Appendix A – Course Syllabi

Course alpha, number, title: ME 201 Thermodynamics

Required or elective: Required


Prerequisite(s): (CEM 141 or CEM 151 or CEM 181H or LBS 171) and ((MTH 234 or concurrently) or (MTH 254H or concurrently) or (LBS 220 or concurrently)) and PHY 183


Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
1. Basic concepts of systems, properties, and equilibrium
2. Mass, the Conservation of Mass principle, and its applications
3. Ideal gases and evaluation of their properties.
4. Simple compressible substances and evaluation of their properties
5. Incompressible substances and evaluation of their properties
6. Energy, the First Law of Thermodynamics and its applications
7. Entropy, the Second Law of Thermodynamics and its applications
8. Applications of the combined laws of thermodynamics
9. Analysis of thermal systems

Course learning Objectives:

Upon successful completion of this course, students can:

1. Distinguish and classify systems and properties according to thermodynamics definitions (closed/open systems, steady/transient systems, intensive/extensive properties, ideal gas/incompressible substance/solid).
   [L: Comprehension] [M: Questions on quizzes, exams ]

2. Apply the first law of thermodynamics and conservation of mass principle to steady and unsteady systems, differentiating between energy transfer by heat, energy transfer by work, and energy transfer by mass transfer.
   [L: Application/Analysis], [M: Questions on quizzes and exams]

3. Understand the concepts of entropy and reversibility and employ them as they apply to open/closed and steady/unsteady systems using the Clausius statement, the Kelvin-Planck statement, and the Entropy statement of the second law of thermodynamics.
   [L: Comprehension/Application], [M: Questions on quizzes and exams]

4. Demonstrate working knowledge of thermodynamic cycles, including power cycles and refrigeration cycles, and manipulate the first and second laws of thermodynamics correspondingly.
   [L: Comprehension/Knowledge], [M: Questions on quizzes and exams]

   [L: Evaluation/Synthesis], [M: Questions on exams]

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## Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **2** = Strong Emphasis, **1** = Some Emphasis, **0** = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—0
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

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<th>Contribution to professional component:</th>
<th>100% Engineering Science 0% Engineering Design</th>
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**Person(s) who prepared this description**: Anthony and Benard

**Date of Preparation**: 2016
Appendix A – Course Syllabi

Course alpha, number, title

ME 222 Mechanics of Deformable Solids

Required or elective

Required

Course (catalog) description


Prerequisite(s)

(MTH 234 and ME 221)

Textbook(s) and/or other required material


Class/Lab schedule:

Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered

(a) Normal and shear stress
(b) Normal and shear strain
(c) Stress at a point
(d) St. Venant’s principle
(e) Bars with axial loads
(f) Thermal stress
(g) Principal and max shear stresses,
(h) Mohr circle
(i) Statically indeterminate axial members
(j) Pressure vessels
(k) Stress concentrations
(l) Torsion of circular bars
(m) Statically indeterminate torsion
(n) Torsion of thin-walled tubes
(o) Review of shear and moment diagrams
(p) Bending stress
(q) Beam shear stress
(r) Beam deflection
(s) Statically indeterminate beams
(t) Yield and failure criteria
(u) Elastic stability

Course learning Objectives

Upon successful completion of this course, students can:

1. Explain the concepts of stress and strain and their relationships to load and deformation, and use the concepts in the solution of problems.
   [L: Knowledge, Application] [M: Exams ]
2. Calculate stresses in statically determinate machine and structural components including:
   a. bolts
   b. axially-loaded bars
   c. components in pure shear
   d. circular shafts in torsion
   e. beams in bending
   f. beams in shear
   g. thin-walled pressure vessels
   h. frame members under combined loading
   [L: Knowledge, Comprehension, Analysis] [M: Exams ]
3. Calculate deformations in statically determinate machine and structural components including:
   a. axially-loaded bars
   b. thermally-loaded bars
   c. components in pure shear
   d. circular shafts in torsion
Appendix A – Course Syllabi

4. Calculate stresses and deformations in statically indeterminate machine and structural components including:
   a. axially-loaded bars
   b. thermally-loaded bars
   c. circular shafts in torsion
   d. beams in bending
   e. beams in shear
   [L: Knowledge, Comprehension, Analysis] [M: Exams ]

5. Compute the principal stresses, principal angles, maximum shear stress and angles, and stresses on any arbitrary plane, given the state of stress at a point;
   [L: Comprehension, Application] [M: Exams ]

6. Explain the concept of elastic stability and why it is important, and calculate critical buckling loads for basic cases of axially-loaded slender bars;
   [L: Knowledge, Comprehension, Analysis] [M: Exams ]

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 2 = Strong Emphasis
- 1 = Some Emphasis
- 0 = Little or No Emphasis

(a) an ability to apply knowledge of mathematics, science, and engineering — 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data — 1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability — 1
(d) an ability to function on multidisciplinary teams — 0
(e) an ability to identify, formulate, and solve engineering problems — 2
(f) an understanding of professional and ethical responsibility — 0
(g) an ability to communicate effectively — 1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 0
(i) a recognition of the need for and the ability to engage in life-long learning — 0
(j) a knowledge of contemporary issues — 0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 1

Contribution to professional component:

90% Engineering Science 10% Engineering Design

Person(s) who prepared this description

Averill, Diaz, Liu, Recktenwald

Date of Preparation

2015
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<tr>
<th>Course alpha, number, title</th>
<th>ME 280 Graphic Communications</th>
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<tr>
<td>Prerequisite(s)</td>
<td>(EGR 100 and (EGR 102 or concurrently)) or ((MTH 116 or concurrently) or (LB 118 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or MTH 103 or (MTH 114 or concurrently))</td>
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<td>Textbook(s) and/or other required material</td>
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<td>Class/Lab schedule</td>
<td>Total Credits: 2 Lecture/Laboratory/Discussion Hours:0/4/0</td>
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| Topics covered              | 1. 3-D Solid Modeling  
2. Technical Sketching  
3. Geometric constriction  
4. Pictorials - isometric and perspective  
5. Dimensioning |
| Course learning objectives   | For the student to be:  
1. able to read and produce freehand engineering sketches,  
2. familiar with operation of 3-D Solid Modeling software,  
3. able to perform basic geometric constructions,  
4. able to produce 2-point perspective sketches of a given object,  
5. able to convert between multi-view projections and 3-D isometric and perspective projection,  
6. able to communicate design and/or engineering ideas through engineering graphics |
| Relationship of course to ME program outcomes | The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:  
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.  
(a) an ability to apply knowledge of mathematics, science, and engineering—1  
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1  
(d) an ability to function on multidisciplinary teams—1  
(e) an ability to identify, formulate, and solve engineering problems—0  
(f) an understanding of professional and ethical responsibility—1  
(g) an ability to communicate effectively—1  
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0  
(i) a recognition of the need for and the ability to engage in life-long learning—0  
(j) a knowledge of contemporary issues—1  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2 |
### Appendix A – Course Syllabi

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<td>Robert Chalou</td>
</tr>
<tr>
<td>Date of Preparation</td>
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Appendix A – Course Syllabi

Course alpha, number, title: ME 285 Computer Aided Design Tools

Required or elective: Elective

Course (catalog) description: Advanced 3-D Solid Modeling, Finite Element Modeling and Mechanism Modeling.

Prerequisite(s): ME 280

Textbook(s) and/or other required material: No textbook

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 0/6/0

Topics covered:
1. Advanced 3-D Solid Modeling
2. Finite Element Modeling and Analysis Using Computer Software
3. Mechanism Design and Analysis Using Computer Software

Course learning objectives:
For the student to be:
1. familiar with the advanced operation of 3-D Solid Modeling software,
2. able to perform advanced geometric constructions,
3. able to communicate design and/or engineering ideas through engineering graphics and Computer Aided Design tools

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—1
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —0
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2
### Appendix A – Course Syllabi

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Appendix A – Course Syllabi

Course alpha, number, title: ME 300 Professional Issues in Mechanical Engineering

Required or elective: Required

Course (catalog) description: This course is a colloquium on professional issues in Mechanical Engineering practice. Professional conduct and ethical behavior in the workplace. Practice in professional writing and oral presentation. Global, economic, environmental and societal context of engineering. Contemporary issues in engineering. Group dynamics and working in teams. Intellectual property.

Prerequisite(s): Completion of Tier I writing requirement

Restriction(s): Open to juniors or seniors in the Mechanical Engineering Major

Textbook(s) and/or other required materials: ASME Professional Practice Curriculum on Engineering Ethics

Class/Lab schedule: Total Credits: 1 Lecture/Laboratory/Discussion Hours: 1/0/0

Topics covered:

a. Professional conduct
b. Engineering ethics
c. Professional communication
d. Global engineering
e. Engineering economics
f. Environmental considerations on design
g. Societal considerations on design
h. Contemporary issues in engineering
i. Group dynamics and working in teams
j. Intellectual property

Course learning objectives: Upon successful completion of this course, students can:

1. Assess ethical behavior using several philosophical models [L: Knowledge, Comprehension] [M: Written Report]
2. Evaluate a practical situation in terms of a professional code of ethics [L: Evaluation] [M: Oral Presentation]
3. Identify situations that represent conflicts of interest and formulate a proper response [L: Comprehension, Analysis, Synthesis] [M: Written Quiz]
4. Apply the standards of professional ethics in written and oral technical communication [L: Application] [M: Written and Oral Presentations]
5. Discuss the impact of engineering solutions in a global, economic, environmental and societal context [L: Comprehension] [M: Written Report or Quiz]
6. Discuss contemporary issues in engineering [L: Comprehension] [M: Oral Report or Quiz]
7. Describe the elements of group dynamics and formulate a plan for effective teamwork [L: Knowledge, Synthesis] [M: Written Quiz]
8. Define intellectual property and discuss its responsible care and use [L: Knowledge, Comprehension] [M: Written Quiz]

Key: L – Level of Learning, M – Method of Measurement
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **2** = Strong Emphasis, **1** = Some Emphasis, **0** = Little or No Emphasis.

1. **(a)** an ability to apply knowledge of mathematics, science, and engineering—0
2. **(b)** an ability to design and conduct experiments, as well as to analyze and interpret data—0
3. **(c)** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
4. **(d)** an ability to function on multidisciplinary teams—0
5. **(e)** an ability to identify, formulate, and solve engineering problems—0
6. **(f)** an understanding of professional and ethical responsibility—2
7. **(g)** an ability to communicate effectively—2
8. **(h)** the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2
9. **(i)** a recognition of the need for and the ability to engage in life-long learning—2
10. **(j)** a knowledge of contemporary issues—2
11. **(k)** an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—0

**Contribution to professional component:**

**Person(s) who prepared this description**

Ron Averill, Alex Diaz, Craig Gunn

**Date of Preparation**

2015
Appendix A – Course Syllabi

Course alpha, number, title
ME 332 Fluid Mechanics

Required or elective
Required

Course (catalog) description

Prerequisite(s)
ME 361 and (CHE 321 or ME 201) and ((ME 391 or concurrently) and completion of Tier I Writing requirement).

Textbook(s)

Class/Lab schedule:
Total Credits: 4 Lecture/Laboratory/Discussion Hours: 3/3/0

Topics covered
(a) Fluid Statics
(b) Bernoulli Equation
(c) Fluid Motion
(d) Conservation of Mass Equation (Control Volume Form, CV)
(e) Momentum Equation (CV)
(f) Energy Equation (CV)
(g) Navier-Stokes Equations and Exact Solutions
(h) Similitude
(i) Internal Flow
(j) External Flow
(k) Laminar and Turbulent Boundary Layer or Compressible Flows

Course learning objectives

1. Hydrostatics Principles
   a) Learn to determine a pressure differential using manometry
   b) Learn to determine the pressure distributions, forces and moments on submerged surfaces,

2. Fluid Flow Conservation Laws
   a) Learn to apply the conservation of mass to a control volume.
   b) Learn to apply the conservation of linear momentum to a control volume.
   c) Learn to apply the conservation of energy to a control volume.
   d) Apply knowledge gained in parts a through c above to solve general fluid flow problems.
   e) Learn to apply the differential form of the mass conservation and the Navier-Stokes equations to solve simple incompressible laminar flow problems.

3. Similarity and Model Testing
   a) Learn the ideas behind fluid flow dynamic similarity.
   b) Learn how to determine non-dimensional groups.
   c) Learn to determine the parameters for model testing.

4. Internal Flow Characteristics
   a) Learn the distinction between laminar and turbulent pipe flow characteristics.
   b) Learn to calculate turbulent pipe flow problems including major and minor losses.

5. External Flow Characteristics
   a) Learn the characteristics of laminar and turbulent boundary layers.
   b) Learn the characteristics of external flows including flow separation, lift and drag coefficients.
   c) Learn to solve for fluid forces on objects using lift and drag coefficient data.

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Appendix A – Course Syllabi

6. Compressible Flow
   a) Isentropic speed of sound.
   b) Isentropic 1-D flows.
   c) Normal shock wave.

7. Laboratory Measurements
   a) Learn the use of flow visualization, pressure transducers, Pitot tubes, and hot-wire anemometry.
   b) Participate in computer data acquisition.
   c) Demonstrate basic fluid mechanics principles including hydrostatics, conservation of mass, momentum and energy, pressure variation along and normal to streamlines, laminar and turbulent flows.
   d) Participate in team building experiences through working in groups and a final group project.
   e) Communicate experimental results with written reports and a final project oral presentation.
   f) Organize the final project including the experimental methodology, setup, project timeline, data processing, and project result presentation (written and oral).

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
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(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—2
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

Contribution to professional component: 100% Engineering Science 0% Engineering Design

Person(s) who prepared this description: Ahmed Naguib and Indrek Wichman

Date of Preparation: 2010, updated 2014
## Course alpha, number, title

ME 361 Dynamics

## Required or elective

Required

## Course (catalog) description


## Prerequisite(s)

(ME 221) and (MTH 235 or MTH 255H or LBS 220)

## Textbook(s) and/or other required material


## Class/Lab schedule:

Total Credits: 3  Lecture/Laboratory/Discussion Hours: 3/0/0

## Topics covered

- (a) particle kinematics: rectilinear, Cartesian, normal and tangential, and polar coordinates
- (b) relative and constrained motion
- (c) Newton’s Laws applied to particles
- (d) free body diagrams
- (e) work-energy methods for particle dynamics
- (f) impulse-momentum methods for particle dynamics
- (g) impact problems
- (h) linear and angular momentum
- (i) kinematics of rigid bodies: translation, rotation, and general plane motion
- (j) kinematics of a system of rigid bodies
- (k) mass moment of inertia
- (l) Newton-Euler equation of motion: for the planar dynamics of rigid bodies
- (m) Work/energy methods for rigid body dynamics
- (n) Impulse-momentum methods for rigid body dynamics

## Course learning objectives

Upon successful completion of this course, students can:

1. Construct an accurate mathematical model of dynamical systems including:
   - a. the kinematics of a particle
   - b. the kinetics of a particle
   - c. the kinematics of a rigid body in a plane
   - d. the kinetics of a rigid body in a plane.
   
   [L – Analysis & Application ] [M – Questions in Homework and Exams]

2. Construct an accurate mathematical model of a dynamical system using
   - a. free body diagrams
   - b. coordinate systems
   - c. vector analysis
   - d. general plane motion
   - e. Newton’s method
   - f. Work-energy methods
   - g. Impulse-momentum methods.
   
   [L – Analysis & Evaluation ] [M – Questions in Homework and Exams]

3. Compute accelerations, velocities, positions, forces, work, energy, momentum, and/or impulses of dynamical systems using the mathematical representation of the system.
   
   [L – Analysis ] [M – Questions in Homework and Exams]

4. Understand and assess the meaning of the computed values.
   
   [L – Evaluation ] [M – Questions in Homework and Exams]
Appendix A – Course Syllabi

Key: L – Level of Learning, M- Method of Measurement

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<th>Date of Preparation</th>
<th>2014</th>
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Appendix A – Course Syllabi

Course alpha, number, title
ME 371 Mechanical Design I

Required or elective
Required

Course (catalog) description
Kinematic analysis of linkage mechanisms, spur gears and cam-follower systems.

Prerequisite(s)
(ME 361 or concurrently)

Textbook(s) and/or other required material

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
1. Fundamentals
   - Reference frames, coordinate transformations, rigid body kinematics, position and displacement, velocity, acceleration
1. Applications
   - Linkage mechanisms, cam/follower systems, gears
2. Manufacturing Processes
   - Primary and secondary manufacturing processes for metals: forging, extrusion, rolling, bending, stamping, casting. Process design issues associated with these processes.
   - Manufacturing of composite and polymeric materials: injection molding, blow molding, lay-up technique, RTM, RIM, compression molding, filament winding, pultrusion. Process design issues associated with these processes.
   - Properties of metals and plastics typically used for engineering applications.
4. Design thinking in the context of engineering/industrial practice
5. Concurrent engineering

Course learning objectives
Upon successful completion of this course, students can:

For linkage mechanisms,
- Construct the loop closure equation and then perform position, velocity and acceleration analysis.
  [L: Comprehension, Analysis] [M: Question in Exams]
- Calculate the number of degrees of freedom (DOF) for a mechanism.
  [L: Knowledge, Analysis] [M: Question in Exams]
- Synthesize a four-bar mechanism. That is, given the desired motion of the mechanism, determine its link lengths.
  [L: Synthesis] [M: Question in Exams, Project]

For cam/follower,
- Identify types of follower, follower motion, joint closure and cams, cam motion constraints, etc.
  [L: Knowledge] [M: Question in Exams]
- Setup SVAJ diagrams for a desired cam/follower motion.
  [L: Comprehension, Analysis] [M: Question in Exams]
- Using Polynomials, design a cam/follower arrangement with a desired motion.
  [L: Synthesis] [M: Question in Exams, Project]

For gears,
- Calculate velocity and torque ratios.
  [L: Analysis] [M: Question in Exams]
Appendix A – Course Syllabi

- Identify the involute tooth form and its properties.
  [L: Knowledge] [M: Question in Exams]
- Recognize the gear nomenclature as defined by AGMA.
  [L: Knowledge] [M: Question in Exams]

Recommend an appropriate manufacturing process for a given design and material
[L: Application, Evaluation] [M: Question in Exams]

Recommend an appropriate material for a given design
[L: Application, Evaluation] [M: Question in Exams]

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<td>i) a recognition of the need for and the ability to engage in life-long learning—0</td>
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<tr>
<td>j) a knowledge of contemporary issues—0</td>
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<tr>
<td>k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1</td>
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<table>
<thead>
<tr>
<th>Contribution to professional component:</th>
<th>50% Engineering Science 50% Engineering Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person(s) who prepared this description</td>
<td>Brian Thompson and Farhang Pourboghrat (original, 2009)</td>
</tr>
<tr>
<td></td>
<td>Diaz (2015)</td>
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<tr>
<td>Date of Preparation</td>
<td>2015</td>
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</tbody>
</table>
### Course alpha, number, title
ME 372 Machine Tool Laboratory

### Required or elective
Elective

### Course (catalog) description
Principles and practice of machine tools. Safety, terminology, measurement, and working procedures for hand and machine tools.

### Prerequisite(s)
none

### Textbook(s) and/or other required material
----

### Class/Lab schedule:
Total Credits: 12 Lecture/Laboratory/Discussion Hours: 0/2/0

### Topics covered
a. Machine shop safety
b. Identification of machines
c. Using hand tools
d. Planning and layout procedures
e. Using a drill press
f. Using a lathe
g. Using a milling machine
h. Using cutting machine tools
i. Fabrication and assembly of parts
j. Welding

### Course learning objectives
Students will know the safety of and be able to use machines in a standard machine shop, including hand tools.

### Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

- (a) an ability to apply knowledge of mathematics, science, and engineering—2
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
- (d) an ability to function on multidisciplinary teams—1
- (e) an ability to identify, formulate, and solve engineering problems—0
- (f) an understanding of professional and ethical responsibility—1
- (g) an ability to communicate effectively—2
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
- (i) a recognition of the need for and the ability to engage in life-long learning—0
- (j) a knowledge of contemporary issues—0
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

### Contribution to professional component:
0% Engineering Science 0% Engineering Design 100% Other

### Person(s) who prepared this description
Roy Bailiff

### Date of
2014
Appendix A – Course Syllabi

Preparation
Appendix A – Course Syllabi

Course alpha, number, title
ME 391 Mechanical Engineering Analysis

Required or elective
Required

Course (catalog) description
Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.

Prerequisite(s)
(MTH 235 or MTH 255H or LBS 220)

Textbook(s) and/or other required material

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
(a) The principle of work, potentials, and conservation of mass.
   i. Vector calculus, including divergence and curl and the directional derivative
(b) Forced spring-mass-damper systems
   i. Ordinary differential equations
   ii. Laplace Transforms (including delta functions)
(c) Coupled systems (spring-mass systems and/or compartment models)
   i. Linear algebra
   ii. Eigenvectors and eigenvalues
(d) The heat, wave, and Laplace equations
   i. Partial differential equations
   ii. Boundary value problems
   iii. Eigenvalue problem
   iv. Fourier series

Course learning objectives
Upon successful completion of this course, students can:
1. State the work, heat, wave, Laplace, forced spring-mass-damper equations.
   [L: Knowledge] [M: Question in Exam]
2. Formulate the conservation of mass and coupled systems equations.
   [L: Synthesis] [M: Question in Exam]
3. Solve all of the above equations using analytical (and some numerical) techniques;
   [L: Analysis] [M: Question in Exam]
4. Use suitable approximations, make quantitative comparisons, and interpret the solutions.
   [L: Evaluation] [M: Question in Exam]

Key: L - Level of Learning, M- Method of Measurement

Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—0
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—0
(h) the broad education necessary to understand the impact of engineering solutions in a
Appendix A – Course Syllabi

global, economic, environmental, and societal context — 0
(i) a recognition of the need for and the ability to engage in life-long learning — 0
(j) a knowledge of contemporary issues — 0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 1

Contribution to professional component:
33% Engineering Science 0% Engineering Design 67% Math and Basic Science

Person(s) who prepared this description
Indrek Wichman and Maureen Blazer-Adams (original, 2009)
Indrek Wichman and Geoffrey Recktenwald (updated, 2014)

Date of Preparation
2014
Appendix A – Course Syllabi

Course alpha, number, title
Course syllabus

Required or elective
Required

Course (catalog) description

Prerequisite(s)
(ME 332 or CE 321 or CHE 311) and ME 391

Textbook(s)

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
a. Basic Concepts of Heat Transfer
b. Heat Conduction
c. 1-D Steady State Solutions to Conduction
d. Thermal Resistance Networks
e. Extended Surfaces (Fins)
f. Steady State Solutions of Multi-Dimensional Problems
g. Transient 1-D and Multidimensional Solutions
h. Introduction to Convection
i. Forced Convection Correlations
j. Natural Convection Correlations
k. Fundamental Principles of Radiation Heat Transfer
l. Elementary Radiation Exchange Between Surfaces

Course learning Objectives
Upon successful completion of this course, students can:

1. Identify appropriate use of the conduction, convection and radiation rate equations.
   [L: comprehension, analysis] [M: examinations, homework]
2. Use the conservation of energy to solve problems.
   [L: analysis, evaluation] [M: examinations, homework]
3. Solve 1D steady-state heat conduction problems by developing and using thermal resistance networks and by using the 1-D heat equation; solve problems involving extended surfaces.
   [L: analysis, evaluation] [M: examinations, homework]
4. Solve simple 2D steady-state heat conduction problems.
   [L: analysis, evaluation] [M: homework]
5. Solve simple transient heat conduction problems using the lumped capacitance method, approximate methods where spatial effects are important, and the error function solution for conduction in a semi-infinite medium.
   [L: analysis, evaluation] [M: examinations, homework]
6. Calculate the convection heat transfer coefficients for forced and natural convection, for both internal and external flows.
   [L: analysis, evaluation] [M: examinations, homework]
7. Calculate convective heat transfer rates for forced and natural convection, for both external and internal flows.
   [L: analysis, evaluation] [M: examinations, homework]
8. Determine blackbody radiant power, and the properties of emissivity, absorptivity and transmissivity.
   [L: comprehension, evaluation] [M: examinations, homework]
9. Calculate appropriate view factors, calculate the radiosity, and compute simple radiation exchange for gray surfaces.
   [L: analysis, evaluation] [M: examinations, homework]
### Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **2 = Strong Emphasis**, **1 = Some Emphasis**, **0 = Little or No Emphasis**.

1. **(a)** an ability to apply knowledge of mathematics, science, and engineering — **2**
2. **(b)** an ability to design and conduct experiments, as well as to analyze and interpret data — **0**
3. **(c)** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability — **0**
4. **(d)** an ability to function on multidisciplinary teams — **0**
5. **(e)** an ability to identify, formulate, and solve engineering problems — **2**
6. **(f)** an understanding of professional and ethical responsibility — **0**
7. **(g)** an ability to communicate effectively — **0**
8. **(h)** the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — **1**
9. **(i)** a recognition of the need for and the ability to engage in life-long learning — **0**
10. **(j)** a knowledge of contemporary issues — **1**
11. **(k)** an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — **1**

### Contribution to professional component:

100% Engineering Science

### Person(s) who prepared this description

- Neil Wright and André Bénard
- Rebecca Anthony (3 June 2016)

### Date of Preparation

2016
Appendix A – Course Syllabi

Course alpha, number, title: ME 412 Heat Transfer Laboratory

Required or elective: Required

Course (catalog) description: Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.

Prerequisite(s): (ME 410) and completion of Tier I writing requirement.


Class/Lab schedule: Total Credits: 2 Lecture/Laboratory/Discussion Hours: 1/2/0

Topics covered:
1. Laboratory Introduction
2. Thermocouple Fabrication and Calibration
3. Error Estimation
4. Measurements in Conduction Heat Transfer
5. Introduction to Infrared Thermography
6. Heat Exchanger Measurements
7. Developing a Forced Convection Correlation
8. Introduction to Power Plant Operations
9. Survey of Industrial Chilled Water Facility
10. Thermal Design Project

Course learning objectives:

Upon successful completion of this course, students can:

1. fabricate thermocouples and use them to measure temperature transients [L: Application] [M: Laboratory Report]
2. distinguish systematic and random errors and calculate uncertainty in compound measurements [L: Analysis, Evaluation] [M: Laboratory Report]
3. apply Fourier’s Law in the measurement of conductivity [L: Analysis, Evaluation] [M: Laboratory Report]
4. measure temperature using IR thermography while identifying and correcting for several sources of error [L: Analysis, Evaluation] [M: Laboratory Report]
5. analyze performance from measurements of a cross-flow heat exchanger [L: Analysis, Evaluation] [M: Laboratory Report]
6. find the constants for a forced convection correlation from measurements [L: Analysis, Evaluation] [M: Laboratory Report]
7. design, build, and test a device to accomplish a specified heat transfer task [L: Synthesis, Evaluation] [M: Report and Design Day Presentation]

Key: L = Level of Learning, M = Method of Measurement

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering — 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data — 2
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability — 2
(d) an ability to function on multidisciplinary teams — 1
(e) an ability to identify, formulate, and solve engineering problems — 1

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Appendix A – Course Syllabi

(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively — 2
(h) the broad education necessary to understand the impact of engineering solutions in a
global, economic, environmental, and societal context — 1
(i) a recognition of the need for and the ability to engage in life-long learning — 1
(j) a knowledge of contemporary issues — 1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
engineering practice—2

Contribution to
professional component: 50% Engineering Science; 50% Engineering Design

Person(s) who prepared this description Neil Wright and André Bénard

Date of Preparation 2015
## ME 416 Computer Assisted Design of Thermal Systems

### Required or elective
Elective

### Course (catalog) description
Classifying, cataloging and processing design information. Modeling of thermal and fluid equipment. Simulation and optimization of thermal systems. Computer based design projects.

### Prerequisite(s)
(ME 410 or concurrently)

### Textbook(s) and/or other required material
Course web site at: http://www.egr.msu.edu/classes/me416/benard

### Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/2/0

### Topics covered
- a. Basic design evaluation and information
- b. Review of thermodynamic concepts
- c. Modeling thermal and fluid equipment (piping, HVAC, pumps, heat exchangers)
- d. Simulation and selection of thermos-fluid equipment
- f. Optimization by operating conditions and of component selection
- g. Introduction to the finite element method in heat transfer

### Course learning objectives

<table>
<thead>
<tr>
<th>1. Basic concepts of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Students are able to participate in and conduct brainstorming sessions</td>
</tr>
<tr>
<td>[L: Application] [M: Project report]</td>
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</tbody>
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<table>
<thead>
<tr>
<th>2. Thermodynamics property and basic concepts</th>
</tr>
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<tbody>
<tr>
<td>a. Students are able to determine thermodynamic properties using mathematical models</td>
</tr>
<tr>
<td>b. Students are able to represent design data in terms of curve fits</td>
</tr>
<tr>
<td>c. Students are able to solve basic thermodynamic problems for open systems</td>
</tr>
<tr>
<td>[L: Application] [M: Questions on quizzes, exams]</td>
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</tbody>
</table>

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<thead>
<tr>
<th>3. Optimization</th>
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<tbody>
<tr>
<td>a. Students are able to determine an appropriate cost function</td>
</tr>
<tr>
<td>b. Students are able to perform a simple optimization</td>
</tr>
<tr>
<td>[L: Application] [M: Questions on quizzes]</td>
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<table>
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<tr>
<th>4. Modeling and design of thermal equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Students are able to calculate the performance of turbomachinery</td>
</tr>
<tr>
<td>b. Students are able to calculate the performance of heat exchangers</td>
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<tr>
<td>c. Students are able to make equipment selection decisions</td>
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<tr>
<td>d. Students are able to design a heat exchanger</td>
</tr>
<tr>
<td>e. Students are able to design piping systems</td>
</tr>
<tr>
<td>[L: Synthesis] [M: Project report]</td>
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<tr>
<th>5. Engineering Economics</th>
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<tbody>
<tr>
<td>a. Students are able to understand the time value of money</td>
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<tr>
<td>b. Students are able to perform a present worth analysis</td>
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<tr>
<td>[L: Application] [M: Questions on quizzes]</td>
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<tr>
<th>6. System Design and simulation</th>
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</thead>
<tbody>
<tr>
<td>a. Students are able to calculate heating and cooling loads</td>
</tr>
<tr>
<td>b. Students are able to calculate state and system parameters for thermal systems</td>
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<tr>
<td>c. Students are able to design the operating conditions for a thermal system</td>
</tr>
<tr>
<td>d. Students are able to understand the interaction between equipment selection and system performance</td>
</tr>
<tr>
<td>[L: Synthesis] [M: Questions on quizzes, exams]</td>
</tr>
</tbody>
</table>
7. Computer Skills and Software Usage
   a. Students are able to write computer programs for basic thermal system analysis
   b. Students are able to use various computer software for thermos-fluid systems
   c. [L: Analysis] [M: Project report ]

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—2
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2

Contribution to professional component:
30% Engineering Science 70% Engineering Design

Person(s) who prepared this description
Andre Benard

Date of Preparation
2016
Course alpha, number, title | ME 417 Design of Alternative Energy Systems
---|---
Required or elective | Elective
Course (catalog) description | Analysis of alternative energy systems, including ocean, wind, fuel cells, solar, and nuclear. Predictive models for the systems. Design studies.
Prerequisite(s) | ME 410 or concurrently
Textbook(s) and/or other required material | Class notes. Course web site (http://www.egr.msu.edu/classes/me417/benard).
Class/Lab schedule: | Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0
Topics covered | 1. Sociological, Political and Economic Aspects of Alternative Energy Sources
2. Review of basic thermal sciences and economic analysis
3. Fuel Cells
4. Wind Energy
5. Geothermal Energy
6. Ocean Energy
7. Solar Energy
8. Nuclear Energy
9. Biomass Energy
10. Energy Storage
Course learning objectives | 1. Students will develop and practice design skills as they apply to alternative energy systems.
[L: Application] [M: Project report]
2. Students will learn how to use simple models to predict the behavior of alternative energy systems and can use these models to design such systems.
[L: Application] [M: Question in Exams/Quizes]
3. Students will gain an understanding of the social, political, and economic aspects of alternative energy sources.
[L: Application] [M: Project report]
Relationship of course to ME program outcomes | The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2
(d) an ability to function on multidisciplinary teams—2
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2
## Appendix A – Course Syllabi

### Contribution to professional component:

<table>
<thead>
<tr>
<th>Engineering Science</th>
<th>Engineering Design</th>
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</thead>
<tbody>
<tr>
<td>30%</td>
<td>70%</td>
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### Person(s) who prepared this description

Craig Somerton and Andre Bénard

### Date of Preparation

2011, updated 2014
### Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 422 Introduction to Combustion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ME 332 or concurrently)</td>
</tr>
<tr>
<td>Class/Lab schedule:</td>
<td>Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0</td>
</tr>
<tr>
<td>Topics covered</td>
<td>a. Review of Thermodynamics</td>
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<td></td>
<td>b. Flame Temperature</td>
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<td></td>
<td>c. Chemical Kinetics</td>
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<td>d. Thermal Explosions</td>
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<td></td>
<td>e. Premixed Flames</td>
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<td></td>
<td>f. Diffusion Flames</td>
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<td>g. Applications (fires, engines, propulsion, military)</td>
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<td>h. Experimental Approach (diagnostics)</td>
</tr>
<tr>
<td></td>
<td>a. Solution of weekly problem sets.</td>
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<td>b. Attendance and participation in classroom lectures.</td>
</tr>
<tr>
<td>1. Automotive - Related Combustion Technology</td>
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<tr>
<td></td>
<td>a. Students understand IC engine combustion mechanisms.</td>
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<tr>
<td></td>
<td>b. Students understand elementary explosion theory.</td>
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<tr>
<td>2. Premixed Flame Combustion Technology</td>
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<tr>
<td></td>
<td>a. Students understand premixed flame analysis</td>
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<td></td>
<td>b. Students understand elementary premixed flame burner design and operation.</td>
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<tr>
<td>3. Diffusion Flames in Industry and in Fire Safety</td>
<td></td>
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<tr>
<td></td>
<td>a. Students understand rudiments of diffusion flame theory</td>
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<td>b. Students understand spray combustion</td>
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<td></td>
<td>c. Students understand and learn the basic, most important processes of fire safety in terms of diffusion flames.</td>
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<tr>
<td>4. Computer Skills</td>
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<tr>
<td></td>
<td>a. Students can solve difficult exercises requiring (or at least aided by) computational methods of solution.</td>
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<td></td>
<td>b. Students can write programs in MATLAB and EXCEL with graph making, etc. for problem sets and the class report.</td>
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<tr>
<td>5. Analytical Skills</td>
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<tr>
<td></td>
<td>a. Students can detect simplified model problems,</td>
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<td></td>
<td>b. Students can perform simple dimensional analysis</td>
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<td></td>
<td>c. Students can solve simple differential equations and extract their physical meaning.</td>
</tr>
<tr>
<td>6. Project Engineering</td>
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</tr>
<tr>
<td></td>
<td>a. Students understand how to define a solvable term-project problem,</td>
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<td></td>
<td>A-29</td>
</tr>
</tbody>
</table>
b. Students can perform necessary background reading, literature searches, design and construction on the project of their choice.

<table>
<thead>
<tr>
<th>Relationship of course to ME program outcomes</th>
<th>Description</th>
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<td>(d) an ability to function on multidisciplinary teams—1</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems—2</td>
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<td>(f) an understanding of professional and ethical responsibility—1</td>
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<tr>
<td>(g) an ability to communicate effectively—2</td>
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<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0</td>
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<tr>
<td>(j) a knowledge of contemporary issues—0</td>
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<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2</td>
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</table>

<table>
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<tr>
<th>Contribution to professional component:</th>
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<tbody>
<tr>
<td>100% Engineering Science 0% Engineering Design</td>
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<table>
<thead>
<tr>
<th>Person(s) who prepared this description</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Tonghun Lee and Indrek S. Wichman</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Date of Preparation</th>
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<tbody>
<tr>
<td>2009, updated 2014</td>
<td></td>
</tr>
</tbody>
</table>
ME 423 Intermediate Mechanics of Deformable Solids

Required or elective: Elective

Course (catalog) description:

Prerequisite(s):
(ME 222)

Textbook(s) and/or other required material:

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
(a) Stress
(b) Strain
(c) Elastic behavior
(d) Plane stress
(e) Plane strain
(f) Yield criteria
(g) Unsymmetrical bending
(h) Torsion of prismatic bars

Course learning objectives:
The student shall be able to:
(1) Describe the significance of and write the following three-dimensional relations: strain-displacement, stress-strain, and static equilibrium.
[L: Analysis] [M: Homework Problems, Question in Exams]
(2) Explain the significance and demonstrate the use of compatibility relations and geometric and traction boundary conditions.
[L: Application] [M: Homework Problems, Question in Exams]
(3) Explain the differences between theory of elasticity and mechanics of materials approaches to predicting mechanical response.
[L: Application] [M: Homework Problems, Question in Exams]
(4) Determine three-dimensional stress states in common structural members, including beams, plates, spinning disks, and cylinders.
[L: Analysis] [M: Homework Problems, Question in Exams]
(5) Apply various failure criteria for ductile and brittle materials to predict failure in common engineering materials.
[L: Analysis, Application] [M: Homework Problems, Question in Exams]
(6) Solve general torsion, bending problems to determine the deflection, ultimate load and strains.
[L: Analysis, Application] [M: Homework Problems, Question in Exams]

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2
(d) an ability to function on multidisciplinary teams—1
Appendix A – Course Syllabi

(e) an ability to identify, formulate, and solve engineering problems — 3
(f) an understanding of professional and ethical responsibility — 2
(g) an ability to communicate effectively — 2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 1
(i) a recognition of the need for and the ability to engage in life-long learning — 2
(j) a knowledge of contemporary issues — 1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 2

Contribution to professional component: 100% Engineering Science

Person(s) who prepared this description: Xinran Xiao, Al Loos

Date of Preparation: 2014
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 425 Experimental Mechanics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Measurement of displacement, strain and motion. Strain gages, sensors, accelerometer, digital image correction and other measurement techniques. Data acquisition.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ME 222)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Experimental Solid Mechanics, A. Shukla, J.W. Dally, College House Enterprises. ISBN 0-9792581-8-9</td>
</tr>
<tr>
<td>Class/Lab schedule</td>
<td>Total Credits: 3 Lecture/Laboratory/Discussion Hours: 2/3/0</td>
</tr>
<tr>
<td>Topics covered</td>
<td>(a) Displacement, strain and stress (b) Electrical resistance strain gage (c) Strain gage circuit and instrumentation (d) Strain gage rosettes and analysis (e) Dynamic strain measurement (f) Basic optics (g) Digital image correlation (h) Data acquisition (i) Accelerometer (j) Sensors</td>
</tr>
<tr>
<td>Course learning objectives</td>
<td>The student will be able to:</td>
</tr>
<tr>
<td></td>
<td>1. Explain the physical phenomena that are the basis of methods of experimental mechanics, including strain gages, electrical resistance strain gage circuit and instrumentation, strain gage rosettes, accelerometers, digital image correlation. [L: Application] [M: Lab Report, Question in Exams]</td>
</tr>
<tr>
<td></td>
<td>2. Describe experimental set-up and procedures [L: Application] [M: Lab Report]</td>
</tr>
<tr>
<td></td>
<td>3. Utilize strain gages and associated instrumentation to measure strains and motion; present the results in graphs, charts and tables. [L: Application, Synthesis] [M: Lab Report]</td>
</tr>
<tr>
<td></td>
<td>4. Verify the measurements with theoretical solutions [L: Analysis, Evaluation] [M: Lab Report]</td>
</tr>
<tr>
<td></td>
<td>5. Write lab reports, analyze and interpret the results, and evaluate the experimental method. [L: Synthesis, Evaluation] [M: Lab Report]</td>
</tr>
<tr>
<td></td>
<td>6. Design devices with sensors and set-up data acquisition [L: Application] [M: Term Project]</td>
</tr>
<tr>
<td>Key</td>
<td>L – Level of Learning, M – Method of Measurement</td>
</tr>
</tbody>
</table>

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 2 = Strong Emphasis
- 1 = Some Emphasis
- 0 = Little or No Emphasis

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—2
Appendix A – Course Syllabi

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—0
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

Contribution to professional component: 70% Engineering Science 30% Engineering Design

Person(s) who prepared this description: Xinran Xiao, and Dahsin Liu

Date of Preparation: 2014
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 426 Introduction to Composite Materials</th>
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<tbody>
<tr>
<td>Required or elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ME 222)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Stress Analysis of Fiber-Reinforced Composite Materials (Updated Edition) by Michael W. Hyer, DEStech Publications, Inc., 2009.</td>
</tr>
</tbody>
</table>

**Class/Lab schedule**

Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

**Topics covered**

- (a) Introduction
- (b) Fibers and Matrices
- (c) Microstructure
- (d) Mechanics of Composite Materials
- (e) Anisotropy and Laminate Theory
- (f) Micromechanics and Interface
- (g) Strength and fracture
- (h) Thermal Response
- (i) Fabrication Techniques
- (j) Composite Designs

**Course learning objectives**

The student shall be able to:

1. identify the advantages and disadvantages of using fiber-reinforced composite materials,
   [L: Knowledge] [M: Question in Exams]
2. analyze structures made of different materials based on elementary strength of materials
   [L: Analysis] [M: Question in Homework, Question in Exams]
3. determine the anisotropic engineering constants of fiber-reinforced composite materials,
   [L: Application] [M: Question in Homework, Question in Exams]
4. find the stress distribution in layered composites based on classical laminate theory,
   [L: Analysis] [M: Question in Homework, Question in Exams]
5. integrate stress analysis with a failure criterion for damage analysis,
   [L: Synthesis] [M: Question in Homework, Question in Exams]
6. design engineering structures with composite materials with minimum confidence,
   [L: Synthesis] [M: Question in Homework, Question in Exams]
7. explain the effects of processing techniques on the properties of composite materials.
   [L: Evaluation] [M: Question in Homework, Question in Exams]

Key: L – Level of Learning, M – Method of Measurement

**Relationship of course to ME program outcomes**

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
- (a) an ability to apply knowledge of mathematics, science, and engineering—2
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health
Appendix A – Course Syllabi

and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a
global, economic, environmental, and societal context —0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
engineering practice—1

Contribution to
professional
component:

90% Engineering Science 10% Engineering Design

Person(s) who
prepared this
description

Alfred Loos (original 2009)
Alfred Loos and Dahsin Liu (updated 2014)

Date of
Preparation

2014
Course alpha, number, title: ME 440 Aerospace Engineering Fundamentals

Required or elective: Elective

Course (catalog) description: Aerodynamics, propulsion, air breathing engine ideal and real cycle analysis, propulsion engine performance and design characteristics.

Prerequisite(s): ME 201 and ME 332 or concurrently

Textbook(s) and/or other required material: Class Notes

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
- a. 1-D Compressible flow aerodynamics
- b. Air breathing Propulsion Cycles Basics
- c. Turboprop, Turbojet, Turbofan, Ducted Fan & Ramjet
- d. Diffusers & Nozzles
- e. Propulsion: Performance & Analysis
- f. Engine selection

Course learning objectives:
Upon successful completion of this course, students can:
1. Develop an understanding of how an air-breathing propulsion engine produces thrust.
   [L: Application] [M: Question in Exams]
2. Apply basic thermo-fluid laws to determine engine cycle analysis and to components energy transfer and transformation calculations.
   [L: Application] [M: Question in Exams]
   [L: Application] [M: Question in Homework & Exams]
4. Develop basic skill in propulsion-engine cycle analysis, performance estimation and engine selection.
   [L: Application] [M: Question in Homework, & Exams]
5. Perform preliminary aerodynamic engine design.
   [L: Synthesis, Evaluation] [M: Question in Homework, & Exams]
6. Enhance engineering problem solving skills.
   [L: Synthesis, Evaluation] [M: Question in Homework, & Exams]
7. Improve design skills in thermal systems.
   [L: Synthesis, Evaluation] [M: Question in Homework, & Exams]

Key: L – Level of Learning, M – Method of Measurement

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1

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(f) an understanding of professional and ethical responsibility—1  
(g) an ability to communicate effectively—2  
(h) the broad education necessary to understand the impact of engineering solutions in a  
   global, economic, environmental, and societal context —0  
(i) a recognition of the need for and the ability to engage in lifelong learning—0  
(j) a knowledge of contemporary issues—0  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for  
   engineering practice—1

<table>
<thead>
<tr>
<th>Contribution to professional component:</th>
<th>75% Engineering Science 25% Engineering Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person(s) who prepared this description</td>
<td>Abraham Engeda</td>
</tr>
<tr>
<td>Date of Preparation</td>
<td>2014</td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

Course alpha, number, title
ME 442 Turbomachinery

Required or elective
Elective

Course (catalog) description
Applying energy, momentum, and continuity equations of thermo-fluids to turbomachinery. Blade geometry and aerodynamics. Performance and design parameters. Turbomachine design.

Prerequisite(s)
(ME 332)

Textbook(s) and/or other required material

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
a. Continuity & Momentum Equation
b. Energy Equation
c. Centrifugal Pumps
d. Blade Geometry
e. Performance Parameters
f. Velocity Triangles
g. Design Procedures
h. Water Turbines
i. Wind Turbines
j. One D Compressible Flow
k. Centrifugal Compressor
l. Axial Flow Gas Turbine

Course learning objectives
To provide students with the understanding of the thermo-fluids theory dealing with energy transfer and transformation in turbomachines, and to develop basic analysis and design experience.

Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering — 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data — 0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability — 1
(d) an ability to function on multidisciplinary teams — 1
(e) an ability to identify, formulate, and solve engineering problems — 1
(f) an understanding of professional and ethical responsibility — 1
(g) an ability to communicate effectively — 1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 0
(i) a recognition of the need for and the ability to engage in life-long learning — 0
(j) a knowledge of contemporary issues — 0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 1

Contribution to professional component:
55% Engineering Science 45% Engineering Design

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Appendix A – Course Syllabi

Person(s) who prepared this description
Norbert Mueller and Abraham Engeda

Date of Preparation
2010, updated 2014
Appendix A – Course Syllabi

Course alpha, number, title: ME 444 Automotive Engines

Required or elective: Elective

Course (catalog) description: Design and development of internal and external combustion engines for vehicular propulsion.

Prerequisite(s): (ME 410 or concurrently)

Textbook(s) and/or other required material: Introduction to Internal Combustion Engines Third Edition Society of Automotive Engineers
Author: Richard Stone

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:

a. Power Cycle Thermodynamics, Mixtures and Solutions
b. Power Plants for Automobiles
c. Piston Engine Components and Electronic Controls
d. Engine Tribology (Friction, Lubrication and Wear)
e. Engine Modeling
f. Engine Vibration and Balance
g. Fuels and Combustion
h. Engine Exhaust Emissions
k. Engine Manufacturing

Course learning objectives:

1.1 Reciprocating Engine fundamentals (major topic). Students have the ability to identify reciprocating engine components including crankshafts, rods, pistons, camshafts, ring pack cylinder heads, intake exhaust manifolds, valve train, fueling system and ignition system. Demonstrate knowledge of the basic design parameters of each of these elements.

1.2 Cycle Analysis. Students can demonstrate knowledge of detail of Otto and Diesel, two and four stroke cycles. Specific emphasis on thermodynamic descriptions of air-standard cycles and knowledge of the differences, which exist between air-standard and real cycles, is discussed. Performance/emission tradeoffs between different engine types.

1.3 Modeling of Engine Thermal-Fluid/Mechanical Processes. Students exhibit a knowledge of the alternatives available to study the detailed processes occurring in an I.C. engine including one-dimensional models and multi-dimensional models of manifold events, in-cylinder processes, turbulence modeling and cylinder-kit analysis (piston, rod, pistons) and vibration analysis.

1.4 Engine Selection(including hybrid concepts), Sizing, Design to Application and Diagnostics. Students exhibit knowledge of functions that influence engine performance including speed, torque, displacement, imep, bmep, bsfc and power-to-weight ratio.

1.5 Environmental considerations and conventional power plant alternatives including emissions, hybrid electric/hydraulic vehicles and fuel cells. Students exhibit knowledge of automotive emissions, emission control system, EPA regulatory system including highway and urban test cycles, global conservation issues and petroleum economics. Significant understanding of current catalytic converter systems and the engine controls associate with those systems. Well-to-wheel efficiency concept is examined.
Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering — 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data — 0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability — 1
(d) an ability to function on multidisciplinary teams — 0
(e) an ability to identify, formulate, and solve engineering problems — 0
(f) an understanding of professional and ethical responsibility — 1
(g) an ability to communicate effectively — 0
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 0
(i) a recognition of the need for and the ability to engage in life-long learning — 0
(j) a knowledge of contemporary issues — 0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 1

Contribution to professional component:

75% Engineering Science, 25% Engineering Design

Person(s) who prepared this description

Harold Schock

Date of Preparation

2010, updated 2014
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 445 Automotive Powertrain Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Design of powertrain systems including piston ring assembly, combustion and induction systems, and transmissions. Performance emission tradeoffs with emphasis on emission control. Detailed design study required.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ME 444)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Introduction to Internal Combustion Engines Third Edition Society of Automotive Engineers Author: Richard Stone</td>
</tr>
<tr>
<td>Class/Lab schedule</td>
<td>Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0</td>
</tr>
</tbody>
</table>
| Course learning objectives       | • Knowledge of basic engine operating principles and definition of performance parameters.  
• Detailed understanding of engine valvetrain design and valve timing effects on performance, fuel efficiency, and emissions tradeoffs. Variable Valve Timing (VVT) schemes.  
• Intake and Exhaust System Tuning Methods for commercial and racing applications; Helmholtz Resonator Theory. Effects of engine design parameters and operating conditions on performance and fuel efficiency.  
• Quasi-One-Dimensional Modeling theory and application. – learn and apply a commercial CAE code to optimize IC engine tuning and cam phasing.  
• Develop written and oral technical presentation skills through homework and team semester projects involving application of practical CAE analysis tools.  
• Understanding of Variable Induction (VIS) and Exhaust (VES) System Design Alternatives  
• Knowledge of flow losses in engine intake and exhaust systems; Basic definitions and design parameters of importance. Develop ability to calculate pressure drop across real world intake and exhaust systems.  
• Modeling combustion and heat transfer. Knock and octane effects.  
• Basics and Modeling of Turbo- and Super-Chargers  
• Knowledge of induction and exhaust noise generation; Basic definitions of sound. Resonator and Muffler designs. |
### Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **2** = Strong Emphasis, **1** = Some Emphasis, **0** = Little or No Emphasis.

1. **(a)** an ability to apply knowledge of mathematics, science, and engineering—2
2. **(b)** an ability to design and conduct experiments, as well as to analyze and interpret data—0
3. **(c)** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
4. **(d)** an ability to function on multidisciplinary teams—1
5. **(e)** an ability to identify, formulate, and solve engineering problems—0
6. **(f)** an understanding of professional and ethical responsibility—1
7. **(g)** an ability to communicate effectively—2
8. **(h)** the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —0
9. **(i)** a recognition of the need for and the ability to engage in life-long learning—0
10. **(j)** a knowledge of contemporary issues—0
11. **(k)** an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

### Contribution to professional component:

- **40%** Engineering Science  **60%** Engineering Design

### Person(s) who prepared this description

James M. Novak

### Date of Preparation

2009, updated 2014
Appendix A – Course Syllabi

Course alpha, number, title

ME 451 Control Systems

Required or elective
Required

Course (catalog) description

Prerequisite(s)
(ME 361 and ECE 345) and completion of Tier I writing requirement.

Textbook(s) and/or other required material

Class/Lab schedule: Total Credits: 4 Lecture/Laboratory/Discussion Hours: 3/3/0

Topics covered
a. Mathematical Preliminaries
b. Laplace Transforms
c. Transfer Functions
d. Modeling of Dynamic Systems including components from:
e. Dynamic System Analysis
f. Dynamic System Response
g. Controller Design to meet time and frequency response specifications

Course learning objectives
1. Math Review: Students can
   a) obtain magnitudes and phase angles from complex numbers  
      [L:Analysis] [M: Question in Exams]
   b) use Laplace transforms to find system transfer function models  
      [L:Analysis] [M: Question in Exams]
2. Models of Physical Systems: Students can
   a) model coupled electromechanical systems  
      [L:Analysis] [M: Question in Exams]
   b) linearize non-linear input/output models about a non-zero operating point.  
      [L:Analysis] [M: Question in Exams]
3. System Time Response: Students can
   a) solve for 1st and 2nd order system time responses  
      [L:Analysis] [M: Question in Exams]
   b) analyze system systems for time response specifications: settling time, overshoot, rise time  
      [L:Analysis] [M: Question in Exams]
4. Control System Characteristics: From transfer function models, students can
   a) analyze system characteristics including
      i) Stability via root locus and Routh-Hurwitz  
      ii) Sensitivity to parameter variation
      iii) Disturbance Rejection and
      iv) Steady-State Accuracy  
      [L:Analysis, Evaluation] [M: Question in Exams]
   b) Root Locus analysis and design PID controllers to specifications for system time domain specifications  
      [L:Synthesis] [M: Question in Exams, Lab Report]
5. Frequency Response Analysis & Design: From transfer function models, students can
   a) solve for system frequency response from transfer functions  
      [L:Analysis] [M: Question in Exams, Lab Report]
Appendix A – Course Syllabi

b) sketch Bode diagrams for open loop frequency response function
   [L:Analysis] [M: Question in Exams]
c) determine gain and phase margin from a Bode diagram
   [L:Analysis] [M: Question in Exams]

6) Design: Students can design
   a) PID controllers from an open loop transfer function
   b) Lead and lag controllers from an open loop transfer function
   [L:Analysis,Synthesis] [M: Question in Exams, Lab Report]

Key: L – Level of Learning, M – Method of Measurement
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

\(2 = \text{Strong Emphasis}, 1 = \text{Some Emphasis}, 0 = \text{Little or No Emphasis}.

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—2
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

50% Engineering Science 50% Engineering Design

Clark Radcliffe and Jongeun Choi

2009, updated 2014
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 456 Mechatronic System Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Application of embedded microcontrollers to the design of mechatronic systems. Design of software and hardware for systems with mechanical, electrical and fluid components plus embedded control systems. Laboratory exercises and design projects. Application to automotive, consumer and commercial systems.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ECE 345 and ME 451 or concurrently)</td>
</tr>
</tbody>
</table>
| Textbook(s) and/or other required material | Course kit prepared for MSU including electronic parts and (2) texts; *What's a Microcontroller?* and *Robotics!*

**Class/Lab schedule:** Total Credits: 3 Lecture/Laboratory/Discussion Hours: 2/6/0

**Topics covered**
- a. What's a microcontroller?
- b. Controlling and Detecting the Outside World
- c. Micro-controlled Movement
- d. Simple Automation
- e. Transducers, Displays & Data Logging
- f. Sensors: Light, Conductivity
- g. Actuator: DC Motor Drive
- h. Measurement and Control: PID Control and Autonomous Robot Control
- i. (2) design projects: individual, and team, of increasing complexity

**Course learning objectives**
- Students can:
  - a. Understand current and potential applications of mechatronic designs.
  - b. Understand the interfacing of embedded controllers with common sensors and actuators.
  - c. Understand the use of digital I/O ports for mechatronic interfaces.
  - d. Understand the application tradeoffs between conventional and smart sensors.
  - e. Understand the tradeoffs between software and hardware solutions to design problems.
  - f. Conduct laboratory exercises to explore mechatronic system design.
  - g. Define, Generate and Test mechatronic designs to solve application problems.

**Relationship of course to ME program outcomes**

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

- (a) an ability to apply knowledge of mathematics, science, and engineering—2
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2
- (d) an ability to function on multidisciplinary teams—1
- (e) an ability to identify, formulate, and solve engineering problems—2
- (f) an understanding of professional and ethical responsibility—1
- (g) an ability to communicate effectively—2
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
- (i) a recognition of the need for and the ability to engage in life-long learning—0
- (j) a knowledge of contemporary issues—0
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

**Contribution to professional**

40% Engineering Science 60% Engineering Design
Appendix A – Course Syllabi

**component:**

<table>
<thead>
<tr>
<th>Person(s) who prepared this description</th>
<th>Clark Radcliffe</th>
</tr>
</thead>
<tbody>
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<td>Date of Preparation</td>
<td>2009, updated 2014</td>
</tr>
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</table>
Appendix A – Course Syllabi

Course alpha, number, title: ME 461 Mechanical Vibrations

Required or elective: Required

Course (catalog) description: Modeling and analysis of oscillatory phenomena found in linear discrete and continuous mechanical systems.

Prerequisite(s): (ME 451) and completion of Tier I writing requirement

Textbook(s) and/or other required material: Rao, S., Mechanical Vibrations, 4th edition, Prentice Hall, 2004.

Class/Lab schedule: Total Credits: 4 Lecture/Laboratory/Discussion Hours: 3/3/0

Topics covered:
- a. Modeling of Systems
- b. Analysis of One DOF Systems
- c. Analysis of Multi DOF Systems
- d. Continuous Systems
- e. Laboratory Experiments
- f. Modal Analysis

Course learning objectives:

1. Mathematical Modeling of Dynamical Systems
   (a) Students can identify the frequency, period, and amplitude of an oscillatory signal.
   (b) Students can express a periodic function in terms of a Fourier series.
   (c) Students can identify the mass, stiffness, and damping elements of a vibration system.
   (d) Students can model a vibration system by incorporating the elements of a vibration system into a free-body diagram.
   (e) Students can apply Newton's second law to obtain the differential equations of motion.

2. Solution of and Physical Interpretation of Ordinary Differential Equation Vibration Models
   (a) Students can compute and interpret the natural frequency and damping ratio.
   (b) Students can determine the free responses of single-degree-of-freedom systems due to initial conditions for damped and undamped systems.
   (c) Students can determine the forced responses of single-degree-of-freedom systems under direct excitation, base excitation, and rotating imbalance.
   (d) Students can determine the free and forced responses of two-degree-of-freedom systems.
   (e) Students can determine the free and forced responses of multiple-degree-of-freedom systems.
   (f) Students can compute mode shapes and natural frequencies.
   (g) Students can decouple a coupled multi-degree-of-freedom systems by using properties of linear normal modes.
   (h) Students can design vibration absorbers (torsional and translational).
   (i) Students can design for vibration isolation.
   (j) Students can understand the principles of accelerometers.

4. Computer Skills
   (a) Students can use Matlab for eigenvalue/vector analysis.
   (b) Students can use Matlab for linear algebra problems.

5. Communication Skills
   (a) Students can write a technical report.
Appendix A – Course Syllabi

(b) Students can analyze, interpret and discuss experimental results.
(c) Students can write an executive summary of a laboratory experiment.

6. General Laboratory Skills
(a) Students can perform digital data acquisition.
(b) Students can use and identify limitations of FFT algorithms.
(c) Students can take appropriate measures to avoid aliasing and leakage.
(d) Students can design, perform, and interpret data from an experiment.
(e) Students can use experiments to validate theory.

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—2
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2

80% Engineering Science 20% Engineering Design

Scott Kiefer and Brian Feeny

2009, updated 2014
Appendix A – Course Syllabi

Course alpha, number, title

ME 464 Intermediate Dynamics

Required or elective

Elective

Course (catalog) description


Prerequisite(s)

(ME 361)

Textbook(s) and/or other required material


Class/Lab schedule:

Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered

(a) Three-dimensional kinematics
(b) Newtonian dynamics of particles and systems of particles
(c) Dynamics of rigid bodies in two and three dimensions
(d) Euler equations
(e) Virtual work
(f) Lagrange method
(g) Applications to dynamics of machinery
(h) Applications to rotor balancing
(i) Applications to vehicle dynamics
(j) Applications to satellite dynamics

Course learning objectives

Upon successful completion of this course, students can:

(1) identify the forces acting on a system by the environment and draw a correct free body diagram
   [L: Application, Analysis] [M: Questions in HW and Exams]
(2) apply Newton/Euler laws and Lagrangian methods to derive the equations of motion for a system model
   [L: Application, Analysis] [M: Questions in HW and Exams]
(3) analyze the equations and obtain solutions analytically when possible
   [L: Application, Analysis] [M: Questions in HW and Exams]
(4) find solutions of equations of motion by numerical methods and interpret results
   [L: Application, Evaluation] [M: Questions in HW]
(5) examine the results from solutions of equations of motion and explain the implications for stability, dynamic loads, and other design issues
   [L: Application, Synthesis, Evaluation] [M: Questions in HW and Exams]
(6) make reasonable assumptions to simplify a mechanical system to the degree that it can be modeled by the principles of dynamics
   [L: Application, Analysis, Evaluation] [M: Questions in HW]

Key: [L – Level of Learning] [M – Method of Measurement; HW=homework]
### Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **2** = Strong Emphasis
- **1** = Some Emphasis
- **0** = Little or No Emphasis

<table>
<thead>
<tr>
<th>Course Outcome Description</th>
<th>Emphasis Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td>2</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>0</td>
</tr>
<tr>
<td>(c) an ability to design a system, component, or process to meet desired needs within</td>
<td>1</td>
</tr>
<tr>
<td>realistic constraints such as economic, environmental, social, political, ethical, health</td>
<td></td>
</tr>
<tr>
<td>and safety, manufacturability, and sustainability</td>
<td></td>
</tr>
<tr>
<td>(d) an ability to function on multidisciplinary teams</td>
<td>0</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td>2</td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td>1</td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>1</td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a</td>
<td>0</td>
</tr>
<tr>
<td>global, economic, environmental, and societal context</td>
<td></td>
</tr>
<tr>
<td>(i) a recognition of the need for and the ability to engage in life-long learning</td>
<td>0</td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td>0</td>
</tr>
<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for</td>
<td>2</td>
</tr>
<tr>
<td>engineering practice</td>
<td></td>
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</tbody>
</table>

### Contribution to professional component:

- 70% Engineering Science
- 30% Engineering Design

### Person(s) who prepared this description

Steve Shaw

### Date of Preparation

2010, updated 2014
Appendix A – Course Syllabi

Course alpha, number, title: ME 465 Computer Aided Optimal Design

Required or elective: Elective


Prerequisite(s): (ME 471 or concurrently)

Textbook(s) and/or other required material: J. Arora, *Introduction to Optimum Design* Elsevier Inc., 2004 (recommended only)

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:

j. Formulation of the Optimal Design Problem
k. Design Variables, Objective Functions
l. Constraints, Constraint Activity
m. Optimality Conditions
n. Post Optimality Analysis
o. Optimization Using Surrogate Models
p. Basic Algorithms for Optimization
q. Optimization Software

Course learning objectives:

1. Develop an operational understanding of the mathematical theory of optimization and its application in optimal design of mechanical and structural components.
2. Ability to model engineering problems in a form that is suitable for optimization.
3. Ability to apply modern computer assisted tools for optimal design to engineering design problems.
4. Ability to communicate technical information through the preparation of technical memoranda, briefs, and reports.

Relationship of course to ME program outcomes:

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2
| **Contribution to professional component:** | 33% Engineering Science 67% Engineering Design |
| **Person(s) who prepared this description** | Alejandro Diaz and Ronald Averill |
| **Date of Preparation** | 2009, updated 2014 |
Appendix A – Course Syllabi

Course alpha, number, title: ME 471 Mechanical Design II

Required or elective: Required

Course (catalog) description: Engineering design of machine elements and mechanical systems. Computer-based analysis in support of design. Design for static and fatigue strength, deflection, and reliability.

Prerequisite(s): ME 371 and ME 391 and ME 222


Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered:
a. Design Methodology and completion of a Design Test Build project
b. Stress Analysis
c. Design for Deflection and Stiffness
d. Materials and their Properties
e. Finite Element Analysis
f. Design for Static Strength
g. Design for Fatigue Strength
h. Optimal Design Methods
i. Design of Machine Components
j. Shaft, Axle and Spindle Design

Course learning objectives:

1. Apply stress and deflection analysis to design beams, shafts and axles
   [L: Application] [M: Question in Exams]
2. Apply failure theories to determine the strength of mechanical components
   [L: Application] [M: Question in Exams]
3. Apply concepts of fatigue to determine the life of mechanical components
   [L: Application] [M: Question in Homework]
4. Analyze the stress and deflection of a mechanical system using finite element analysis software and verify the solution using hand calculations
   [L: Analysis, Evaluation] [M: Finite Element Project Report]
5. Design, build and test a mechanical system as part of a design team. This includes completing all the steps in product development – developing product specifications; applying project planning and time management; completing concept generation; analyzing and critiquing design alternatives; optimizing designs with respect to performance, cost, weight, and manufacturability; building and testing a prototype
6. Produce a design report as part of a design team. This report will document the activities performed in the mechanical design process, justify design decisions and recommend future design improvements
7. Demonstrate and defend a mechanical design prototype as part of a design team
   [L: Synthesis, Evaluation] [M: Design Day Presentation]

Key: L – Level of Learning, M – Method of Measurement

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within
realistic constraints such as economic, environmental, social, political, ethical, health
and safety, manufacturability, and sustainability—2
(d) an ability to function on multidisciplinary teams—2
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a
  global, economic, environmental, and societal context —0
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
  engineering practice—2

Contribution to
professional
component: 33% Engineering Science 67% Engineering Design

Person(s) who
prepared this
description Scott Kiefer and Farhang Pourboghrat (original, 2009)
Ron Averill and Alex Diaz (updated, 2014)

Date of
Preparation 2014
Appendix A – Course Syllabi

Course alpha, number, title
ME 475 Computer Aided Design of Structures

Required or elective
Elective

Course (catalog) description
Computational methods for analysis, design, and optimization of structural components. Basic concepts in geometric modeling, finite element analysis, and structural optimization.

Prerequisite(s)
(ME 471 or concurrently)

Textbook(s) and/or other required material
A First Course in the Finite Element Method by, Daryl L Logan. 3rd Edition (recommended)

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 2/2/0

Topics covered
a. Geometric Modeling
b. Typical Engineering Structures
c. Finite Element Models
d. Finite Element Data Structures
e. Frames and Support Structures
f. Modeling of Thin Structures
g. Reinforcements of Thin Struct.
h. Design Optimization Modeling
i. Structural Design Variables

Course learning objectives
1. Understanding of the finite element method and its use in design of simple structures found in typical engineering applications.
2. Ability to use modern computer assisted geometric modeling, analysis, and design with tools used in standard practice in the industry.
3. Ability to use these tools through case studies in design of simple structural components.
4. Ability to communicate technical information through the preparation of technical memoranda, briefs, and reports.
5. Understanding of the theory and practice of optimization of structural components, including optimal sizing of components, and shape and layout design optimization.

Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2

Contribution to professional
33% Engineering Science 67% Engineering Design

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Appendix A – Course Syllabi

component:

Person(s) who prepared this description: Ronald Averill

Date of Preparation: 2010, updated 2014
Appendix A – Course Syllabi

Course alpha, number, title
ME 477 Manufacturing Processes

Required or elective
Elective

Course (catalog) description
Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining, and surface processing. Selection of manufacturing processes based on design and materials.

Prerequisite(s)
(ME 222 and MSE 250) and completion of Tier I writing requirement.

Textbook(s) and/or other required material

Class/Lab schedule:
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
(a) Materials and Physical Properties
(b) Casting
(c) Material removal
(d) Material fastening
(e) Metal forming
(f) Sheet metal fabrication
(g) Joining processes
(h) Surface technology
(i) Non-traditional manufacturing
(j) Environmentally-sensitive engineering
(k) Concurrent product development
(l) Evaluation of alternative concepts: decision theory

Course learning objectives
The student shall be able to
(1) Use knowledge from materials science and engineering design to address manufacturing problems.
(2) Explain the relationships among microstructure, properties and manufacturing processes.
(3) Select appropriate manufacturing processes based on design and material properties.
(4) Understand the advantages and disadvantages of using various processing techniques.

Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—1
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—2

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<table>
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<tr>
<th>Contribution to professional component:</th>
<th>Engineering Science, Engineering Design,</th>
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<tbody>
<tr>
<td>Person(s) who prepared this description</td>
<td>Brian Thompson</td>
</tr>
<tr>
<td>Date of Preparation</td>
<td>2009, updated 2014</td>
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</tbody>
</table>
Appendix A – Course Syllabi

Course alpha, number, title

ME 478 Product Development

Required or elective

Elective

Course (catalog) description

Simulation of industrial environment for product development. Product concept, design, and manufacturing.

Prerequisite(s)

(ME 477) and completion of Tier I writing requirement.

Textbook(s) and/or other required material

No Required Textbook

Class/Lab schedule:

Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered

(a) Individual Conceptual Design
(b) Computer aided design
(c) Manufacturing process
(d) Relationship between design and manufacturing
(e) Group Design and Manufacturing

Course learning objectives

Upon successful completion of this course, the student shall have:

1. An ability to design a system, component, or process to meet desired needs: for a term project: a product is focused in order to identify a variety of design and manufacturing processes
   [L: Application] [M: Project Report]

2. An ability to function on multi-disciplinary teams: the course is focused on various aspects of manufacturing; including a multi-disciplinary team from materials science and mechanical engineering
   [L: Application] [M: Project Report]

3. An ability to identify, formulate, and solve engineering problems: projects require solving new problems based on the fundamentals developed in class as well as other prerequisites; requires logical development and presentation of new solutions based on engineering background.
   [L: Application] [M: Project Report]

4. An understanding of professional and ethical responsibility: the consequences of failing to properly consider at various stages of manufacturing are discussed in a number of scenarios.
   [L: Application] [M: Project Report]

5. An ability to communicate effectively: the need for strong written and oral communications is reinforced with a term project: the broad education necessary to understand the impact of engineering solutions in a global and societal context: some manufacturing processes are presented with overall cost and benefit issues in a global and social context.
   [L: Application] [M: Project Report]

6. Recognition of the need for, and an ability to engage in life-long learning: students are encouraged to participate in the SME and ASME student chapters.
   [L: Application] [M: Project Report]

7. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice: calculators are used to make predictions using mathematical models. New developments in the topic related to manufacturing are introduced.
   [L: Application] [M: Project Report]

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—1
Appendix A – Course Syllabi

(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) recognition of the need for and the ability to engage in life-long learning—0
(j) knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2

Contribution to professional component: Engineering Design

Person(s) who prepared this description: Patrick Kwon

Date of Preparation: 2014
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ME 481 Mechanical Engineering Design Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Required</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(ME 410 and ME 471) and completion of Tier I Writing requirement</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Thompson, Creative Engineering Design, Okemos</td>
</tr>
<tr>
<td>Class/Lab schedule:</td>
<td>Total Credits: 3 Lecture/Laboratory/Discussion Hours: 1/4/2</td>
</tr>
<tr>
<td>Course learning objectives</td>
<td>Given a real world design projects students will be able to:&lt;br&gt;(a) define the problem&lt;br&gt;(b) specify function and develop constraints&lt;br&gt;(c) behave professionally with a client&lt;br&gt;(d) present written and oral progress reports&lt;br&gt;(e) create numerous potential solutions&lt;br&gt;(f) evaluate these solutions&lt;br&gt;(g) select the solution with the highest potential for success&lt;br&gt;(h) analyze this solution&lt;br&gt;(i) develop plans for creating/acquiring the parts&lt;br&gt;(j) manufacture and test the prototype&lt;br&gt;(k) write the final report and present the final oral and poster presentations</td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Relationship of course to ME program outcomes</th>
<th>The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:</th>
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<td>The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:</td>
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<td>(a) an ability to apply knowledge of mathematics, science, and engineering—2</td>
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<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1</td>
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</tr>
<tr>
<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2</td>
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<td>(d) an ability to function on multidisciplinary teams—2</td>
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<td>(e) an ability to identify, formulate, and solve engineering problems—2</td>
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</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility—2</td>
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<tr>
<td>(g) an ability to communicate effectively—2</td>
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</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1</td>
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</tr>
<tr>
<td>(i) a recognition of the need for and the ability to engage in life-long learning—2</td>
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<tr>
<td>(j) a knowledge of contemporary issues—1</td>
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<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2</td>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2</td>
</tr>
</tbody>
</table>

| Contribution to professional component: | 0% Engineering Science 100% Engineering Design |

| Person(s) who prepared this description | Craig Somerton |

| Date of Preparation | 2009, updated 2014 |
Course alpha, number, title
ME 489 Technical Communications for Engineers

Required or elective
Elective

Course (catalog) description
Investigation of technical communication in the engineering workplace. Drafting, revising, and editing communications directed at a variety of audiences. Includes team writing activities, presentations, style, and flow.

Prerequisite(s)
Junior in the College of Engineering

Textbook(s) and/or other required material
None

Class/Lab schedule:
Total Credits: 2 Lecture/Laboratory/Discussion Hours: 2/0/0

Topics covered
a. Audience in writing
b. Critical thinking in communication
c. The issue of grammar
d. Real world communication
e. Career communication
f. Flow and Structure
g. Presentation preparation
h. The elements of scientific writing
i. The language of communication
j. Ethics
k. Editing
l. The variety of writing styles

Course learning objectives
Upon successful completion of this course, students can:
1. Prepare papers directed at audiences of interested parties, peer audiences, and higher level of competence readers.
   [L: Application] [M: Audience directed papers]
2. Create a presentation to an audience of peers
   [L: Application] [M: Presentation]
3. Analyze papers written by others in class
   [L: Analysis] [M: Identify elements needing change in other’s written text]
4. Identify grammatical elements in text.
   [L: Knowledge, Evaluation] [M: Assess parts of speech in text]
5. Identify the elements of technical text
   [L: Synthesis, Evaluation] [M: Text evaluation, questions in exams]
6. Create text that follows specific structures in writing with elements of flow
   [L: Synthesis, Evaluation] [M: Semester project]
7. Demonstrate and defend ethical behavior
   [L: Synthesis, Evaluation] [M: In-class Presentation]

Key: L – Level of Learning, M – Method of Measurement

Relationship of course to ME program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—0
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
Appendix A – Course Syllabi

(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—2
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—2
(i) a recognition of the need for and the ability to engage in life-long learning—2
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—0

Contribution to professional component:

<table>
<thead>
<tr>
<th>% Engineering Science</th>
<th>% Engineering Design</th>
</tr>
</thead>
</table>

Person(s) who prepared this description
Craig Gunn

Date of Preparation
2014
Appendix A – Course Syllabi

**Course alpha, number, title**
ME 494 Biofluid Mechanics and Heat Transfer

**Required or elective**
Elective

**Course (catalog) description**
Applications of fluid mechanics, heat transfer, and thermodynamics to biological processes, including blood flow in the circulatory system, heart function, effects of heating and cooling on cells, tissues, and proteins. Pharmaco-kinetics.

**Prerequisite(s)**
(ME 410 or concurrently) or (CHE 311 or concurrently) or (BE 350 or concurrently)

**Textbook(s) and/or other required material**

**Class/Lab schedule:**
Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

**Topics covered**
- Work done by the heart
- Blood rheology and flow in the cardiovascular system
- Transport across capillary and cellular membranes
- Engineering analysis of the kidneys
- Thermodynamics analysis of cryopreservation
- Modeling of bio-heat transfer: environmental and internal (i.e., the Pennes Bioheat equation)
- Response of proteins, cells, & tissue to heating & cooling
- Modeling of Burns and Thermal therapies
- Pharmacokinetics, the absorption & elimination of drugs by the body

**Course learning objectives**
Upon successful completion of the course, students can:
- Apply an energy balance to biomedical systems and organs (e.g., the heart)
- Analyze pulsatile flow in the circulatory system using standard models
- Analyze basic flows in the system and determine wall shear stress
- Compute flows across membranes due to osmotic pressure and electropotential
- Predict the response of proteins and cells to hyperthermia
- Calculate heat transfer rates within the body and between the body and environment
- Calculate drug absorption and elimination in the body
- Propose, research, and analyze a (highly constrained) biotransport topic

**Relationship of course to ME program outcomes**
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical,
Appendix A – Course Syllabi

health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—0
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—0
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

Contribution to professional component: Engineering Science 100%.

Person(s) who prepared this description: Neil Wright

Date of Preparation: 2015
Appendix A – Course Syllabi

Course alpha, number, title  ME 495 Tissue Mechanics

Required or elective  Elective

Course (catalog) description  Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

Prerequisite(s)  (ME 222)

Textbook(s) and/or other required material  Mow & Hayes, Basic Orthopaedic Biomechanics

Class/Lab schedule:  Total Credits: 3  Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered
(a) Muscle/Force Systems
(b) Tendon/Ligament Models
(c) Cartilage Mechanics
(d) Physical Regulation of Soft Tissues
(e) Bone Biomechanics
(f) Mechanics of Fracture Fixation
(g) Mechanics of Artificial Joints

Course learning objectives  The student shall be able to:
(1) Develop statically determinate and indeterminate systems of forces representing a body joint and compute muscle forces,
(2) Be able to compute risks of injury to bones from simplified loading conditions and integrate effects of age, sex, etc.,
(3) Compute some basic properties of joint cartilage using a poroelastic approach,
(4) Determine the viscoelastic responses of ligaments and tendons using simple phenomenological models and hereditary integral formulations,
(5) Understand basic mechanical principles of bone fracture fixation techniques,
(6) Lean the basic technique of strain-adaptive-remodeling used in FEA models of bone remodeling around implants

Relationship of course to ME program outcomes  The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—0
(d) an ability to function on multidisciplinary teams—0
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—0
(g) an ability to communicate effectively—0
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
(i) a recognition of the need for and the ability to engage in life-long learning—0
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

Contribution to professional  Engineering Science 50% Basic Math & Science 50%
Appendix A – Course Syllabi

component:

<table>
<thead>
<tr>
<th>Person(s) who prepared this description</th>
<th>Roger C. Haut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Preparation</td>
<td>2009, updated 2014</td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

Course alpha, number, title: ME 497 Biomechanical Design

Required or elective: Elective

Course (catalog) description: Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.

Prerequisite(s): none

Textbook(s) and/or other required material: Ulrich and Eppinger, McGraw Hill, Product Design and Development, Fourth Edition

Class/Lab schedule: Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0

Topics covered: Lectures and product team coaching to instruct and illustrate topics that will prepare students to meet the course objectives. This course is taught concurrently with a marketing course that involves a marketing professor as instructor and product team coach and marketing students who work with engineering students on the product teams. Topics include market research, product conception, design, prototype development and presentation, and project management.

Course learning objectives:
1. Identify useful product ideas based on assessment of users’ needs.
2. Identify and evaluate product benefits from the users’ perspective.
3. Interpret product benefits to define desirable product attributes and features.
4. Design and build product prototypes that incorporate these product attributes.
5. Evaluate product performance with users.
6. Redesign and modify prototypes based on user feedback.
7. Present product prototype and market research with emphasis on selling to users.
8. Work effectively in team of engineering and business students.

Relationship of course to ME program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
2 = Strong Emphasis, 1 = Some Emphasis, 0 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—0
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—2
(d) an ability to function on multidisciplinary teams—2
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—2
(i) a recognition of the need for and the ability to engage in life-long learning—2
(j) a knowledge of contemporary issues—0
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2

Contribution to professional component: Engineering Science 50% Engineering Design 50%.

Person(s) who: Tamara Reid Bush

A-72
Appendix A – Course Syllabi

prepared this
description

Date of Preparations: 2009, updated 2014
### Appendix A – Course Syllabi

#### Appendix A – Course Syllabuses – Courses offered by other engineering departments

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>Required or elective</th>
<th>Course (catalog) description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 100, Introduction to Engineering Design</td>
<td>Required</td>
<td>Engineering design process as modeled by team-based, interdisciplinary design projects. Roles of engineers and the contributions of engineering in society. Project management, and design of products and processes to specified outcomes under specified constraints. Introduction to computing tools and physical equipment in support of engineering design. Engineering ethics.</td>
</tr>
</tbody>
</table>

#### Prerequisite(s)
(MTH 116 or concurrently) or (MTH 132 or concurrently) or (MTH 152H or concurrently) or (LBS 118 or concurrently)

#### Textbook(s) and/or other required material
The course is administered by the department of undergraduate studies. Introduction to Engineering Design, E Source Publication, Pearson Custom Publication

#### Course learning outcomes
Students will be able to implement an organized methodology in solving engineering design problems that are new and/or unfamiliar, and effectively communicate solutions to scientists, engineers, or laypersons by:
- Explaining the multi-step method for solving engineering design problems.
- Implementing the multi-step method for solving open-ended design problems (that are at an appropriate technical level).
- Utilizing computer tools to effectively present engineering data/analyses/designs.
- Clearly communicating (verbally and in writing) the solutions for simple design problems in formats suitable for either other technical professionals or laypersons, including detailed technical reports or brief business letters/memos.

Students will be able to function effectively on cross-functional design teams by:
- Defining the functional attributes of an effective work team.
- Describing the influence of individual personality traits on team dynamics.
- Completing a limited-scope design project as part of a team, and functioning as an effective team member.

Students will be able to explain the unique aspects of the engineering profession, its significance to society, its ethical framework, and career opportunities in this field by:
- Describing the unique role of engineers, as related to other technical and non-technical professionals and workers.
- Describing the unique aspects of the various engineering disciplines.
- Describing the range of specializations, job types, and career paths available to engineers.
- Describing the key principles that form the foundation of the Engineering Code of Ethics.

#### Topics covered
Engineering as a profession
Engineering design
Team management
Project management
Computing and engineering tools
Engineering ethics and professionalism
Career planning

#### Class/Lab schedule (number of sessions per week and Credits)
- Discussion: 1  
- Laboratory: 2  
- Credits: 2
Appendix A – Course Syllabi

duration of each session):

<table>
<thead>
<tr>
<th>Contribution of course to meeting the requirements of Criterion 5</th>
<th>Engineering Topics: The course contains engineering analysis, design and significant project component</th>
</tr>
</thead>
</table>

Relationship of course to program outcomes

- **A. Apply knowledge of math, science and engineering implementation** - the students during the course of the semester are required to write technical memos and reports in support of the two major design projects. In these memos and reports the students have present their reasoning behind their design.
- **B. Design and conduct experiments, analyze/interpret data** - the student teams (4-5/team) are engaged in two design experiences. As part of this the teams are required to develop prototype of their proposed design. Furthermore, the teams have to present the analysis results to in support of the prototype.
- **C. Design system, component, or process to meet needs within realistic constraints** - the design projects that the student teams work on during the course of the semester have to be done within the constraints of time, cost, materials, size and the capability of each team member.
- **D. Function on multi-disciplinary teams** - the project teams are truly multi-disciplinary. For example a team could have students who have declared Civil Engineering, Mechanical Engineering, Chemical Engineering and Engineering No-Pref.
- **E. Identify, formulate, and solve engineering problems** - the two design projects are engineering in nature. The students have to present the problem and the formulation needed to complete the project.
- **F. Professional and Ethical responsibilities** - there are formal presentations during the lecture hour on professional ethics, intellectual property issues, and plagiarism.
- **G. Communicate effectively** - the students are routinely submitting technical memos documenting the progress of the design projects. In addition to that each student team has to make an oral presentation in defense of their prototype.
- **J. Contemporary issues** - discussions about the Engineer of the future and the roles of an engineer in 2020.
- **K. Techniques, skills and tools for engineering practice** - significant use of MS office tools, other tools as needed to complete the design projects

Person(s) who prepared this description

W. Booth, Engr Dean  
T. Hinds (lead instructor) and N. Buch (director of the program)

Date of Preparation

2016-07-18
### Course alpha, number, title

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 102</td>
<td>Introduction to Engineering Modeling</td>
</tr>
</tbody>
</table>

### Required or elective
- Required

### Course (catalog) description
- Application of systematic approaches to engineering problems. Problem decomposition and identification of a solution approach. Solution using tools such as advanced spreadsheet features and MATLAB. Data representation, curve fitting and analysis. Mathematical modeling of engineering systems. Application of principles through team-based engineering projects.

### Prerequisite(s)
- (EGR 100 or concurrently) and ((MTH 132 or concurrently) or (MTH 152H or concurrently) or (LB 118 or concurrently))

### Textbook(s) and/or other required material
- Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven C. Chapra, McGraw Hill

### Course learning outcomes
- Students will be able to systematically solve engineering problems by:
  - Decomposing problems to determine solution approaches based on principles of mathematics and science
  - Developing appropriate algorithms to lead to a solution
  - Generating solutions using appropriate computational tools
  - Interpreting and communicating results

- Students will be able to write programs to solve engineering problems and model systems using a computational environment such as MATLAB.

- Students will be able to graphically portray two- and three-dimensional data in a meaningful manner and form conclusions and make recommendations from such graphical information, using both spreadsheets programs and advanced computational environments such as MATLAB.

### Topics covered
- Approaches to problem-solving, problem decomposition, estimation and problem synthesis
- Solutions of mathematical expressions and systems of equations in Excel and MATLAB
- Use of functions in MATLAB
- Data analysis and plotting in MATLAB and Excel
- Introduction to structured programming: sequential, conditional, and iterative control structures (e.g. looping and branching)
- Application of above in individual and team-based assignments.

### Class/Lab schedule
- Credits: 2  Discussion: 1  Laboratory: 3

### Contribution of course to meeting the requirements of Criterion 5
- Engineering Topics: The course contains only engineering analysis and a minor project component. There is no design.

### Relationship of course to program
- H. Apply knowledge of math, science and engineering implementation - the students are required to decompose and solve various classes of engineering problems as part of both lecture and laboratory assignments. They also use these skills to complete a team-
Appendix A – Course Syllabi

outcomes - based analysis and modeling project.

I. Design and conduct experiments, analyze/interpret data – individually, the students use numerical methods to analyze and interpret sets of data. Also, student teams (4-5/team) are engaged in one project consisting of modeling an engineering system and analyzing their results.

J. Design system, component, or process to meet needs within realistic constraints – as part of their lab project, the student teams are to model an engineering system and provide proposed operating conditions based on desired system outcomes.

K. Function on multi-disciplinary teams - the project teams are truly multi-disciplinary. For example, a team could have students who have declared Civil Engineering, Mechanical Engineering, Chemical Engineering and Engineering No-Pref.

L. Identify, formulate, and solve engineering problems - the students decompose and solve engineering problems both in lecture and in lab. They also develop a solution method and execute a solution for the team-based lab project.

G. Communicate effectively - the student teams prepare and submit a technical report of their lab project. They also prepare and submit progress statements for their project.

L. Use techniques, skills and tools for engineering practice – significant use of MS office tools and MATLAB programming tool as needed to complete individual and team-based lecture and lab assignments and project.

Person(s) who prepared this description

W. Booth, Engr Dean
T. Hinds (lead instructor) and N. Buch (director of the program)

Date of Preparation

2016-07-18
<table>
<thead>
<tr>
<th>COURSE ALPHA, NUMBER, AND TITLE</th>
<th>CE 221, Statics</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQUIRED OR ELECTIVE</td>
<td>required ☑ elective ☑</td>
</tr>
<tr>
<td>typically taken by:</td>
<td>freshmen ☐ sophomores ☐ juniors ☐ seniors (more than one can be checked)</td>
</tr>
<tr>
<td>COURSE (catalogue) DESCRIPTION</td>
<td>Vector description of forces and moments. Two- and three- dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames, and machines. Coulomb friction.</td>
</tr>
<tr>
<td>PREREQUISITE(S)</td>
<td>{(PHY 183 or PHY 183B or PHY 193H) or (PHY 231 and PHY 233B)} and ((MTH 234 or concurrently) or (LB 220 or concurrently) or (MTH 254H or concurrently))</td>
</tr>
<tr>
<td>COURSE LEARNING OUTCOMES</td>
<td>Course learning outcomes are referred to as course learning objectives (CLOs) by the department and are congruent with the “topics covered.” At the end of the course, the students will be able to “do” or “have done” the list below.</td>
</tr>
<tr>
<td>TOPICS COVERED</td>
<td>1. Explain the differences between scalar and vector quantities and provide examples.</td>
</tr>
<tr>
<td></td>
<td>2. Solve problems requiring vector operations, such as determining unit vectors, resultant forces and direction cosines.</td>
</tr>
<tr>
<td></td>
<td>3. Demonstrate an understanding of dot product and be able to recognize situations where the DOT product is applicable.</td>
</tr>
<tr>
<td></td>
<td>4. Demonstrate the ability to sketch free body diagrams for particles and rigid bodies and be able to apply the equations of equilibrium to compute unknown forces.</td>
</tr>
<tr>
<td></td>
<td>5. Demonstrate an understanding of cross product and be able to compute moments and couples using the cross product method.</td>
</tr>
<tr>
<td></td>
<td>6. Demonstrate the ability to compute the magnitude and location of equivalent force resultants for discrete and distributed force systems.</td>
</tr>
<tr>
<td></td>
<td>7. Identify “zero” force members in trusses.</td>
</tr>
<tr>
<td></td>
<td>8. Compute member forces in trusses using the method of joints and the method of sections.</td>
</tr>
<tr>
<td></td>
<td>9. Compute internal forces (moment, shear and axial) in beams and be able to sketch the internal force diagrams.</td>
</tr>
<tr>
<td></td>
<td>10. Compute support reactions for frames and machines.</td>
</tr>
<tr>
<td></td>
<td>11. Compute the location of the centroid and moment of inertia for rigid bodies.</td>
</tr>
<tr>
<td>CLASS/LAB SCHEDULE</td>
<td>lecture: length = 50 minutes; typical day(s) and time(s): M, W; 9:10-10:00 (in spring) or 3:00-3:50 pm (in fall)</td>
</tr>
<tr>
<td></td>
<td>labs: length = 110 minutes; typical day(s) and times: M,W,Th, Fr (various times)</td>
</tr>
<tr>
<td>CONTRIBUTION OF COURSE TO MEETING THE REQUIREMENTS OF CRITERION 5</td>
<td>Engineering topics: contains engineering analysis—yes ☑ no ☐ contains engineering design—yes ☐ no ☑ contains engineering significant design project—yes ☐ no ☑</td>
</tr>
<tr>
<td>RELATIONSHIP OF COURSE TO ME PROGRAM OUTCOMES</td>
<td>The following measurement standard is used to evaluate the relationship between the course objectives and selected educational-program outcomes:</td>
</tr>
<tr>
<td></td>
<td>1 = Strong Emphasis, 2 = Emphasis, 3 = No Emphasis</td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Education Outcome</th>
<th>Level of Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. an ability to apply knowledge of mathematics, science, and engineering</td>
<td>3</td>
</tr>
<tr>
<td>b. an ability to design and conduct experiments, as well as to analyze and</td>
<td>1</td>
</tr>
<tr>
<td>interpret data</td>
<td></td>
</tr>
<tr>
<td>c. an ability to design a system, component, or process to meet desired needs</td>
<td>1</td>
</tr>
<tr>
<td>d. an ability to function on multi-disciplinary teams</td>
<td>1</td>
</tr>
<tr>
<td>e. an ability to identify, formulate, and solve engineering problems</td>
<td>3</td>
</tr>
<tr>
<td>f. an understanding of professional and ethical responsibility</td>
<td>1</td>
</tr>
<tr>
<td>g. an ability to communicate effectively</td>
<td>1</td>
</tr>
<tr>
<td>h. the broad education necessary to understand the impact of engineering solutions</td>
<td>1</td>
</tr>
<tr>
<td>i. a recognition of the need for and the ability to engage in life-long learning</td>
<td>1</td>
</tr>
<tr>
<td>j. a knowledge of contemporary issues</td>
<td>1</td>
</tr>
<tr>
<td>k. an ability to use the techniques, skills, and modern engineering tools</td>
<td></td>
</tr>
<tr>
<td>necessary for engineering practice</td>
<td>2</td>
</tr>
<tr>
<td>l. application of advanced mathematics</td>
<td>2</td>
</tr>
<tr>
<td>m. design, build, and test in mechanical systems area</td>
<td>1</td>
</tr>
<tr>
<td>n. design, build, and test in thermal/fluids area</td>
<td>1</td>
</tr>
<tr>
<td>capstone design experience</td>
<td>1</td>
</tr>
</tbody>
</table>

**PERSON(S) WHO PREPARED THIS DESCRIPTION**

Richard W. Lyles and office staff based on actual faculty-generated syllabus for the course with contribution and review by course instructor(s): Neeraj Buch and Gilbert Baladi, Neil T. Wright, Mechanical Engineering

**DATE OF PREPARATION**

March-April 2010
Appendix A – Course Syllabi

Course Alpha, number, title

MSE 250 Introduction to Materials Science

Course (catalog) description
Structure of metals, ceramics and polymers. Phase diagrams, thermomechanical treatments, physical and mechanical properties, diffusion, microstructure studies, environmental effects.

Prerequisite(s)
(CEM 141 Or CEM 151 Or LB 171)

Class/Lab schedule:
3(2-3)—Two 50-minute lectures/week, 1 collective lab lecture/recitation/week, one three-hour laboratory section per week (1 hr lab lecture and 2 hr lab)

Textbook(s) required

Topics covered

Lab Topics:

Course learning Goals [a-k assessed]

A. (Prerequisites)
B. describe the basic concepts of atomic bonding, interatomic potentials and atomic coordination in solids as they relate to metals, polymers, and ceramics.
C. explain how atomic diffusion happens, and calculate diffusivities and diffusion distances at an arbitrary temperature.
D. explain how to obtain elastic moduli, yield strength, ultimate strength, toughness and strain-to-fracture, from experimental load-displacement curves.
E. identify materials that are viscoelastic and explain how they deform with time.
F. explain how and why cracks nucleate and grow.
G. make quantitative estimates of fatigue life based on loading parameters and fracture toughness level.
H. determine equilibrium phases, their quantity, and composition as a function of temperature and composition from a binary phase diagram.
I. explain how thermal treatments affect the distribution of equilibrium and non-equilibrium phases in steel.
J. identify the most common environmental factors that degrade structural materials, and methods to minimize/mitigate them.

Laboratory:
B. Describe the basic concepts of crystallography including Miller Indices of planes and directions, relating density to crystallographic parameters, and stacking sequence of closed-packed crystal structures.
C. Experimentally identify elastic modulus, yield strength, ultimate strength, toughness and strain-to-fracture, from load-displacement curves.
D. Identify correlations between materials hardness with other mechanical properties.
E. Identify measurement techniques for different engineering materials.
F. Identify mechanisms and approaches commonly used to strengthen different engineering materials.
G. Characterize microstructures of phase separated systems under equilibrium conditions.
H. Characterize changes in properties of steel due to thermal treatments and relate to changes to microstructure.
I. make oral presentations that effectively describe experimental findings.
J. Write a laboratory report that describes experimental work accurately and objectively [g].
K. Contribute with my skills to a team that effectively conducts experimental, analytical, writing and proof reading to generate a good laboratory report [d].

Relationship of course to ME program outcomes

The following measurement standard is used to evaluate the relationship between the course objectives and selected educational-program outcomes:

1 Strong Emphasis, 2 = Emphasis, 3 = No Emphasis

Indicate the level of emphasis of each education outcome in the course: (1, 2 or 3)

o. an ability to apply knowledge of mathematics, science, and engineering—2
Appendix A – Course Syllabi

p. an ability to design and conduct experiments, as well as to analyze and interpret
data—2
q. an ability to design a system, component, or process to meet desired needs—1
r. an ability to function on multi-disciplinary teams—1
s. an ability to identify, formulate, and solve engineering problems—2
t. an understanding of professional and ethical responsibility—1
u. an ability to communicate effectively—2
v. the broad education necessary to understand the impact of engineering solutions in
   a global/societal context—2
w. a recognition of the need for and the ability to engage in life-long learning—1
x. a knowledge of contemporary issues—1
y. an ability to use the techniques, skills, and modern engineering tools necessary for
   engineering practice—2
z. application of advanced mathematics—1
   aa. design, build, and test in mechanical systems area—1
   bb. design, build, and test in thermal/fluids area—1
   cc. capstone design experience—1

Contribution to professional component:
college-level mathematics and basic sciences—0 credits
with experimental experience—yes
engineering topics—3 credits
general education—0 credits

Person(s) who prepared this description
D.S. Grummon

Date of preparation
June 8, 2010
Course, number, and title

ECE 345 - Electronic Instrumentation Systems

Course (catalog) description

Electrical and electronic components, circuits and instruments. Circuit laws and applications, frequency response, operational amplifiers, semiconductor devices, digital logic, counting circuits.

Prerequisites(s)

MTH 235, PHY 184

Textbook(s) and/or other required material

G. Wierzba, *ECE 345: Course e-Notes and Lab Manual*. Available at LuLu.com


Course objectives

At the completion of the lecture component of the course, the students should be able to:

- a) Analyze DC circuits
- b) Perform a DC analysis of Diode and BJT circuits
- c) Analyze op-amp and comparator circuits
- d) Apply network theorems for circuit analysis
- e) Analyze first order RL and RC circuits
- f) Analyze AC circuits in steady-state using phasors
- g) Understand the meaning of filtering

At the completion of the lab component of the course, the students should be able to:

- h) Describe the accuracy specifications of an instrument
- i) Assemble an electronic circuit on a protoboard
- j) Make circuit measurements using an oscilloscope and a digital multimeter
- k) Display the I-V characteristics of a diode on a curve tracer.
- l) Program a microcontroller
- m) Describe the meaning of amplification and power boosting
- n) Describe the meaning of rectification and regulation
- o) Configure a transistor as a switch

Topics covered

<table>
<thead>
<tr>
<th>Topics</th>
<th>Lectures (Approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Electric Circuits</td>
<td>4</td>
</tr>
<tr>
<td>Diodes</td>
<td>2</td>
</tr>
<tr>
<td>Op-Amps and Comparators</td>
<td>2</td>
</tr>
<tr>
<td>Resistive Network Analysis</td>
<td>5</td>
</tr>
<tr>
<td>BJT Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>Transient Analysis</td>
<td>3</td>
</tr>
<tr>
<td>AC Network Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topics</th>
<th>Labs (Approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test and Measurement Equipment</td>
<td>1</td>
</tr>
<tr>
<td>Prototyping Circuits</td>
<td>1</td>
</tr>
<tr>
<td>Diode Curve Tracer</td>
<td>1</td>
</tr>
<tr>
<td>Introduction to Microcontrollers</td>
<td>1</td>
</tr>
<tr>
<td>Build Your Own Digital DC Voltmeter</td>
<td>1</td>
</tr>
<tr>
<td>Serial Liquid Crystal Display</td>
<td>1</td>
</tr>
<tr>
<td>Power Amplifier for a Portable MP3 Player</td>
<td>1</td>
</tr>
<tr>
<td>DC Power Supply and Regulator</td>
<td>1</td>
</tr>
<tr>
<td>Light Activated Exhaust Fan</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

Contribution of course to meeting the professional component

- a. college-level mathematics and basic sciences – 0 credits
  with experimental experience-no
- b. engineering topics – 3 credits
- c. general education – 0 credits

The following measurement standard is used to evaluate the relationship between the course objectives and selected educational-program outcomes:

1 = Strong Emphasis, 2 = Emphasis, 3 = No Emphasis

Indicate the level of emphasis of each education outcome in the course: (1, 2 or 3)

- a. an ability to apply knowledge of mathematics, science, and engineering—1
- b. an ability to design and conduct experiments, as well as to analyze and interpret data—2
- c. an ability to design a system, component, or process to meet desired needs—2
- d. an ability to function on multi-disciplinary teams—2
- e. an ability to identify, formulate, and solve engineering problems—2
- f. an understanding of professional and ethical responsibility—3
- g. an ability to communicate effectively—2
- h. the broad education necessary to understand the impact of engineering solutions in a global/societal context—3
- i. a recognition of the need for and the ability to engage in life-long learning—2
- j. a knowledge of contemporary issues—3
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
- l. application of advanced mathematics—2
- m. design, build, and test in mechanical systems area—1
- n. design, build, and test in thermal/fluids area—1
- o. capstone design experience—1

Class/laboratory schedule

3(2-3) Two 50-minute lectures/week and one three-hour laboratory/week

Person(s) who prepared this description

Gregory M. Wierza

Date of Preparation

March 18, 2010

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### APPENDIX A – CONTINUED – COURSES OFFERED BY SUPPORTING DEPARTMENTS

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>BS 110, Organisms and Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required or elective</strong></td>
<td>Elective (one of several courses student may select to meet biological science requirement)</td>
</tr>
<tr>
<td><strong>Course (catalog) description</strong></td>
<td>Biological diversity and organismal biology. Principles of evolution, population biology, and community structure.</td>
</tr>
<tr>
<td><strong>Prerequisite(s)</strong></td>
<td>(None)</td>
</tr>
<tr>
<td><strong>Textbook(s) and/or other required material</strong></td>
<td>Biology (8th Edition) by Neil A. Campbell, Jane B. Reece, Benjamin Cummings/Pearson Higher Education.</td>
</tr>
<tr>
<td><strong>Course learning outcomes</strong></td>
<td>Organisms &amp; Populations Biological diversity and organismal biology, Principles of evolution, population biology, and community structure.</td>
</tr>
<tr>
<td><strong>Topics covered</strong></td>
<td>Organismal Diversity, Population Ecology, Community Ecology, Mendelian Genetics, Genes in Populations, Evolutionary Biology</td>
</tr>
<tr>
<td><strong>Class/Lab schedule (number of sessions per week and duration of each session):</strong></td>
<td>Credits: 4; Discussion: 3; Laboratory: 3</td>
</tr>
<tr>
<td><strong>Contribution of course to meeting the requirements of Criterion 5</strong></td>
<td>100% Basic Science</td>
</tr>
</tbody>
</table>

#### Relationship of course to program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- **1** = Little or No Emphasis,
- **2** = Some Emphasis,
- **3** = Strong Emphasis.

- **(a)** an ability to apply knowledge of mathematics, science, and engineering—3
- **(b)** an ability to design and conduct experiments, as well as to analyze and interpret data—1
- **(c)** an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
- **(d)** an ability to function on multidisciplinary teams—1
- **(e)** an ability to identify, formulate, and solve engineering problems—1
- **(f)** an understanding of professional and ethical responsibility—2
- **(g)** an ability to communicate effectively—1
- **(h)** the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2
- **(i)** a recognition of the need for and the ability to engage in life-long learning—1
- **(j)** a knowledge of contemporary issues—2
Appendix A – Course Syllabi

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
John Merrill, Director, Biological Sciences Program
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation 2016-07-18
### BS 111, Cells and Molecules

**Course (catalog) description**
Macromolecular synthesis; energy metabolism; molecular aspects of development; principles of genetics.

**Prerequisite(s)**
- [CEM 141 (General Chemistry) or concurrently] or [CEM 151 (General and Descriptive Chemistry) or concurrently] or [LB 171 (Principles of Chemistry I – Structure) or concurrently] or [CEM 181H (Honors Chemistry I) or concurrently]

**Textbook(s) and/or other required material**

**Course learning outcomes**
Students will develop an understanding of basic principles of cellular and molecular biology necessary for further training or for self-learning

**Topics covered**
- Cell structure and function
- Energy metabolism
- Cell Cycle
- Chromosomes and genes
- Molecular basis of heredity
- Genome organization
- Gene expression
- Cell Communication

**Class/Lab schedule (number of sessions per week and duration of each session):**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Discussion</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Contribution of course to meeting the requirements of Criterion 5**
100% Basic Science

**Relationship of course to program outcomes**
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis
- 2 = Some Emphasis
- 1 = Little or No Emphasis

(a) an ability to apply knowledge of mathematics, science, and engineering—1
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—2
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—2
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
Appendix A – Course Syllabi

(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description:
W. Booth, Engr Dean
John Merrill, Director, Biological Sciences Program
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation: 2016-07-18
Appendix A – Course Syllabi

Course alpha, number, title
BS 111L, Cell and Molecular Biology Laboratory

Required or elective
Elective

Course (catalog) description
Principles and applications of common techniques used in cell and molecular biology.

Prerequisite(s)
BS111 (Cell and Molecular Biology) or concurrently

Textbook(s) and/or other required material
No required textbook, locally produced laboratory manual.

Course learning outcomes
Students will develop an understanding of some basic principles of cellular and molecular biology with hands-on experimentation, along with general aspects of the scientific method.

Topics covered
Diffusion
Protein Chemistry
Enzymology
Biochemical Pathways
Glycolysis
Photosynthesis
Cell communication
Molecular Genetics
Scientific Methodology
Data Collection and Analysis

Class/Lab schedule (number of sessions per week and duration of each session):
Credits: 2 Discussion: 1 Laboratory: 3

Contribution of course to meeting the requirements of Criterion 5
100% Basic Science

Relationship of course to program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—3
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—2
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
Appendix A – Course Syllabi

- (l) application of advanced mathematics—1
- (m) design, build, and test in mechanical systems area—1
- (n) design, build, and test in thermal/fluids area—1
- (o) capstone design experience—1

Person(s) who prepared this description:
- W. Booth, Engr Dean
- John Merrill, Director, Biological Sciences Program
- Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation: 2016-07-18
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>CEM 141, General Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Required</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Elements and compounds; reactions; stoichiometry; thermochemistry; atomic structure; chemical bonding; states of matter; solutions; acids and bases; aqueous equilibria.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>{[MTH 103 (College Algebra) or concurrently] or [MTH 110 (Finite Mathematics and Elements of College Algebra) or concurrently] or [MTH 116 (College Algebra and Trigonometry) or concurrently] or [MTH 124 (Survey of Calculus I) or concurrently] or [MTH 132 (Calculus I) or concurrently] or [MTH 152H (Honors Calculus I) or concurrently] or [LB 118 (Calculus I) or concurrently]] or designated score on Mathematics Placement test</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>The text assigned to CEM 141 is a custom paperback edition of Chemistry by Paul Kelter et al (ISBN 0618990070 Cengage). An OWL access code is required in this course.</td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>This course serves as a first course in General Chemistry.</td>
</tr>
</tbody>
</table>
| Topics covered | tools of chemistry  
| | atoms, molecules and ions  
| | stoichiometry  
| | thermochemistry  
| | the gaseous state  
| | quantum theory and electronic structure  
| | chemical periodicity  
| | chemical bonding  
| | molecular geometry |
| Class/Lab schedule | Credits: 4; Lecture: 4; Laboratory: 0 |
| Contributions of course to meeting the requirements of Criterion 5 | 100% Basic Science |
| Relationship of course to program outcomes | The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:  
| | 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.  
| | (a) an ability to apply knowledge of mathematics, science, and engineering—3  
| | (b) an ability to design and conduct experiments, as well as to analyze and interpret data—1  
| | (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1  
| | (d) an ability to function on multidisciplinary teams—1  
| | (e) an ability to identify, formulate, and solve engineering problems—1  
| | (f) an understanding of professional and ethical responsibility—1 |
Appendix A – Course Syllabi

(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) a recognition of the need for and the ability to engage in life-long learning —1
(j) a knowledge of contemporary issues —1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice —1
(l) application of advanced mathematics —1
(m) design, build, and test in mechanical systems area —1
(n) design, build, and test in thermal/fluids area —1
(o) capstone design experience —1

Person(s) who prepared this description
W. Booth, Engr Dean
Steven Poulcos, Undergraduate Coordinator
Neil T. Wright, Associate Professor, Mechanical Engineering
Date of Preparation 2016-07-18
Appendix A – Course Syllabi

**Course alpha, number, title**

CEM 161, Chemistry Laboratory I

**Required or elective**

Required

**Course (catalog) description**

Experiments in general chemistry; stoichiometry, calorimetry, electrochemistry, molecular geometry, gas laws, kinetics, acids and bases, and inorganic chemistry.

**Prerequisite(s)**

[CEM 141 (General Chemistry) or concurrently] or [CEM 151 (General and Descriptive Chemistry) or concurrently]

**Textbook(s) and/or other required material**

The Chemistry 161 Laboratory Manual by Paul Hunter

OWL: problem sets web site

**Course learning outcomes**

This is the first General Chemistry Laboratory

**Topics covered**

mass and density
stochiometry
solubility
phosphorous in detergents
thermochemistry
electrochemistry
kinetics
chemical equilibrium
volumetric analysis
determination of pH

**Class/Lab schedule**

Credits: 1  Discussion: 0  Laboratory: 3

Three hour lab

**Contribution of course to meeting the requirements of Criterion 5**

100% Basic Science

**Relationship of course to program outcomes**

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—3

(b) an ability to design and conduct experiments, as well as to analyze and interpret data—3

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1

(d) an ability to function on multidisciplinary teams—1

(e) an ability to identify, formulate, and solve engineering problems—1

(f) an understanding of professional and ethical responsibility—1

(g) an ability to communicate effectively—1

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 1

(i) a recognition of the need for and the ability to engage in life-long learning—1

(j) a knowledge of contemporary issues—1

(k) an ability to use the techniques, skills, and modern engineering tools necessary for
Appendix A – Course Syllabi

engineering practice—1
(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Steven Poulis, Undergraduate Coordinator
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation 2016-07-18
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ENT 205, Pests, Society and Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective (one of several courses student may select to meet biological science requirement)</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(None)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Principles of Integrated Pest Management (Flint and van den Bosch)</td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>Nature of pests and their impact on society, and an analysis of the principles of integrated pest management and their impact on environmental quality.</td>
</tr>
</tbody>
</table>
| Topics covered              | Nature of pests  
History of pest science  
Evolution of IPM  
Principles of IPM  
Biological monitoring  
Environmental monitoring  
Strategies of IPM  
Tactics of IPM  
Case study 1: Fruit  
Case study 2: Vegetables |
| Class/Lab schedule (number of sessions per week and duration of each session): | Credits: 3  Discussion: 3  Laboratory: 0 |
| Contribution of course to meeting the requirements of Criterion 5 | 100% Basic Science |

Relationship of course to program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
- An ability to apply knowledge of mathematics, science, and engineering—3
- An ability to design and conduct experiments, as well as to analyze and interpret data—1
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
- An ability to function on multidisciplinary teams—1
- An ability to identify, formulate, and solve engineering problems—1
- An understanding of professional and ethical responsibility—2
- An ability to communicate effectively—1
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2
- A recognition of the need for and the ability to engage in life-long learning—1
- A knowledge of contemporary issues—2
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
Appendix A – Course Syllabi

(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Gabriel James Ording, Entomology
Neil T. Wright, Mechanical Engineering

Date of Preparation
2016-07-18

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Appendix A – Course Syllabi

Course alpha, number, title: MMG 201, Fundamentals of Microbiology

Required or elective: Elective (one of several courses student may select to meet biological science requirement)

Course (catalog) description: Microbial structure, function, growth, control, and diversity. Role of microbes in health, industry, and the environment

Prerequisite(s): (None)

Textbook(s) and/or other required material: Alcamo, Microbes in Society or Batzing, Microbiology: An Introduction

Course learning outcomes: Provide an overview of microbiology at the introductory level for those whom this will be the sole course in the discipline and who lack college-level general biology.

Topics covered:细胞结构
微生物代谢
微生物繁殖
微生物多样性
宿主-寄生关系
微生物作为病原体
宿主反应
微生物在环境
控制微生物
工业微生物的使用

Class/Lab schedule (number of sessions per week and duration of each session): Credits: 3  Discussion: 3  Laboratory: 0

Contribution of course to meeting the requirements of Criterion 5: 100% Basic Science

Relationship of course to program outcomes: The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—2
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
Appendix A – Course Syllabi

(l) application of advanced mathematics — 1
(m) design, build, and test in mechanical systems area — 1
(n) design, build, and test in thermal/fluids area — 1
(o) capstone design experience — 1

Person(s) who prepared this description

W. Booth, Engr Dean
Patricia H. Jackson, Microbiology & Molecular Genetics
Neil T. Wright, Mechanical Engineering

Date of Preparation 2016-07-18
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>MMG 301, Introductory Microbiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective (one of several courses student may select to meet biological science requirement)</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Fundamentals of microbiology, including microbial structure and function, nutrition and growth, death and control. Importance and applications of major microbial groups.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>[BS 111 (Cells and Molecules) or LB 145 (Biology II: Cellular and Molecular Biology) or LB 149H (Honors Cell and Molecular Biology)] and [[CEM 251 (Organic Chemistry I) or concurrently] or [CEM 351 (Organic Chemistry I) or concurrently] or CEM 143 (Survey of Organic Chemistry)]</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Brock, <em>Biology of Microorganisms</em>, 6th ed</td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>Understand unique attributes of different groups of microbes and of major groups of bacteria, role of structural components of microbes in cell function, basis of functional processes in growth.</td>
</tr>
<tr>
<td>Topics covered</td>
<td>the groups of microbes bacterial structure physiological processes metabolism growth regulation nutrition and culture genetics bacteriophage sterilization</td>
</tr>
<tr>
<td>Class/Lab schedule (number of sessions per week and duration of each session):</td>
<td>Credits: 3  Discussion: 3  Laboratory: 0</td>
</tr>
<tr>
<td>Contribution of course to meeting the requirements of Criterion 5</td>
<td>100% Basic Science</td>
</tr>
<tr>
<td>Relationship of course to program outcomes</td>
<td>The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes: 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.</td>
</tr>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering—3</td>
<td></td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1</td>
<td></td>
</tr>
<tr>
<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1</td>
<td></td>
</tr>
<tr>
<td>(d) an ability to function on multidisciplinary teams—1</td>
<td></td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems—1</td>
<td></td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility—2</td>
<td></td>
</tr>
<tr>
<td>(g) an ability to communicate effectively—1</td>
<td></td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —2</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A – Course Syllabi

(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description

W. Booth, Engr Dean
CLAIRE VIEILLE, Microbiology & Molecular Genetics
Neil T. Wright, Mechanical Engineering

Date of Preparation
2016-07-18
### Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course number, title</th>
<th>Required or elective</th>
<th>Course (catalog) description</th>
<th>Prerequisite(s)</th>
<th>Textbook(s) and/or other required material</th>
<th>Course learning outcomes</th>
<th>Topics covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 132, Calculus I</td>
<td>Required</td>
<td>Limits, continuous functions, derivatives and their applications. Integrals and the fundamental theorem of calculus.</td>
<td>[MTH 103 (College Algebra) and MTH 114 (Trigonometry)] or [MTH 116 (College Algebra and Trigonometry) or designated score on Mathematics Placement test]</td>
<td>Thomas’ Calculus, 11th edition</td>
<td>Engineering calculus course</td>
<td>Limits, Continuous Functions, Derivatives, Application of Derivative, Integrals, Fundamental Theorem, Exponential and Logarithms</td>
</tr>
</tbody>
</table>

**Class/Lab schedule**

| Credits: 3 | Discussion: 3 | Laboratory: 0 |

**Contribution of course to meeting the requirements of Criterion 5**

100% Basic Science

**Relationship of course to program outcomes**

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis
- 2 = Some Emphasis
- 1 = Little or No Emphasis

(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
Appendix A – Course Syllabi

(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Pavel Sikorskii, Exec. Assoc. Director of the Undergraduate Program, Department of Mathematics, MSU
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation 2016-07-18
Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>MTH 133, Calculus II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Required</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>MTH 132 (Calculus I) or MTH 152H (Honors Calculus I)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Thomas’ Calculus, 11th edition</td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>Engineering calculus (second course)</td>
</tr>
<tr>
<td>Topics covered</td>
<td>Applications of the Integral, Methods of Integration, Transcendental Functions, Polar Coordinates, Indeterminate Forms, Improper Integrals, Parametric Curves, Sequences and series, Power series, Taylor series</td>
</tr>
<tr>
<td>Class/Lab schedule (number of sessions per week and duration of each session):</td>
<td>Credits: 4 Discussion: 4 Laboratory: 0</td>
</tr>
<tr>
<td>Contribution of course to meeting the requirements of Criterion 5</td>
<td>100% Basic Science</td>
</tr>
</tbody>
</table>

Relationship of course to program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
- (a) an ability to apply knowledge of mathematics, science, and engineering—3
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- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
- (d) an ability to function on multidisciplinary teams—1
- (e) an ability to identify, formulate, and solve engineering problems—2
- (f) an understanding of professional and ethical responsibility—1
- (g) an ability to communicate effectively—1
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
- (i) a recognition of the need for and the ability to engage in life-long learning—1
- (j) a knowledge of contemporary issues—1
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1

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Appendix A – Course Syllabi

A-103

(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description:
W. Booth, Engr Dean
Pavel Sikorskii, Exec. Assoc. Director of the Undergraduate Program, Department of Mathematics, MSU
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation: 2016-07-18
Appendix A – Course Syllabi

Course alpha, number, title
MTH 234, Multivariable Calculus

Required or elective
Required

Course (catalog) description
Vectors in space. Functions of several variables and partial differentiation. Multiple integrals. Line and surface integrals. Green's and Stokes's theorems.

Prerequisite(s)
MTH 133 (Calculus II) or MTH 153H (Honors Calculus II) or LB 119 (Calculus II)

Textbook(s) and/or other required material
Thomas' Calculus, 11th edition

Course learning outcomes
Engineering calculus class at level III.

Topics covered
Vectors in space
Linear algebra
Cylindrical, spherical coords.
Functions of Several Variables
Curves and Surfaces in Space
Lagrange multipliers
Partial Derivatives
Multiple integrals
Line and surface integrals
Green’s and Stoke’s Theorems

Class/Lab schedule (number of sessions per week and duration of each session):
Credits: 4  Discussion: 4  Laboratory: 0

Contribution of course to meeting the requirements of Criterion 5
100% Basic Science

Relationship of course to program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.

(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
Appendix A – Course Syllabi

(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Pavel Sikorskii, Exec. Assoc. Director of the Undergraduate Program, Department of Mathematics, MSU
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation 2016-07-18
Appendix A – Course Syllabi

Course alpha, number, title: MTH 235, Differential Equations

Required or elective: Required


Prerequisite(s): MTH 234 (Multivariable Calculus) or MTH 254H (Honors Multivariable Calculus) or LB 220 (Calculus III)

Textbook(s) and/or other required material: Boyce & DiPrima Elementary Differential Equations and Boundary Value Problems, 9th edition

Course learning outcomes:
A service course for engineers. A course in the major for computational mathematics.

Topics covered:
Separable & exact equations
Linear differential equations
Laplace Transforms
Systems of first order ODE
Introduction to PDE
Fourier series

Class/Lab schedule:
Credits: 3  Discussion: 4  Laboratory: 0

Contribution of course to meeting the requirements of Criterion 5:
100% Basic Science

Relationship of course to program outcomes:
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1
(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—1
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context—1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—2
(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
Appendix A – Course Syllabi

(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description

W. Booth, Engr Dean
Pavel Sikorskii, Exec. Assoc. Director of the Undergraduate Program, Department of Mathematics, MSU
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation

2016-07-18
Appendix A – Course Syllabi

Course alpha, number, title  PHY 183, Physics for Scientists and Engineers I
Required or elective  Required
Course (catalog) description  Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, and waves.
Prerequisite(s)  MTH 132 (Calculus I) or MTH 152H (Honors Calculus I) or LB 118 (Calculus I)
Textbook(s) and/or other required material  Bauer & Westfall, University Physics (McGraw-Hill, 2010)
Course learning outcomes  Introduce students to the laws of mechanics, with the use of calculus.
Topics covered  Units, numbers, scientific notation, problem solving strategies, vectors
Motion in 1, 2, 3 dimensions, kinematics
Forces and motion
Work and energy
Energy conservation
Momentum and collisions
Conservation of momentum
Systems of particles, center of mass
Rotational motion, torque, moment of inertia
Conservation of angular momentum
Static equilibrium, stability
States of matter, stress and strain
Fluids
Gravitation
Oscillations: harmonic, damped, driven
Waves
Sound
Class/Lab schedule (number of sessions per week and duration of each session):  Credits: 4; Laboratory: 0
In addition to 4 lecture hours per week there is an open help room, staffed by TAs, which is available to students for and homework assistance 5 days/week, 9 am to 10 pm. Weekly homework assignments are expected to provide 3-5 hours of time-on-task and provide immediate feedback and peer-to-peer instruction opportunity via use of the Ion-capacitor course management and online homework system.
Contribution of course to meeting the requirements of Criterion 5  100% Basic Science
Relationship of course to program outcomes  The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1
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(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—2
Appendix A – Course Syllabi

(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a
global, economic, environmental, and societal context—2
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
engineering practice—2
(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description

W. Booth, Engr Dean
Wolfgang Bauer, Chairperson, Department of Physics and Astronomy
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation
2016-07-18
## Appendix A – Course Syllabi

### Course alpha, number, title

<table>
<thead>
<tr>
<th>Course (catalog) description</th>
<th>Required or elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity &amp; magnetism, electromagnetic waves, light &amp; optics, interference &amp; diffraction.</td>
<td>Required</td>
</tr>
</tbody>
</table>

### Prerequisite(s)

{PHY 183 (Physics for Sci & Engr I) or PHY 183B (Physics for Sci & Engr I) or PHY 193H (Honors Physics I-Mechanics) or PHY 233B (Calculus Concepts in Physics I) or LB 271 (Physics I)} and {MTH 133 (Calculus II) or MTH 153H (Honors Calculus II) or LB 119 (Calculus II)}

### Textbook(s) and/or other required material


### Course learning outcomes

Introduce students to the laws of electricity and magnetism, optics, and relativity

### Topics covered

- Electrostatics, Coulomb interaction
- Electric field; Gauss’ Law
- Electric potential; Capacitance
- Currents and circuits
- Magnetic field; Ampere's Law
- Induction
- Alternating currents
- Electromagnetic oscillations, waves, spectrum, polarization
- Geometric optics; lenses, optical instruments
- Interference & diffraction
- Relativity

### Class/Lab schedule

- Credits: 4; Laboratory: 0
- In addition to 4 lecture hours per week there is an open help room, staffed by teaching assistants, which is available to students for problem solving and homework assistance 5 days per week from 9 am to 10 pm. Weekly homework assignments are expected to provide 3-5 hours of time-on-task and provide immediate feedback and peer-to-peer instruction opportunity via use of the lon-capacity course management and online homework system.

### Contribution of course to meeting the requirements of Criterion 5

100% Basic Science

### Relationship of course to program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
- (a) an ability to apply knowledge of mathematics, science, and engineering—3
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- (d) an ability to function on multidisciplinary teams—1
- (e) an ability to identify, formulate, and solve engineering problems—2
- (f) an understanding of professional and ethical responsibility—1
- (g) an ability to communicate effectively—1
- (h) the broad education necessary to understand the impact of engineering solutions in a
Appendix A – Course Syllabi

- global, economic, environmental, and societal context — 2
  (i) a recognition of the need for and the ability to engage in life-long learning — 1
  (j) a knowledge of contemporary issues — 2
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice — 2
  (l) application of advanced mathematics — 3
- (m) design, build, and test in mechanical systems area — 1
- (n) design, build, and test in thermal/fluids area — 1
- (o) capstone design experience — 1

Person(s) who prepared this description:
- W. Booth, Engr Dean
- Wolfgang Bauer, chairperson, Department of Physics and Astronomy
- Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation: 2016-07-18
Appendix A – Course Syllabi

Course alpha, number, title

PLB 105, Plant Biology

Required or elective
Elective (one of several courses student may select to meet biological science requirement)

Course (catalog) description
Plant structure, function, development, genetics, diversity and ecology.

Prerequisite(s)
(None)

Textbook(s) and/or other required material
Introductory Botany Second Edition

Course learning outcomes
The students should understand the anatomy, physiology and evolutionary history of plants. In addition the students should be able to evaluate topic such as biofuels and GMO crops.

Topics covered
Plant cell structure
Osmosis, diffusion, transport
Anatomy of primary growth
Anatomy of secondary growth
Plant development
Transpiration & translocation
Photosynthesis & respiration
Plant genetics
Evolutionary theory
Molecular biology techniques
Transgenic plants

Class/Lab schedule
Credits: 3  Discussion: 3  Laboratory: 0

Contribution of course to meeting the requirements of Criterion 5
100% Basic Science

Relationship of course to program outcomes
The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:
3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.
(a) an ability to apply knowledge of mathematics, science, and engineering — 3
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(d) an ability to function on multidisciplinary teams — 1
(e) an ability to identify, formulate, and solve engineering problems — 1
(f) an understanding of professional and ethical responsibility — 2
(g) an ability to communicate effectively — 1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context — 3
(i) a recognition of the need for and the ability to engage in life-long learning — 1
(j) a knowledge of contemporary issues — 2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
Appendix A – Course Syllabi

engineering practice—1
(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Curtis G. Wilkerson
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation
2016-07-18
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>PSL 250, Introductory Physiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective (one of several courses student may select to meet biological science requirement)</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Function, regulation and integration of organs and organ systems of higher animals emphasizing human physiology.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>(None)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td>Fundamental of Physiology by Lauralee Sherwood, 2006.</td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>Understanding the fundamental physiological processes in higher animals, emphasizing human physiology and developing critical thinking skills required for a foundation in life sciences.</td>
</tr>
<tr>
<td>Topics covered</td>
<td>neurophysiology muscle physiology cardiovascular physiology renal physiology endocrinology and reproduction digestion alterations in disease</td>
</tr>
<tr>
<td>Class/Lab schedule (number of sessions per week and duration of each session):</td>
<td>Credits: 4; Discussion: 4; Laboratory: 0</td>
</tr>
<tr>
<td>Contribution of course to meeting the requirements of Criterion 5</td>
<td>100% Basic Science</td>
</tr>
</tbody>
</table>

Relationship of course to program outcomes

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(j) a knowledge of contemporary issues—2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1
(l) application of advanced mathematics—1
(m) design, build, and test in mechanical systems area—1
Appendix A – Course Syllabi

- design, build, and test in thermal/fluids area—1
- capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation
2016-07-18
### Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>STT 351, Probability and Statistics for Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Required</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>Probability models and random variables. Estimation, confidence intervals, tests of hypotheses, simple linear regression. Applications to engineering.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>MTH 234 (Multivariable Calculus) or MTH 254H (Honors Multivariable Calculus) or LB 220 (Calculus III)</td>
</tr>
<tr>
<td>Textbook(s) and/or other required material</td>
<td><em>Probability and Statistics by Jay Devore, 7th edition, published by Thomson Higher education, CA.</em></td>
</tr>
<tr>
<td>Course learning outcomes</td>
<td>To introduce engineering students to calculus based probability and statistics with engineering applications</td>
</tr>
</tbody>
</table>
| Topics covered             | probability models  
|                            | conditional probability  
|                            | independence  
|                            | random variables  
|                            | estimation and testing  
|                            | one and two-sample tests  
|                            | confidence intervals  
|                            | simple linear regression  
|                            | correlation  
|                            | engineering applications |
| Class/Lab schedule (number of sessions per week and duration of each session): | Credits: 3  Discussion: 3  Laboratory: 0 |
| Contribution of course to meeting the requirements of Criterion 5 | 100% Basic Science |

### Relationship of course to program outcomes

The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:

- 3 = Strong Emphasis
- 2 = Some Emphasis
- 1 = Little or No Emphasis

(a) an ability to apply knowledge of mathematics, science, and engineering—3
(b) an ability to design and conduct experiments, as well as to analyze and interpret data—2
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(d) an ability to function on multidisciplinary teams—1
(e) an ability to identify, formulate, and solve engineering problems—2
(f) an understanding of professional and ethical responsibility—1
(g) an ability to communicate effectively—1
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —1
(i) a recognition of the need for and the ability to engage in life-long learning—1
(j) a knowledge of contemporary issues—1
(k) an ability to use the techniques, skills, and modern engineering tools necessary for
Appendix A – Course Syllabi

engineering practice—1
(l) application of advanced mathematics—3
(m) design, build, and test in mechanical systems area—1
(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1

Person(s) who prepared this description
W. Booth, Engr Dean
Hira L. Kou, Chair, Department of Statistics and Probability
Neil T. Wright, Associate Professor, Mechanical Engineering

Date of Preparation 2016-07-18
<table>
<thead>
<tr>
<th>Course alpha, number, title</th>
<th>ZOL 141 – INTRODUCTION TO HUMAN GENETICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required or elective</td>
<td>Elective (one of several courses student may select to meet biological science requirement)</td>
</tr>
<tr>
<td>Course (catalog) description</td>
<td>ZOL 141 will cover the principles of human genetics using human examples as much as possible. There will also be discussion of the problems, opportunities, and ethical issues created by advances in genetic technology and knowledge. The intent of the course is to educate citizens, not train geneticists. But learning any biology unavoidably requires learning some details.</td>
</tr>
<tr>
<td>Prerequisite(s)</td>
<td>ME 410 or concurrently</td>
</tr>
<tr>
<td>Textbook(s) or other required material</td>
<td>Class notes. Course web site (<a href="http://www.egr.msu.edu/classes/me417/somerton/">http://www.egr.msu.edu/classes/me417/somerton/</a>).</td>
</tr>
<tr>
<td>Class/Lab schedule</td>
<td>Total Credits: 3 Lecture/Laboratory/Discussion Hours: 3/0/0</td>
</tr>
<tr>
<td>Topics covered</td>
<td>Cells, Chromosomes, &amp; Cell Division</td>
</tr>
<tr>
<td></td>
<td>Transmission of Genes</td>
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<td></td>
<td>Transmission of Genes &amp; Blood Types</td>
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<td></td>
<td>Pedigree Analysis</td>
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<td>Complex Patterns of Inheritance</td>
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<td>Cytogenetics</td>
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<td>Development &amp; Sex Determination</td>
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<td>DNA Structure &amp; Chromosome Organization</td>
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<td>Gene Expression: Genes to Proteins</td>
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<td>From Proteins to Phenotypes</td>
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<td></td>
<td>Mutation: The Source of Genetic Variation</td>
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<td></td>
<td>Genes &amp; Cancer</td>
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<td>Clones, Testing for Alleles or Identity</td>
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<td></td>
<td>Population Genetics &amp; Human Evolution</td>
</tr>
<tr>
<td></td>
<td>Genetic Therapy &amp; Genetic Counseling</td>
</tr>
<tr>
<td>Course learning objectives</td>
<td>For the student to understand in sufficient detail the genetic background of humans to be able to discuss the problems, opportunities, and ethical issues created by advances in genetic technology and knowledge.</td>
</tr>
<tr>
<td>Relationship of course to ME program outcomes</td>
<td>The following measurement standard is used to evaluate the relationship between the course outcomes and the educational-program outcomes:</td>
</tr>
<tr>
<td></td>
<td>3 = Strong Emphasis, 2 = Some Emphasis, 1 = Little or No Emphasis.</td>
</tr>
<tr>
<td></td>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering—3</td>
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<td></td>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data—1</td>
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<tr>
<td></td>
<td>(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability—1</td>
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<td></td>
<td>(d) an ability to function on multidisciplinary teams—1</td>
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<td></td>
<td>(e) an ability to identify, formulate, and solve engineering problems—1</td>
</tr>
<tr>
<td></td>
<td>(f) an understanding of professional and ethical responsibility—2</td>
</tr>
<tr>
<td></td>
<td>(g) an ability to communicate effectively—1</td>
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<tr>
<td></td>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context —3</td>
</tr>
<tr>
<td></td>
<td>(i) a recognition of the need for and the ability to engage in life-long learning—1</td>
</tr>
<tr>
<td></td>
<td>(j) a knowledge of contemporary issues—2</td>
</tr>
<tr>
<td></td>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice—1</td>
</tr>
<tr>
<td></td>
<td>(l) application of advanced mathematics—1</td>
</tr>
<tr>
<td></td>
<td>(m) design, build, and test in mechanical systems area—1</td>
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Appendix A – Course Syllabi

<table>
<thead>
<tr>
<th>Contribution to professional component</th>
<th>Basic Science 100%</th>
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</table>

<table>
<thead>
<tr>
<th>Person(s) who prepared this description</th>
<th>Neil T. Wright, Associate Professor, Mechanical Engineering, based on syllabus handed to students by the instructor, Daniel Friderici</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Date of Preparation</th>
<th>15 June 2010</th>
</tr>
</thead>
</table>

(n) design, build, and test in thermal/fluids area—1
(o) capstone design experience—1