the theory covered with MECH-371
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO1 and SO6

Course Student Outcomes through Performance Indicators:	Students will demonstrate the ability to:	
	Assessed for Student Outcomes	**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. Max Denis	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 381: Microcontroller in ME

Catalog Data:	**MECH-381 Microcontroller in ME Credits 3.** Study of microcontrollers and their applications as control devices in mechanical systems. Review of electric circuits and semiconductor devices; digital logic, Boolean algebra, logic gates; microcontroller architecture - internal data handling and control, input and output; microcontroller programming languages; digital sensing and control through parallel and serial communication; microcontroller interrupt programming and servicing; actuation control via digital to analog conversion; direct digital control of stepper motor actuator.
Credits and Requirements:	3 Cr. and required course
Class Schedule	M/W 8:00-9:20 am.
Laboratory Schedule:	Two 80-minutes class sessions per week for one semester
Pre-requisite Course:	ELEC-225, ELEC 226
Co-requisite Course:	None
Required Texts:	1. Mechatronics System Design, by Devdas Shetty and Richard A. Kolk (ISBN -13 978-1-4390-6198-5), 3rd Edition, 2012. 2. Fast and Effective Embedded Systems Design: Applying the ARM mbed, by Rob Toulson and Tim Wilmshurst; Publisher: Newness (an imprint of Elsevier), ISBN: 978-0-08-097769-3; 2012 (pdf copy available) 3. Class Handouts
Course Coordinator:	Dr. Esther Ososanya
Course Goals and Objectives:	The goals are to teach: • the fundamental concepts of digital logic analysis and synthesis, • Microcomputer architecture, basic hardware interface, and control of mechanical devices, • key aspects of the ARM mbed microcontroller, and how the mbed can be applied in some of the most exciting and innovative intelligent products emerging today. This is the first course in a mechatronics sequence for non-Electrical Engineering majors. Learning modules and a set of lab experiments demo from the mbed microcontroller board Lab Kits are included to demonstrate many of the topics covered in class.
Topics Covered:	a. Digital Systems and Binary Numbers b. Boolean Algebra and Logic Gates c. Combinational Logic Design

<table>
<tr><td></td><td colspan="2">d. Synchronous Sequential Logic
e. Registers and Counters
f. Digital Systems Design
g. Measurement and Instrumentation
h. Typical Microcomputer and Microcontroller systems architecture
i. ARM mbed Microcontroller overview: Digital Input/Output, Analog Input/Output, A/D and D/A converters.</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="2">1. Use of Digital Logic Design tools _ LABVIEW
2. Use of Embedded System microcontroller _ARM MBED</td></tr>
<tr><td>Relationship of course to ME 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 the ability to:</td></tr>
<tr><td>Assessed for Student Outcomes Performance Indicators</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.

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.</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Esther Ososanya</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Electrical and Computer Engineering Department Curriculum Committee.</td></tr>
</table>

MECH 406: Engineering Economics

Catalog Data:	**MECH 406: Engineering Economic Credits 3.** Studies the application of economic principles to engineering problems and their effects on engineering decision-making.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 50-minutes lecture session per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Senior standing
Co-requisite Course:	None
Required Texts:	Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, Engineering Economic Analysis, Latest Edition, Oxford University Press,
Course Coordinator:	Chandra Pathak (instructor), Dr. Behera (owner)
Course Objectives:	The objective of Engineering Economics Analysis course is to prepare engineering student to use economic principles and cost analysis of engineering projects. Students will learn interest formulas, how to compare different engineering projects using present worth method, future value method, annual payment method and benefit-cost technique to make engineering decisions. Upon completion of the course the student will be able to: • Develop and manipulate equations to obtain analytical solutions interests and equivalence. • Demonstrate knowledge of uniform, arithmetic, and gradient series. • Develop appropriate mathematical equations to solve for nominal interest rates for engineering economic systems. • Develop appropriate mathematical equations to enable the comparison of alternative engineering designs using present worth, future worth and annual payment analyses methods. • Use the knowledge in the engineering practice. • Evaluate engineering solutions that consider social, environmental, and economic factors
Topics Covered:	1. Introduction, quantifying alternatives for decision making; Engineering economics terminology - Interest and Equivalence (Simple and Compound interest) 2. Uniform series sinking fund factor, uniform series capital recovery factor 3. Arithmetic gradient series 4. Geometric gradient series 5. Comparing alternative engineering designs using present worth analysis technique 6. Comparing alternative engineering designs using future worth analysis technique

	7. Comparing alternative engineering designs using annual payment analysis technique 8. Benefit-Cost Analysis 9. Depreciation methods and their impact on engineering design alternatives.	
Lab Experiment and Activities	None	
Relationship of course to Program:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO2, SO3, SO4	
Course Outcomes:	Students will demonstrate the ability to:	
	ssessed for Student Outcomes Performance Indicators	**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., Civil and Mechanical Engineering) **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-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities
Prepared by:	Civil and Mechanical Engineering Faculty	
Approved by DCC:	Civil and Mechanical Engineering Curriculum Committee	

MECH 462: Design of Energy System

Catalog Data:	**MECH-462 Design of Energy Syestem Credits 3.** Covers the design of ducting and piping systems, design of heat exchangers and fluid/rotor energy converters; characteristics of pumps, fans, compressors and turbines, computer-aided design, and simulation of energy systems.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Senior Standing
Co-requisite Course:	None
Required Texts:	Analysis and Design of Energy System, by B.K. Hodge and Robert P. Taylor, Prentice Hall, 3rd Edition
Course Coordinator:	Dr. Pawan Tyagi, PhD
Course Objectives:	The purpose of this course is: • To familiarize students with design of piping system to move fluid from source to an end point • To educate student about computer based iterative methods for applying Hardy Cross method to estimate power requirement to attain a desired flow rate. • To make student understand the concepts of heat exchanger design principles. • To make student competent in developing computer-based programs to analyze the attributes of heat exchangers by using NTU method. • To develop oral presentation skills. • To guiding student to understand the design of energy systems concepts from self-study and discussions in the class with instructor and peers.
Topics Covered:	1. Importance and applications of the study of design of energy systems. 2. Understanding fundamentals of fluid flow through pipes 3. Performing head loss analysis and calculations through series and parallel pipe network 4. Understanding the fundamentals and design of heat exchangers 5. Performing analysis of heat exchanger properties using Log mean temperature difference and NTU methods. 6. Prime movers or motors for fluid flow 7. Design and analysis of a heat exchanger for practical application.
Lab Experiment and	None

Activities		
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO2, SO3, SO5, SO7	
Course Outcomes	Students will demonstrate ability to:	
	Assessed for Student Outcomes Performance Indicators	**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 **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 **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 **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. **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.
Prepared by:	Dr. Pawan Tyagi, PhD	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 465: Advanced Manufacturing

Catalog Data:	**MECH 465 Advanced Manufacturing Credits 3.** This course will provide understanding of the basic elements of advance manufacturing such as mode-based product design, metal and plastic 3D manufacturing.
Credits and Requirements:	3 Cr. and required course
Class Schedule	One 180-minute lecture session per week for one semester
Laboratory Schedule:	Workshop project sessions during the class schedule and assignments
Pre-requisite Course:	Senior level standing
Co-requisite Course:	None
Required Texts:	a. Groover, M. P., Fundamentals of Modern Manufacturing, 5th edition., John Wiley & Sons, New York, 2012; ISBN-13: 978-1118393673 b. Reference Book: Shetty, D, "Product Design for Engineers" Cengage Learning, 2016 Boston, USA c. Reference Book: Gibson, Rosen and Stucker "Additive Manufacturing Technologies, Rapid Prototyping to Direct Digital Manufacturing Springer, New York, 2010; ISBN 978-1-4419-1119-3 Additional notes provided by instructor
Course Coordinator:	Dr. Devdas Shetty
Course Objectives:	The overall objective of the course is to master the theory and basic understanding of modern manufacturing processes. On completion of the course, the students will be able to design a manufacturing method for a special product including the tolerances of size and surface finish that can be attained by the process. This course is designed to give students a strong foundation of additive manufacturing, both in terms of design and fabrication.
Topics Covered:	(1) Manufacturing engineering, Tolerance and quality issues in design and manufacture of a product. (2) Mechanics of material removal: Theory and technology of metal forming, (3) Metal cutting, Mechanics of orthogonal and oblique cutting; Tool wear and Tool life; Machinability; Analysis of turning, drilling and milling and finishing processes; (4) Manufacturing process layout, Process flow charts; (5) Tools of efficient product design. Design for assembly and disassembly (DFA and DFD), Practices for implementing concurrent engineering; (6) Nontraditional manufacturing using laser technology, electron beam, ultrasonic manufacturing techniques (7) Role of virtual manufacturing in industry, Industry 4.0 (8) Theory and adaptation of additive manufacturing processes for the creation of parts and assemblies. The module also examines

	virtual prototyping tools that help companies take new products to market as well as the role of additive manufacturing that emphasizes quickly creating output in the form of a prototype. The emerging emphasis on product reliability and the desire to reduce product development time have focused on the use of software tools for design and production. Manufacturing strategy for globally competitive market evaluation, selection and adoption of additive manufacturing in acceptable scale.	
Lab Experiment and Activities	Group projects involved designing and fabricating Surface Roughness Measurement unit; Creation for parts in Additive Manufacturing using state of the art EOS 280 machine	
Relationship of course to ME Curriculum:	Meets Educations Objectives through Student Outcomes Student Outcomes: SO2	
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to:	
	Assessed for Student Outcomes	**SO2-A** Able to 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** Able to 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** Able to 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.
Prepared by:	Dr. Devdas Shetty	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 478: Mechatronics

Catalog Data:	**MECH-478 Mechatronics Credits 3.** Fundamental concepts in mechatronics including instrumentation, integration of mechanical, electronics, and control engineering. Operating principles of electromechanical actuators, motors, sensors, drives, and analog motion control. Modeling, simulation, analysis, virtual prototyping and visualization of mechanical systems, and Applications of microcontrollers, and microprocessor interfacing to eletromechanical systems.
Credits and Requirements:	3 Cr. and required course
Class Schedule	M/W 8:00-9:20 am.
Laboratory Schedule:	Two 80-minutes class sessions per week for one semester
Pre-requisite Course:	MECH 381
Co-requisite Course:	None
Required Texts:	4. Mechatronics System Design, by Devdas Shetty and Richard A. Kolk (ISBN -13 978-1-4390-6198-5), 3rd Edition, 2012. 5. Fast and Effective Embedded Systems Design: Applying the ARM mbed, by Rob Toulson and Tim Wilmshurst; Publisher: Newness (an imprint of Elsevier), ISBN: 978-0-08-097769-3; 2012
Course Coordinator:	Dr. Esther Ososanya
Course Goals and Objectives:	This course provides an opportunity for students to participate in multidisciplinary laboratory experiments and classroom project and learn how mechanical, electrical and computer engineering technologies can be combined to produce a microprocessor-controlled electro-mechanical system. Students spend a semester simulating, designing, constructing, programming, and testing their systems. The course stimulates students' interest in engineering design practices and creativity. **<u>Goals of Course:</u>** • Learn the basics of digital electronics and mechatronic system elements. • Learn to program a microcontroller, develop and debug applications software • Learn the basics of sensor and actuator theory, design, and application. • Gain experience designing and controlling basic mechatronic systems • perform model-based control system design and implementation using visual programming (VisSim and Solid Thinking Embed), and Perform real time control of mechanical system using NI Compact-DAQ devices with

	LabVIEW or the Quarc Control software, and microcontrollers	
Topics Covered:	None	
Lab Experiment and Activities	3. Use of Embedded System microcontroller _ARM MBED 4. Solid Thinking Simulation and Use of Mechatronics Platform Technology	
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO5	
Course Outcomes	Students will demonstrate the ability to:	
	Assessed for Student Outcomes Performance Indicators	**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. **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 creating a collaborative and inclusive environment **SO5-B** Ability to plan collaborative tasks, understand individual responsibility, share responsibilities and information on schedule, and engage in the success of team goals
Prepared by:	Dr. Esther Ososanya	
Approved by DCC:	Electrical and Computer Engineering Department Curriculum Committee.	

MECH 483: Robot Mechanics and Control

Catalog Data:	**MECH 483 Robot Mechanics and Control Credits 3.** Introduces types of industrial robots, sensing of robot motion and position, electro-mechanical, hydraulic and pneumatic actuators; sampled data, proportional, integral and derivative controller; robot coordinates, motion, dynamic and path control, as well as introduction to robot programming
Credits and Requirements:	3 Cr. and selective course
Class Schedule	One 2 hour 30 minutes session per week for one semester
Laboratory Schedule:	Assigned within class hours
Pre-requisite Course:	Senior Standing
Co-requisite Course:	None
Required Texts:	1. Industrial Robotics, Technology, programming and applications by Mickell Groover, ISBN-13: 978-0070249899, ISBN-10: 007024989X , McGraw Hill 2. Introduction to Robotics: Mechanics and Control (3rd Edition) by John J. Craig Pearson Prentice Hall . 2. Robotics, Vision and Control, Fundamental Algorithms In MATLAB® Updated Ed. Corke, Peter Unmanned Aerial Vehicle Textbook: https://www.amazon.com/Small-Unmanned-Aircraft-Theory-Practice/dp/0691149216
Course Coordinator:	Dr. Devdas Shetty
Course Objectives:	This course provides an integrative treatment of all the relevant concepts, with an eye toward modern, practical applications making it an excellent choice for a senior/ first year graduate course. Robotics is a diverse field bringing together disparate areas from computer science, electrical engineering, and mechanical engineering. Learning about robotics will become an increasingly essential skill as it becomes a major part of our life. The course is set up in such a way, that it brings together theories from a number of fields: mechanics, control and programming, vision and machine learning applied to the design and application of intelligent robot. Even though robotics is a complex subject, several emerging computer techniques with modern tools can help one design a project to create an easy-to-use interface.
Topics Covered:	The course starts with fundamentals of robot mechanisms, dynamics, and controls. It includes planar and spatial kinematics, differential motion, energy method for robot mechanics; mechanism design for manipulation and traction; multi-rigid-body dynamics; force and compliance control, balancing control, visual feedback, human-machine interface; actuators, sensors, wireless networking, and embedded software. The course is expected to offer a well-balanced and intellectually

	satisfying treatment of robot mechanics, and control from planning to the choice and sequence of topics, to the level of detail in the analysis, and the clear connections made between the latest technologies and the theoretical foundations of robotics.
Lab Experiment and Activities	Laboratory Projects involving Robot Sawyer and additional simulation and modeling experiments related to EMBED &Robotics
Relationship of course to ME Curriculum:	Meets: Educational Objectives through Student Outcomes Student Outcomes: **SO1, SO2**
Course Student Outcomes through Performance Indicators:	Students will demonstrate ability to: **Assessed for Student Outcomes** **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. **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.
Prepared by:	Dr. Devdas Shetty
Approved by DCC:	Mechnical Engineering Department Curriculum Committee

MECH 487: Photovoltaic and Solar Thermal Energy System

Catalog Data:	**MECH-487 PV and Solar Thermal Energy System Credits 3.** The course focuses on science and technology of solar energy harvesting. Major focus will be on photovoltaics cells (PV). This course will teach science and technology of PV cells. Various complimentary systems required to channel energy from PV cells to electrical appliances will be discussed. This course will also introduce key developments to make PV cells economical and more energy efficient. During this course, we will also highlight the impact of governmental policies and socio-economic conditions on the proliferation of solar energy harvesting.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Junior/Senior Standing
Co-requisite Course:	None
Required Texts:	**Notes and online materials** http://pveducation.org/
Course Co-coordinator:	Dr. Pawan Tyagi, PhD
Course Objectives:	The purpose of this course is to expose the student to the concepts and engineering of solar energy harvesting. After this course, students should be able to do the followings: • Realize the importance of solar energy harvesting in solving global problem, like global warming. • Become conversant with the science and engineering of solar thermal systems and photovoltaic cells. • Understand and apply the basic knowledge of solar energy system to analyze the new solar energy systems or propose ideas for new systems. • Develop effective communication and work in team.
Topics Covered:	1. Overview of energy resources and justification for using solar energy. Potential of solar energy to producing sustainable environment, economy, and human health. Fundamentals of solar radiation. 2. Introduction of common solar energy harvesting approaches: Photovoltaics cells and solar thermal energy systems. 3. Introduction to various components of a complete PV and solar thermal systems. 4. Understanding the light absorption and electricity generation mechanism of p-n junction solar cells. 5. Science of built in potential and current generation in a photovoltaic cell. 6. Deciphering solar cell efficiency using experimental data

<table>
<tr><td></td><td colspan="2">7. Science and engineering of solar thermal water and air heaters.</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, SO3, SO4, SO6</td></tr>
<tr><td rowspan="2">Course Outcomes</td><td colspan="2">Students will be able 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
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-B Evaluate impact of engineering solutions in global, economic, environmental, and societal contexts and incorporate their sensitivities.
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</td></tr>
<tr><td>Prepared by:</td><td colspan="2">Dr. Pawan Tyagi, PhD</td></tr>
<tr><td>Approved by DCC:</td><td colspan="2">Mechanical Engineering Department Curriculum Committee</td></tr>
</table>

MECH 488: Photovoltaic and Solar Thermal Energy System

Catalog Data:	**MECH-488 Fuel Cell Science and Technology Credits 3.** Fuel cells are introduced as a renewable energy resource. This course covers the concepts and fundamentals of fuel cells. Various types of fuel cells will be discussed to give in-depth understanding of practical fuel cell device. Experiments will be conducted, as necessary.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Junior/Senior Standing
Co-requisite Course:	None
Required Texts:	Fuel cell fundamentals, 2nd ed, Ryan O'Hare, John Wiley & Sons, 2009
Course Co-coordinator:	Dr. Pawan Tyagi, PhD
Course Objectives:	The purpose of this course is: • To familiarize students with hydrogen-based economy and how to utilize fuel cells for chemical to electrical energy conversion. • To familiarize relation between thermodynamics and electrical potential generation • To teach the fundamental principles of electrical current generation in the fuel cell and dependence on material parameters. • To familiarize with properties of electrolyte and ionic transport mechanisms. • To familiarize with different methods of evaluating fuel cell performance. • To provide foundational knowledge about the differences in fuel cell mechanisms and overall fuel cell systems. • To develop oral presentation skills. • To guiding student to understand the fuel cell systems from self-study and discussions in the class with instructor and peers.
Topics Covered:	1. Overview of energy resources and justification for using fuel cell energy and introduction of fuel cells. 2. Thermodynamics of converting chemical energy into electricity. Understanding the effect of temperature, pressure, and reactant concentration on the voltage produced by a fuel cell. Definition of fuel cell efficiency. Thermal and mass balance in fuel cell. 3. Understanding fuel cell reaction kinetics to understand the origin of current and factor affecting it. Role of electrolyte medium and electrode materials in governing current generation.

<table>
<tr><td></td><td colspan="3">4. Introduction of charge transport through electrolyte and external circuits.
5. Study the process of supplying reactants on to the electrode and removing byproduct from the fuel cell.
6. Methods of studying fuel cell performance and the fundamentals of charge-transport, electrochemical impedance spectroscopy (EIS), and Tafel equation. Analyzing the experimental data to obtain alpha and exchange current density.
7. Overview of the fuel cell types and understanding complete fuel cell systems. Understanding PEMFC and SOFC fuel cells.</td></tr>
<tr><td>Lab Experiment and Activities</td><td colspan="3">None</td></tr>
<tr><td>Relationship of course to CE Curriculum:</td><td colspan="3">Meets Program Educations Objectives through Student Outcomes
Student Outcomes: SO1, SO3, SO4, SO6</td></tr>
<tr><td rowspan="5">Course Outcomes</td><td colspan="3">Students will be able to:</td></tr>
<tr><td rowspan="4">Assessed for Student Outcomes Performance Indicators</td><td>SO1-D</td><td>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</td></tr>
<tr><td>SO2-B</td><td>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>SO3-A</td><td>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</td></tr>
<tr><td>SO3-B</td><td>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</td></tr>
<tr><td>Prepared by:</td><td colspan="3">Dr. Pawan Tyagi, PhD</td></tr>
<tr><td>Approved by DCC:</td><td colspan="3">Mechanical Engineering Department Curriculum Committee</td></tr>
</table>

MECH 491 Senior Design Project I

Catalog Data:	**MECH-491 Senior Design Project I Lec. Credits 3.** Covers creative design, design problem formulation, structure of open-ended solution processes in system design; familiarization with technological resources; group projects on design of complex mechanical systems, feasibility studies, group presentation of project feasibility, and developing impact and planning statement.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Senior Standing
Co-requisite Course:	None
Required Texts:	The Engineering Design Process, by Atila Ertas, Jesse C. Jones ISBN 0-471-51796-8 John Wiley
Course Coordinator:	Dr. Jiajun Xu, PE
Course Objectives:	The objective of this course is to introduce students to important elements of engineering measurements and analysis of experimental data. The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course 3511 224. It prepares students to design and conduct experiments objectively to examine analytical findings and development of products.
Topics Covered:	1)The engineering design process; problem definition, design constraints and requirements; 2) Project management techniques; 3) System modeling and simulation; 4) Design analyses for material selection and production technology; 5) Optimization in design, statistics in design and design for reliability; 6) Safety, environmental considerations and the 'ability' factors; 7) Ethics in engineering practice; 8) Project definition and team selection; 9) Literature survey, alternate design solutions; 10) Preliminary design and detailed design; 11) Report preparation; 12) Oral presentation
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO4, SO5, SO6
Course Outcomes	Students will demonstrate ability to:

	Assessed 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. **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. **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 (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. **SO5-C** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance). **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. Jiajun Xu, PE	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

MECH 492 Senior Design Project II

Catalog Data:	**MECH-492 Senior Design Project II Lec. Credits 3.** Continuation of group projects from Senior Design Project I, including consideration of economic, risk and reliability factors, and development of preliminary designs, prototypes, tests and optimization, and project report and presentation.
Credits and Requirements:	3 Cr. and required course
Class Schedule	Two 75-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	Senior Standing
Co-requisite Course:	None
Required Texts:	The Engineering Design Process, by Atila Ertas, Jesse C. Jones ISBN 0-471-51796-8 John Wiley
Course Coordinator:	Dr. Jiajun Xu, PE
Course Objectives:	The objective of this course is to introduce students to important elements of engineering measurements and analysis of experimental data. The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course 3511 224. It prepares students to design and conduct experiments objectively to examine analytical findings and development of products.
Topics Covered:	1)The engineering design process; problem definition, design constraints and requirements; 2) Project management techniques; 3) System modeling and simulation; 4) Design analyses for material selection and production technology; 5) Optimization in design, statistics in design and design for reliability; 6) Safety, environmental considerations and the 'ability' factors; 7) Ethics in engineering practice; 8) Project definition and team selection; 9) Literature survey, alternate design solutions; 10) Preliminary design and detailed design; 11) Report preparation; 12) Oral presentation
Lab Experiment and Activities	None
Relationship of course to ME Curriculum:	Meets Program Educations Objectives through Student Outcomes Student Outcomes: SO1, SO2, SO3, SO4, SO5, SO6, SO7
Course Outcomes	Students will demonstrate ability to:

	Assessed for Student Outcomes Performance Indicators	**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; **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-B** Evaluate impact of engineering solutions in global, economic, environmental and societal contexts and incorporate their sensitivities. **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; **SO5-C** Able to develop a constructive team environment (inclusiveness, diversity, conflict resolution and assistance); **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); **SO7-B** Acknowledge the need for lifelong learning for a professional career by identifying the continuing education opportunities in the profession.
Prepared by:	Dr. Jiajun Xu, PE	
Approved by DCC:	Mechanical Engineering Department Curriculum Committee	

ME495: ME SPECIAL TOPIC - Nanotechnology Process

Catalog Data:	**MECH-495 Special Topics (Nanotech Processes), 3 Credits 3.** Overview of the broad spectrum of processing approaches involved in "top down", "bottom up", and hybrid nanofabrication. Covers nucleation and growth, photolithography, physical vapor deposition, etching, and metallization, and hands-on projects of these basic nanofabrication techniques.
Credits and Requirements:	3 Cr. and required course
Class Schedule	One 150-minutes lecture sessions per week for one semester
Laboratory Schedule:	None
Pre-requisite Course:	PHYS-203, PHYS-207, CHEM 111, CHEM113
Co-requisite Course:	None
Required Texts:	The Science and Engineering of Microelectronic Fabrication by Campbell Stephen, *Second Edition*, Oxford University Press, New York
Course Co-coordinator:	Dr. Hongmei Dang
Course Objectives:	The purpose of this course is to get an understanding of nanofabrication techniques, a particular emphasis on photolithography, physical vapor deposition and hands-on projects of these basic nanofabrication techniques and advanced design process flows and nanofabrication techniques for micro- and nano-scale Field-Effect transistors, solar cells and medical devices
Topics Covered:	Mechanism of Thin Film Growth; Photolithography; Vacuum and Plasma; Thermal Evaporation; E-Beam Evaporation; Sputtering; Liftoff process; Wet and dry etching; Fabrication processes of Nanoscale Field-Effect Transistors, Solar Cells and Medical Devices; Hands-on lab projects of Solar Cells including solar cell fabrication such as Photolithography, Thin film Deposition, Etching and Metallization.
Lab Experiment and Activities	None
Relationship of course to CE Curriculum:	Meets Program Educations Objectives through Student Outcomes: SO1, SO2, SO3, SO5, SO6
Course Outcomes	Students will be able to:

Assessed for Student Outcomes Performance Indicators	SO1-B Apply scientific, engineering and mathematical principles toward solving problems in nanotechnology area demonstrate competency of performing analysis and appropriately apply scientific principles to analyze processes. SO1-C Develop procedures and methods to solve complex engineering problems involving in nanotechnology and identify solutions that are within reasonable required accuracy and constraints. SO1-D Effectively utilize fabrication and characterization tools for a specific engineering task and assignment and demonstrate competency comparing results from alternative tools or techniques. SO2-A Analyze the design problem, develop a clear needs statement, formulate design objectives, identify constraints and develop design solution for nanoscale devices. SO2-B Integrate prior knowledge into design process (such as concept, modeling, evaluation) to develop solutions for nano-devices including solar cells and MOS capacitor. SO2-C Develop nano-devices that will meet realistic constraints such as economic and safety issues, and explain impact of the nano-devices on social or economic aspects. SO3-A Produce lab reports and design reports using appropriate formats and grammar and citations. SO3-C Produce lab reports with appropriate graphics such as figures and tables in written and clearly explain and analyze figures and tables in lab report. 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. SO5-C Able to develop a constructive team environment such as diversity and assistance. SO6-A Develop and conduct fabrication and characterization experimentation according to the assumptions, constraints, the experiment, laboratory procedure and safety protocols. SO6-B Analyze and interpret data, and verify experimental results according to theory and compares experimental results. SO6-C Draw conclusions that are supported by the analysis and interpretation of data according to experimental results and theory of nanotechnology area.
Prepared by:	Dr. Hongmei Dang
Approved by DCC:	Electrical and Computer Engineering Department Curriculum Committee.