

X. COURSE SYLLABI

E. MECHANICAL ENGINEERING COURSES

MEEN 2312: Statics and Dynamics of Rigid Bodies II
MEEN 2313: Mechanics of Solids
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MEEN 3212: Materials Engineering and Selection
MEEN 3322: Thermodynamics II
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MEEN 4341: Corrosion Engineering
MEEN 4392: Advanced Control Systems

Course Title: MEEN 2312: Statics and Dynamics of Rigid Bodies II

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course is a continuation of GEEN 2311: Statics and Dynamics I, covering topics including moments of inertia for areas, principles of work and energy, angular momentum, planar kinematics, and vibrations normally covered in a traditional two-course sequence of Statics and Dynamics.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving play the dominant role in this problem-solving course taken by both civil engineering and mechanical engineering majors.

III. Detailed Course Description

The course is a continuation of GEEN 2311: Statics and Dynamics I, and uses the same textbook as the first mechanics course. The topics include moments of inertia for areas, principles of work and energy, angular momentum, planar kinematics, and vibrations. It is a lecture course only, with a strong emphasis on mathematics and problem solving.

IV. Requirements Fulfilled

This course is required for majors in civil and mechanical engineering.

V. Required Prerequisites

- GEEN 2311: Statics and Dynamics I
- MATH 1324: Calculus III

VI. Learning Outcomes

- To learn basic principles of statics and dynamics in this second mechanics course.
- To develop problem-solving skills for problems related to statics and dynamics.

VII. Assessment Strategy

This course is a problem-solving course, and, as such, requires extensive homework. Short quizzes and examinations are used to test competencies.

- Homework — Critical thinking and problem-solving skills are applied to the solution of numerous problems in mechanics.
- Short Quizzes — Because there are so many different concepts introduced in this mechanics course, short quizzes are given to test the student's mastery of the concepts and their critical-thinking skills.
- Examinations — Because this is largely a problem-solving course, examinations are used to assess the individual's progress in applying critical thinking to solve mechanics problems.

VIII. Course Format

This is a lecture course with homework problems to be completed outside of class.

Classroom Hours (3 hours per week)

Class: 3

Lab: 0

IX. Topics to Be Covered

- A. Moments of inertia; radius of gyration
- B. Work and energy relationships
- C. Linear impulse and momentum
- D. Angular momentum, steady flow streams, and propulsion
- E. Rigid body planar kinematics
- F. Vibrations

X. Laboratory Exercises

This course does not have a laboratory.

XI. Technology Component

This problem-solving course relies heavily on hand-held calculators. Computers and calculators are used for graphing and finding numerical solutions to the problems.

XII. Special Projects / Activities

No special projects are assigned for this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Hibbeler, R. C. *Engineering Mechanics: Statics and Dynamics*, 10th Edition. Upper Saddle River, New Jersey: Prentice Hall, 2003.
ISBN: 0-131-04624-1

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 2313: Mechanics of Solids

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course covers applications of conservation principles and stress/deformation relationships to solid bodies. It draws upon the principles from Statics and Dynamics I, physics, and mathematics courses.

II. PMU Competencies and Learning Outcomes

This course stresses critical thinking and problem-solving skills. It builds professional competencies as it requires students to apply the knowledge learned in Statics and Dynamics I, physics, and mathematics courses.

III. Detailed Course Description

The course covers conservation principles and stress/deformation relationships to structural members. Thin-walled pressure vessels; columns; torsion and flexural members; shear, bending moment, and deflection systems are analyzed and solved in the course. Indeterminate structures are introduced.

IV. Requirements Fulfilled

This course is required for majors in civil and mechanical engineering.

Civil engineering students take the course in their sophomore year, because it is a prerequisite for the structures courses which start in the junior year.

Mechanical engineering majors take the course in the second semester of their junior year.

V. Required Prerequisites

Successful completion of:

- GEEN 2311: Statics and Dynamics I
- MATH 1324: Calculus III

Concurrent registration in:

- MEEN 2312: Statics and Dynamics of Rigid Bodies II

VI. Learning Outcomes

- To learn the various analysis techniques applicable to the mechanics of solids bodies.
- To develop the skills to recognize and to solve stress-related problems.

VII. Assessment Strategy

This problem-solving course assesses the student's ability to critically analyze different types of mechanical system components. These skills are assessed through examinations and homework.

- Examinations — In-class exams are given to assess the critical thinking and problem-solving skills.
- Homework — Homework problems are assigned to reinforce the lecture material and give the students practice on solving the many different problems encountered in this mechanics course.

VIII. Course Format

The course is a lecture-only course, with homework problems to be solved outside of class.

Classroom Hours (3 hours per week)

Class: 3

Lab: 0

IX. Topics to Be Covered

A. Introduction

1. Normal stress and strain
2. Mechanical properties of materials
3. Elasticity, plasticity, and creep
4. Linear elasticity, Hooke's law, and Poisson's ratio
5. Shear stress and shear strain
6. Allowable stresses and allowable loads

B. Axially loaded members

1. Design for axial loads
2. Changes in lengths of axially loaded members
3. Changes in lengths of nonuniform bars

C. Statically indeterminate structures; thermal effects, misfits, and prestrains; and stresses on inclined sections

D. Torsion

1. Torsional deformation of circular bars
2. Circular bars of linearly elastic materials
3. Nonuniform torsion

E. Stresses and strains in pure shear; relationship between modulus of elasticity and shear modulus; transmission of power by shafts; statically indeterminate torsional members; shear forces and bending moments

1. Types of beams, loads, and reactions
2. Shear forces and bending moments

F. Relationship among loads, shear forces, and bending moments; and shear-force and bending-moment diagrams

G. Stresses in beams

1. Review of centroids and moments of inertia
2. Pure bending and nonuniform bending
3. Curvature of a beam
4. Longitudinal strains in beams
5. Normal stresses in beams

- H. Design of beams for bending stresses; shear stresses in beams with rectangular and circular cross sections; and shear stresses in webs of beams with flanges
- I. Built-up beams and shear flow; composite beams; transformed section method; analysis of stress and strain
 - 1. Plane stress
 - 2. Principal stresses and maximum shear stresses
- J. Mohr's circle for plane stress; pressure vessels; beams and combined loadings
 - 1. Spherical and cylindrical pressure vessels
 - 2. Maximum stresses in beams
- K. Combined loadings; deflections of beams; deflections by integration of bending moment equation
- L. Deflections by integration of shear force and load equations; method of superposition; statically indeterminate beams
Types of statically indeterminate beams
- M. Method of superposition; buckling of columns
 - 1. Buckling and stability
 - 2. Columns with pinned ends
 - 3. Columns with other support conditions
- N. Design formulas for columns

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

This is largely a problem-solving course that makes extensive use of hand held calculators and students' personal laptop computers. No assignments require extensive use of computer laboratory facilities.

XII. Special Projects / Activities

There are no special projects for this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Gere, J. M. *Mechanics of Materials*, 5th Edition. Pacific Grove, CA: Brooks/Cole, 2001.
ISBN: 0-534-37133-7

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3211: Materials Engineering I

Semester Credit Hours: 2 (2.0)

I. Course Overview

This course examines the relationships between material structure and the mechanical, electrical, magnetic, thermal, and optical properties of materials. The macroscopic properties of materials are discussed in relation to the microscopic properties.

II. PMU Competencies and Learning Outcomes

The course builds on the foundation courses of mathematics, physics, and chemistry to develop critical thinking and problem solving skills. Teamwork is enhanced through group projects, and communication skills are sharpened through oral and written reports.

III. Detailed Course Description

The course covers the various material structures, including chemical structure, microstructure, crystalline structure, interface structure, and phase diagrams. Bulk properties of metals, polymers, and ceramics are discussed with respect to the various structures. It also covers mechanical, electrical, optical, magnetic, and thermal properties of materials.

IV. Requirements Fulfilled

This course is required for all majors in civil, electrical, and mechanical engineering.

V. Required Prerequisites

Successful completion of:

- CHEM 1421: Chemistry for Engineers I
- PHYS 1421: Physics for Engineers I

Concurrent registration in:

- MATH 1324: Calculus III

VI. Learning Outcomes

- To learn how the structure of materials influences the mechanical, electrical, and thermal properties of materials
- To develop an understanding of material properties to aid in the material selection process

VII. Assessment Strategy

The course assesses student knowledge and skills through examinations, homework, and class projects.

- Examinations – In-class exams are given to test the student’s ability to solve problems and assimilate the material from previous courses, particularly from chemistry, physics, and mathematics courses.
- Homework – problems is assigned, both for individual solutions and for team assignments
- Projects – is used for team building and for written and oral reports. A team leader is selected for each project to give each student an opportunity to display and learn leadership skills

VIII. Course Format

The course is two hours of lecture a week, but projects are assigned which require extensive use of computers.

Classroom Hours (2 hours per week)

Class: 2

Lab: 0

IX. Topics to Be Covered

- A. Introduction to materials science and atomic bonding
- B. Material structure of metals and ceramics
- C. Material structure of polymers
- D. Defects, diffusion
- E. Mechanical properties
 1. Bending
 2. Deformation
 3. Strengthening
 4. Stress/strain
- F. Material failure
- G. Phase diagrams
- H. Phase transformations
- I. Electrical properties
- J. Thermal properties
- K. Optical and magnetic properties
- L. Chemical properties, corrosion, degradation
- M. Composite materials

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are required to use the computer for homework assignments. They use the Internet for projects assigned to be completed outside of course.

XII. Special Projects/Activities

Because this course is an introductory materials course that includes majors from all three degree programs, mini design projects is assigned involving interdisciplinary materials-related projects. Also, smaller projects can be assigned that are within a discipline, such as role of semiconductors or superconductivity for electricals; composite materials or various types of concrete mixes for civils; superalloys or corrosion protection for mechanicals.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Collister, W. D., Jr. *Materials Science and Engineering: An Introduction*, Sixth Edition. New York, New York: Wiley and Sons, Inc., 2003.
ISBN: (To be completed)

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3212: Materials Engineering and Selection

Semester Credit Hours: 2 (2,0)

I. Course Overview

Building on the core materials science course taken by all engineering majors, this course examines the thermo-mechanical properties of materials. It places special emphasis on design and manufacturability.

II. PMU Competencies and Learning Outcomes

This course builds professional competencies and critical thinking abilities through by extending the subject matter of previous courses to a more in-depth level. The final project builds teamwork abilities, technical capabilities and oral and written communications skills.

III. Detailed Course Description

Course coverage includes thermal and mechanical properties of materials, strengthening mechanisms, phase transformation, polymer processing, composites, nondestructive evaluation, and basic manufacturing methods.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

Successful completion of:

- MEEN 3211: Materials Engineering I
- MEEN 2313: Mechanics of Solids (co-requisite)

VI. Learning Outcomes

- To learn more in-depth material about the various thermal and mechanical properties and how to influence their property behavior.
- To develop the skills necessary for appropriate materials selection for design and manufacturability.

VII. Assessment Strategy

Students are assessed through examinations, homework, and one project assigned outside of class. The project is completed in small teams of two to four people. All other work evaluates the individual skills of the student.

- Examinations – In-class exams assess the capability of the students to apply the prior knowledge gained in materials science, mathematics, chemistry, and physics to materials selection and manufacturability.
- Homework – homework problems are regularly assigned for work out of class, which involve critical thinking skills
- Project – one team project is assigned, which requires both a written and oral report.

VIII. Course Format

Two lecture hours per week is required for the course.

Classroom Hours (2 hours per week) **Class: 2**
Lab: 0

IX. Topics to Be Covered

- A. Mechanical properties of materials
 1. Tensile
 2. Hardness
 3. Impact
 4. Fatigue
 5. Creep
- B. Design for manufacturability
- C. Strengthening mechanisms
- D. Phase transformations
- E. Production/manufacturing techniques
 1. Thermal
 2. Forming
- F. Material removal processes
 1. Machining
 2. Cutting
- G. Polymer processing
 1. Extrusion
 2. Molding
- H. Composites
- I. Joining
 1. Welding
 2. Fasteners

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students use their personal laptop computers, the Internet, and handbooks for materials selection. A design project is assigned to teams which require extensive use of the computer and Internet outside of class.

XII. Special Projects/Activities

There is a design project in which students work in teams to design a product, select the appropriate materials, discuss various tradeoffs and alternatives, and then develop the manufacturing procedures and drawings to make the product. Students present their design to the class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

1. Kalpakjian, S. and S. R. Schmid. *Manufacturing Processes for Engineering Materials*, 4th Edition. Englewood Cliffs, New Jersey: Prentice Hall, 2003.
ISBN:
2. Callister, W. D., Jr. *Materials Science and Engineering: An Introduction*, 6th Edition. New York, New York: John Wiley and Sons, Inc., 2003.
ISBN:

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3322: Thermodynamics II

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course continues the introduction to concepts of thermodynamics begun in GEEN 2313: Thermodynamics I. Topics cover thermodynamic cycles including power, propulsion, and refrigeration cycles and associated machinery.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course. Students are introduced to chemical processes, reactions, and equilibria; gas, power, refrigeration, and propulsion cycles; and the thermodynamics of compressible flow. They learn to solve problems involving changes in thermodynamic properties using these concepts. This course builds on the prior knowledge from thermodynamics, chemistry, physics, and calculus courses. Frequent written homework assignments build communications abilities. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

The fundamentals of thermodynamics as developed in GEEN 2313: Thermodynamics I are used to develop understanding in a continuing study of thermodynamic cycles, including power, propulsion, and refrigeration cycles and associated machinery. Mixtures of ideal gases are considered. The concepts of chemistry are used to study chemical reactions and equilibrium. An introduction to the effects of compressibility on fluid flow also is included.

IV. Requirements Fulfilled

This is a required course in the Mechanical Engineering curriculum.

V. Required Prerequisites

Successful completion of:

- GEEN 2313: Thermodynamics I

Concurrent registration in:

- GEEN 3311: Introduction to Fluid Mechanics

VI. Learning Outcomes

- To teach students the application of the laws of thermodynamics and thermodynamic properties to thermal power generation, air conditioning, and compressible flow.
 - Students understand how simple thermodynamic processes are combined into working thermal systems and become familiar with current technology.
 - Students know the role of Maxwell's equations in relating thermodynamic properties, their use with thermophysical data, and the nature of equations of state.
 - Students learn the properties of ideal gas mixtures and applications to air conditioning and cooling towers.
 - Students learn stoichiometry, thermochemistry and the interrelation between fossil fuel usage and atmospheric emissions.
 - Students learn the principles of chemical and phase equilibrium.
 - Students learn the principles of compressible flow.
- To introduce the notion of obtaining satisfactory compromise to engineering solutions when conflicting requirements and physical laws are in play.

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the student from tests taken in an in-class setting.

- Examinations – in-class exams are given to test the student's ability to solve problems using thermodynamics and to assimilate the material from previous courses, particularly, chemistry, physics, and mathematics.
- Homework – problems are assigned for individual student submission.

VIII. Course Format

This course is a lecture course meeting three hours per week in a lecture room setting. The students are required to work on homework problems in an out-of-class setting.

Classroom Hours (3 hours per week) **Class:** 3
Lab: 0

IX. Topics to Be Covered

1. Vapor and gas power, propulsion and refrigeration cycles and machinery. Properties of mixtures of ideal gases; psychrometry and its application to air-conditioning; cooling towers.
2. Chemical reactions, combustion fuels; stoichiometry; thermochemistry; flame temperature.
3. Chemical equilibrium and calculation of equilibrium composition for combustion reactions; law of mass action; third law of thermodynamics; phase rule.
4. Thermodynamics of compressible flow; one-dimensional steady flow in ducts and nozzles. Normal shock waves, speed of sound. Supersonic and subsonic flows. Flow with friction and heat transfer.

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students are required to use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Moran, M.J., and H.N. Shapiro. *Fundamentals of Engineering Thermodynamics*, 4th Edition. _____: J. Wiley and Sons, 2000.
ISBN:

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3332: Computational Methods

Semester Credit Hours: 3 (3,0)

I. Course Overview

In this course students acquire knowledge about tools that are available for analysis of engineering problems, and they learn to apply these tools effectively. Topics include Taylor series, numerical integration and differentiation, non-linear algebraic equations; boundary value problems; finite difference solutions; and finite element solutions of ordinary differential equations.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to various numerical methods used to solve engineering problems. Problems are assigned to teams who analyze, solve, and report. Assignments build communications skills through written homework. One oral presentation is made on a group project. The course builds technology competencies by extending programming skills learned in other courses and through the use of computing and programming analysis tool MATLAB.

III. Detailed Course Description

This course presents numerical methods to solve problems related to Mechanical Engineering fields. These include Taylor series, numerical integration and differentiation, non-linear algebraic equations; boundary value problems; finite difference solutions; and finite element solutions of ordinary differential equations. Students learn which techniques to apply to different systems – both what works, and what does not work. The students learn to solve mathematical equations using both numerical and analytical tools.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- GEEN 2312: Introduction to Computing
- MATH 2332: Differential Equations

VI. Learning Outcomes

- To learn how to obtain numerical solutions to a variety of engineering problems using the computer.
- To develop the skills necessary to identify when numerical methods can be used and which method should be applied to solve the engineering problem.

VII. Assessment Strategy

Students are assessed in a variety of ways. Homework problems are assigned covering previous coursework in mathematics, chemistry, thermodynamics, and other core courses. These assess the student's ability to apply the knowledge from prior courses. Computer programming skills are assessed using the MATLAB program. In addition, there are examinations, homework, team projects, oral presentations, and a written report.

- Examinations – provide the instructor with an opportunity to assess the student's ability to work independently to solve engineering problems
- Projects – provide students with an opportunity to work in teams, analyzing and solving problems and presenting solutions both orally and in written reports.
- Homework – provide students with an opportunity to solve more extensive problems, thus assessing his critical thinking and analysis skills

All of these assessment methods are useful in the capstone course, where the students is required to analyze, evaluate various design alternatives, report orally on the design selected, and write up the results in a design report.

VIII. Course Format

This is a lecture course, but students are required to work on projects outside of class in a computer-aided laboratory.

Classroom Hours (3 hours per week)

Class: 3

Computer Project Lab:

(as needed)

IX. Topics to Be Covered

- A. Application of MATLAB to numerical solutions
- B. Taylor series; round off and truncation errors
- C. Numerical solutions of non-linear algebraic and transcendental equations
- D. Numerical solutions of linear algebraic equations
- E. Numerical integration
- F. Numerical differentiation
- G. Numerical solutions to ordinary differential equations
- H. Finite difference solutions of partial differential equations
- I. Curve fits and least-squares analysis

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students use their personal laptop computers extensively in this course. The students use MATLAB software and program most of the numerical solutions used in this course. Students learn the numerical programming techniques first before they are allowed to use the “built-in” functions of MATLAB.

XII. Special Projects/Activities

During the semester, students are assigned one major project, which is solved in two-to-four person teams. The students analyze a problem, program the solution using MATLAB, and obtain results. They write a report on their solution and results, prepare a PowerPoint presentation, and make an oral presentation to the class.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Chapra, S. C., and R. P. Canale. *Numerical Methods for Engineers*, 4th Edition. _____: McGraw Hill, 2002.

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

MATLAB software

Course Title: MEEN 3391: Mechanical Engineering Design I

Semester Credit Hours: 3 (3,0)

I. Course Overview

The first course in the Mechanical Engineering design sequence introduces students to the concepts of design and the design process. An additional focus is on kinematics, linkages, and an introduction to mechanisms.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of planar and spatial motion. This course enhances professional competencies by building on prior knowledge from mathematics, physics, and statics and dynamics. Frequent written homework assignments build communications abilities. Computer solutions which are part of the homework build technology skills. No formal oral presentations or group assignments are included in the course.

III. Detailed Course Description

This introduction to engineering design and the design concept provides an understanding of the kinematics of machine elements, including linkages, rolling and sliding contacts, cams, and gears and gear trains. Both static and dynamic force analyses in mechanisms are introduced. Students are expected to have a thorough understanding of calculus, physics, and statics and dynamics to be successful in this course. Mechanical engineering majors take this course in the first semester of the junior year.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MATH 2332: Differential Equations
- MEEN 2312: Statics and Dynamics of Rigid Bodies II

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

The students are required to use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB are required in this course.

XII. Special Projects/Activities

There are no special projects associated with this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Waldron, K.J., and G.L. Kinzel. *Kinematics, Dynamics, and Design of Machinery*, 2nd Edition. _____: J. Wiley & Sons, 2004.
ISBN:

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3392: Mechanical Engineering Design II

Semester Credit Hours: 3 (3,0)

I. Course Overview

The second course in the mechanical engineering design sequence introduces students to the concepts of the control of dynamical systems. In this course, students learn to solve control problems for both steady-state and transient responses.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to control concepts that are a direct application of the mathematics and mechanics they have taken to this point in their curriculum. Students learn to solve problems in both transient and steady-state modes of dynamical response. Frequent written homework assignments build communications abilities. An open-ended design project by groups of three students builds teamwork skills.

III. Detailed Course Description

The concepts of dynamics and control of mechanical systems are presented. The students learn to solve control problems for both steady-state and transient responses. Control design featuring both time and frequency response is covered. Several classes of controllers are covered. Students are expected to have a thorough understanding of mathematics and statics and dynamics to be successful in this course. Mechanical engineering students take this course in the second semester of the junior year.

IV. Requirements Fulfilled

This course is required for majors in mechanical engineering.

V. Required Prerequisites

- MEEN 3332: Computational Methods
- MEEN 3391: Engineering Design I

VI. Learning Outcomes

- Develop analytical and computational tools for examining the behavior and calculating the response of lumped mechanical systems.
 - Students are able to develop equations of motion for lumped mechanical systems, and analyze the behavior of such systems in both the frequency and time domain.
 - Students are able to use commercial software packages such as MATLAB and Excel to study the behavior of systems.

- I. Vibration isolation and vibration absorbers
- J. Block diagrams and system component interconnections
- K. Control design to satisfy time and frequency response specifications
- L. P, PI, PD and PID controllers
- M. State-space representation of systems

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students use their laptop computers in doing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions, using MATLAB and Excel, are required.

XII. Special Projects/Activities

There is a design project in this course. Teams of three students select from a group of projects to be completed as a team effort. This design project is a computer-based solution.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Ogata, K. *System Dynamics*, 3rd Edition. ____: Prentice Hall, 1992.
ISBN:

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.

Course Title: MEEN 3393: Mechanical Engineering Design III

Semester Credit Hours: 3 (3,0)

I. Course Overview

The third course in the mechanical engineering design sequence introduces students to the concepts of mechanical strength and reliability in the design of machine components. Stress, reliability, and failure analysis are considered.

II. PMU Competencies and Learning Outcomes

Critical thinking and problem solving are the cornerstones of this course, as students are introduced to the concepts of stress analysis as applied to mechanical systems. Frequent written homework assignments build communications abilities and frequent computer solutions build technology skills. A group project, involving an open-ended design, builds teamwork skills.

III. Detailed Course Description

This course presents the concepts of mechanical design from the point of view of stress analysis. Machine components are designed based on a reliability and failure analysis. Various types of mechanisms is discussed. Students are expected to have a thorough understanding of mathematics, statics and dynamics, mechanics of solids, and the first two design courses to be successful in this course. Mechanical engineering students take this course in the first semester of the senior year.

IV. Requirements Fulfilled

This is a required course in the Mechanical Engineering curriculum.

V. Required Prerequisites

- MEEN 2313: Mechanics of Solids
- MEEN 3332: Computational Methods
- MEEN 3392: Engineering Design II

VI. Learning Outcomes

- To cover the basics of machine design, including the design process, engineering mechanics and materials, failure prevention, and the characteristics of the principal types of machine elements.
- To offer a practical approach to mechanical design through a variety of real-world examples.
- To encourage the students in understanding the connections between design and analysis.

VII. Assessment Strategy

The course is a lecture course in which the students are expected to be participants in classroom discussion. There are regular homework assignments, and students receive feedback from the instructor regarding their performance on the homework. The major part of the course grade is based on the performance of the students from tests taken in an in-class setting.

- Examinations – in-class exams is given to test the student’s ability to solve problems using thermodynamics and to assimilate the material from previous courses, particularly, chemistry, physics, and mathematics.
- Homework – problems are assigned for individual student submission.
- Design project – An open-ended design project is assigned. Students are divided into groups of three for the design projects

VIII. Course Format

This course meets in a lecture room setting. Students are required to work on homework problems in an out-of-class setting. A design project, in a group setting, is required of all students.

Classroom Hours (3 hours per week) Class: 3
Lab: 0

IX. Topics to Be Covered

- A. Design concepts
- B. Materials
- C. Load and stress analysis
- D. Failures resulting from static and variable loading
- E. Permanent and nonpermanent joinings
- F. Mechanical springs
- G. Bearings – contact and journal
- H. Gears
- I. Brakes, clutches, and flywheels
- J. Shafts and axles

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

Students are required to use their laptop computers in completing and submitting their homework assignments. Examinations are taken in the classroom using no electronic assistance. Computer solutions using MATLAB and Excel are required.

XII. Special Projects/Activities

There is a design project in this course. Teams of three students select from a group of projects to be done as a team effort. This design project is a computer-based solution.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Shigley, J.E., C.R. Mischke, R.G. Budynas. *Mechanical Engineering Design*, 7th Edition. ____: McGraw-Hill, 2004.
ISBN:

B. Alternative Textbooks

None.

C. Supplemental Print Materials

None.

D. Supplemental Online Materials

None.