COURSE SYLLABI

I. Course Number and Name

MECH 1305: Graphic and Design Fundamentals

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Norman D. Love

IV. Textbook, Title, Author, and Year

Samuel, S., Pragada, A., Stevenson, B., & Weeks, E. (2008). *Basic to Advanced NX6: Modeling, Drafting and Assemblies*. Published by Design Visionaries.

V. Specific Course Information

a. Description: An introduction to solid modeling concepts and software, dimensioning, and basic computer-aided engineering
b. Prerequisites: None
c. Required

VI. Specific Goals for the Course

The primary objective of this class is to provide an introduction to solid modeling, drafting, and computer aided engineering using the computer aided design package NX. Specifically students should leave with the ability to do/know all of the following:

a. Solid modeling,
b. Parametric modeling and design intent,
c. Tolerancing,
d. Drafting,
e. Creating assemblies, and
f. Configurational design

This class significantly addresses the following ABET Objectives:

Program Outcomes
- C [3]
- K [3]

VII. Brief List of Topics to be Covered

a. Introduction
    i. Create new part files
    ii. Open and close part files
    iii. The steps in a Basic Modeling Procedure
    iv. Know what the “Roles” do in NX
    v. Dynamically rotate, pan and zoom a model using the mouse
    vi. Use of selection filters
b. Fundamental Curves
    i. Draw basic curves freehand and with inferred points
    ii. Draw basic curves with specific dimensions
    iii. Use trim and extend
    iv. Know the difference between “dumb” and associate curves
    v. Draw a Helix
    vi. Draw a text curve
    vii. Delete and blank a curve
    viii. Change a curve’s appearance
c. Multiview Projections and NX Sketcher
    i. Enter Sketcher
    ii. Fully constrain a sketch
    iii. Constrain the sketch to the datum
    iv. Use dimensions and constraints to constrain the sketch
    v. How to use the Mirror Sketch feature
    vi. The function of the inferred dimension icon?
    vii. Describe how to use the following constraints
        1. Perpendicular
        2. Parallel
        3. Concentric
        4. Tangent
d. Sectional View/Design Features
    i. Extrude a Sketch into a solid
    ii. Use the Draft Angle option in Extrude
    iii. Revolve a Sketch into a solid
    iv. Use the Block, Cylinder, Cone and Sphere Primitives as a base in your solid model
e. Advanced Design Features
    i. Understand how to use the various methods in locating design features.
        5. Horizontal
        6. Vertical
        7. Perpendicular

8. Distance
9. Point onto Point
10. Point onto Line

ii. Know the three basic steps in defining a Design Feature
   11. Locate the face on which to construct the design feature (or pick the sketch)

iii. Define the Design Feature geometry
iv. Position the Design Feature on the face or plane
v. Know how to use Circular Arrays
vi. Know the difference between a counter bore hole, a counter sink hole and a straight hole
vii. Create a Block, and Cylinder primitive
viii. Perform Boolean operations on solids
ix. Create a Pad Design Feature
x. Create a Boss Design Feature
xi. Create a Slot
xii. Know how to fully position a Pad and Slot feature

f. Dimensions and Detail Features
   i. Create a Chamfer, and Edge Blend
   ii. Perform a Trim Body operation
   iii. Perform a Draft and body Taper operation
   iv. Difference between a Body Taper and Draft
   v. Manufacturing operations typically requiring the use of Draft and Body Taper

g. Expressions
   i. Define variables in the Expressions window
   ii. Use Expressions in defining you Design Features, Sketches, etc
   iii. Use the Expressions window to edit dimensions and expressions

h. Tolerancing/Feature Editing
   i. Use the part navigator to edit features
   ii. Be able to move features in the part navigator
   iii. Modify feature parameters
   iv. Modify feature positioning

i. Basic Assemblies
   i. Top-down assembly
   ii. How to edit in the assembly with “Work Part”
   iii. How to edit with “Displayed Part”
   iv. How to reposition a part in Assembly
   v. How to edit Touch/Align Constraints in an Assembly

    vi. How to change a part's appearance (color, translucency and visibility) in Assembly
    vii. How to make an exploded assembly view
    viii. Create new parts within an assembly
    ix. How to use WAVE link to link geometry from the assembly to the newly created parts

j. Engineering Drawings/Basic Drafting
    i. Create engineering drawings from solid models
    ii. Arrange and manage 2D views in drafting mode
    iii. Add the UTEP drawing patterns, text and notes

k. Drafting
    i. Add sectional and auxiliary views to the drawing sheet
    ii. Modify the view style so that hidden lines are shown in the view
    iii. Modify the view style so that smooth lines are or are not shown
    iv. Add and edit Title Block
    v. Fully dimension a simple part
    vi. Append the dimension text to add notes such as TYP of PLCS
    vii. Modify a dimension so that the arrows are inside or outside the dimension extension lines
    viii. Modify the text location in a dimension
    ix. Add the UTEP drawing patterns, text and notes
    x. Add notes and labels
    xi. Add centerline symbols
    xii. Create thread and weld symbols

I. Course Number and Name

MECH 1321: Statics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor’s or Course Coordinator’s Name

Yirong Lin

IV. Text Book, Title, Author, and Year

Hibbeler, R. C.(2009). *Engineering Mechanics: Statics*. 12th Edition

V. Specific Course Information

a. Description: Principles of mechanics, vectors, force systems, equilibrium of particles and rigid bodies, force analysis of truss structures, distributed forces, centroids, and friction.
b. Prerequisites: MATH 1411: Calculus
c. Required

VI. Specific Goals for the Course

At the end of the course, students will learn the principles that govern the behavior of rigid-body mechanical engineering systems in static equilibrium. Specifically, students will be able to do the following:

a. Identify an engineering problem appropriate for engineering mechanics analysis;
b. Draw a free-body diagram and identify all forces an moments acting on an object at rest;
c. Represent force and moment systems with equivalent systems;
d. Perform an analysis to identify all forces an moments acting internally or externally on an object;
e. Determine geometric properties of one, two and three dimensional objects

This class significantly addresses the following ABET Objectives:

Program Outcomes
A[3]

E[3]

VII. Brief List of Topics to be Covered

a. General Principles
    i. Classification of mechanics
    ii. International and English units
    iii. General procedure for analysis
b. Force Vectors
    i. Scalars and vectors
    ii. Vector operations
    iii. Cartesian vectors
    iv. Dot product
    v. Addition of vectors
c. Equilibrium of a Particle
    i. Condition for the equilibrium of a particle
    ii. Free-body diagram
    iii. Three dimensional force systems
d. Force Systems Resultant
    i. Cross product
    ii. Principle of moments
    iii. Moment of a force in scalar and vector formulation
    iv. Simplification of a force and couple system
    v. Reduction of a simple distributed loading
e. Equilibrium of a Rigid Body
    i. Conditions for rigid body equilibrium
    ii. Equations for equilibrium
    iii. Two and three force member
f. Structural Analysis
    i. Simple trusses
    ii. The method of joints
    iii. The method of sections
    iv. Space trusses
    v. Flames and machines
g. Internal Forces
    i. Internal forces developed in structural members
    ii. Shear and moment equations and diagrams
    iii. Relations between distributed load, shear and moment
h. Friction
    i. Dry friction
    ii. Frictional forces and flat belts
    iii. Frictional forces on journal bearings

i. Center of Gravity and Centroid
    i. Center of gravity, center of mass, and the centroid of a body
    ii. Composite bodies
    iii. Resultant of a general distributed loading
j. Moment of Inertia
    i. Definition of moments of inertia for areas
    ii. Parallel-Axis theorem for an Area
    iii. Radius of gyration of an area

I. Course Number and Name

MECH 2131: Manufacturing Engineering Lab

II. Credits and Contact Hours

1 Credit Hour

III. Instructor's or Course Coordinator's Name

Angel Lerma/Barry Benedict

IV. Text Book, Title, Author, and Year

None

V. Specific Course Information

a. Description: Basic, automated, and advanced manufacturing concepts. Shop demonstration and practices.
b. Prerequisite: MECH 1305: Graphic and Design Fundamentals
c. Required

VI. Specific Goals for the Course

The primary objective of this class is to introduce the fundamentals of the machining trade. Emphasis is placed on the following topics:

a. Machine shop safety,
b. Blueprint interpretation,
c. Measuring instruments,
d. Hand tools,
e. Machine shop conventional machines,
f. Principles of computer numerical control machines and programming.

This class significantly addresses the following ABET Objectives:

Program Outcomes

C[3]
K[3]

I. Course Number and Name

MECH 2311: Introduction to Thermal-Fluid Sciences

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Evgeny Shafirovich

IV. Text Book, Title, Author, and Year

Çengel, Y. A., Cimbala, J. M., & Turner, R. H. (2008). *Fundamentals of Thermal Fluid Sciences*. 4th Edition. McGraw-Hill

V. Specific Course Information

a. Description: An introduction to basic concepts of thermodynamics and fluid mechanics to include properties, property relationships, states, and fluids. Presentation of the basic equations of thermal-fluid science, continuity, first and second laws of thermodynamics, and momentum.
b. Prerequisites: MATH 1312: Calculus II
c. Required

This course contains one credit hour of basic mathematics.

VI. Specific Goals for the Course

At the end of this class the typical students should be able to:

a. Understand the concepts of temperature, pressure, and energy.
b. Evaluate properties of pure substances and use property data for solving problems.
c. Apply the principles of conservation of mass and energy to closed and open systems.
d. Understand and apply the second law of thermodynamics, including concepts such as irreversibility and Carnot cycle.
e. Understand the concept of entropy, use relations and property diagrams involving entropy.

f. Understand the basic concepts of fluid mechanics and properties such as viscosity and surface tension.
g. Solve fluid statics problems.
h. Apply the Bernoulli and energy equations.
i. Apply the conservation of momentum to control volumes.
j. Students will learn to graphically represent integrals of functions.
k. Students will be able to analyze functions finding maximums, minimums and inflection points.
l. Students will be able to compute exact and inexact differentials (partial derivatives).

This class significantly addresses the following ABET Objectives:

Program Outcomes
A[3]
E[3]

VII. Brief List of Topics to be Covered

a. Introduction and overview
b. Basic concepts of thermodynamics
c. Energy, energy transfer, and general energy analysis
d. Properties of pure substances
e. Energy analysis of closed systems
f. Mass and energy analysis of control volumes
g. The second law of thermodynamics
h. Entropy
i. Introduction to fluid mechanics, properties of fluids
j. Fluid statics
k. Bernoulli and energy equations
l. Momentum analysis of flow systems

I. Course Number and Name

MECH 2322: Mechanics of Materials

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Ramana Chintalapalle, Jack Chessa and L. Roy Xu

IV. Text Book, Title, Author, and Year

Hibbeler. R. C. (2011). *Mechanics of Materials I*. 8^{th} Edition. Prentice Hall.

V. Specific Course Information

a. Description: Determination of stresses, deflections, and stability of deformable bodies, including axial loading, torsion, beam bending, column buckling, and principal and compound stresses and matrix structural analysis.
b. Prerequisites: MECH 1321: Mechanics I- Statics
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be able to:

a. Solve basic axial, torsion and beam bending stress analysis and deflection problems.
b. Solve simple combined loading stress analysis and deflection problems.
c. Have a good understanding of stress and strain components, stress transformation in 2D and 3D.
d. Solve statistically indeterminate problems.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]
E[3]

VII. Brief List of Topics to be Covered

a. Stress, strain and basic elasticity
    i. Stress, normal and shear
    ii. Strain, normal and shear
    iii. Hooke's law (uniaxial and generalized)
    iv. Poisson's effect
b. Axial
    i. Deformation under axial loading
    ii. Normal strain and stress under axial loading
    iii. Statistically indeterminate problems
    iv. Saint-Venant's principle
    v. Thermal stresses
c. Torsion
    i. Torsion stresses
    ii. Torsion deformations
    iii. Total angle of twist
    iv. Statistically indeterminate shafts
d. Pure bending
    i. Stresses in pure bending
    ii. Deformations in symmetric beams
    iii. Bending in composite beams
e. Shear/transverse loading
    i. Basics of shear stresses
    ii. Determination of shear on a beam
    iii. Shear in thin walled members
f. Stress and strain transformations
    i. Transformation of plane stresses
    ii. Determination of principal stresses
    iii. Mohr's circle in two-dimensions
    iv. Calculation of principal stress states
g. Combined loading
    i. Combined torsion/axial
    ii. Combined axial/bending
    iii. Combined torsion/bending
h. Design of shafts and beams
    i. Shear and bending moment diagrams
    ii. Relationship between load, shear and bending moment
    iii. Design of prismatic beams
i. Beam deflection
    i. Elastic curvature ODE

ii. Solution with various end conditions by integration
iii. Statically indeterminate beams
iv. Use of superposition
v. Bema deflection tables
vi. Solution by moment-area methods

j. Column buckling
   i. Introduction to structural stability and buckling
   ii. Euler formula for pinned-pinned case
   iii. Extension to other end conditions

I. Course Number and Name

MECH 2331: Materials and Manufacturing Processes

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

C.V. Ramana

IV. Text Book, Title, Author, and Year

Henkel, D. P., & Pense, A. W. (2002). *Structure and Properties of Engineering Materials* McGraw Hill.

Askeland, D. R., Fulay, P.P., & Wright, W. J. (2011). *The Science and Engineering Materials.* Cengage Learning Engineering.

V. Specific Course Information

a. Description: Properties of engineering materials and failure theories. Introduction to manufacturing processes, manufacturing equipment and quality assurance.
b. Prerequisites: CHEM 1305: Chemistry I
c. Required

VI. Specific Goals for the Course

In future years, structural materials and processes in aerospace, power, marine, engine and other mechanical and chemical propulsion applications will have to meet the challenges of reaching new heights of efficiency and service life. In this context, engineers must be prepared to better handle the industrial and technological challenges specifically to engineer novel materials and predict their failures due to deterioration. However, the ability to improve the efficiency by engineering and designing can only be derived from the knowledge of structure-property relationships and deterioration mechanisms of a wide range of engineering materials, specifically those as encountered by mechanical engineers in the industry. This course is intended and designated to prepare the mechanical engineers with a broad knowledge and skill set in the topical area of structure and properties of engineering materials. Specifically, students will explore the fundamentals of engineering materials, which include simple metals to advanced ceramics and composites, and their properties. By learning the course contents, students will be able to answer questions for selection of engineering materials in terms of property requirement, processes involved, prediction of service life, and cost and efficiency.

Course Objectives:

- Introduce various types of engineering materials that are most common to the mechanical engineers in the industry
- Develop familiarity with materials' structure, properties and phenomena for efficient designing
- Discuss options to further increase the efficiency, reduce costs, and establish the environmental safety

This class significantly addresses the following ABET Objectives:

Program Outcomes
C [3]

VII. Brief List of Topics to be Covered

1. Introduction to Engineering Materials
2. Structure
3. Crystal Imperfections
4. Equilibrium and Kinetics
5. Phase Diagrams
6. Phase Transformations
7. Mechanical Properties
8. Thermal Properties
9. Deterioration of Properties and Failure Prevention
10. Oxidation and Corrosion
11. Ceramics
12. Composites
13. Selection and Designing of Engineering Materials
14. Manufacturing Industries
15. Operations of Manufacturing
    a. Quality Control
    b. Manufacturing Systems
    c. Product Design
    d. Manufacturing Engineering

I. Course Number and Name

MECH 2340: Mechanics II - Dynamics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Roger Gonzalez

IV. Text Book, Title, Author, and Year

Hibbeler, R. C. (2010). *Engineering Mechanics – Dynamics*. 12th Edition. Pearson

V. Specific Course Information

a. Description: An introduction to dynamics (kinematics and kinetics) of particles and rigid bodies, work and energy, impulse and momentum.
b. Prerequisites: MECH 1321: Statics
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should learn Newtonian mechanics which is an important topic for engineers. The objective of this course is to present to the students the concepts and applications of the motions of bodies using the principles established by Newton and Euler.

This course presents an introduction to dynamics (kinematics and kinetics) of particles and rigid bodies, work and energy, impulse and momentum.

This class significantly addresses the following ABET Objectives:

Program Outcomes
- A [3]
- E [3]

VII. Brief List of Topics to be Covered

Below is a list of the detail topics to be covered in this class:

1) Kinematics of a particle
2) Kinetics of a particle: force and acceleration
3) Kinetics of a particle: work and energy
4) Kinetics of a particle: impulse and momentum
5) Planar kinematics of a rigid body
6) Planar kinetics of a rigid body: force and acceleration
7) Planar kinetics of a rigid body: work and energy
8) Planar kinetics of a rigid body: impulse and momentum

I. Course Number and Name

MECH 2342: Electro-Mechanical Systems

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

A. Bronson

IV. Text Book, Title, Author, and Year

Hambley, A. R. (2011). *Electric Engineering: Principles and Applications*. 5th Edition. Pearson.

V. Specific Course Information

a. Description: This course provides fundamental education in electrical circuit analysis techniques to nonelectrical engineering majors. Some topics include circuit equations and network theorems, introduction to digital logic circuits, motors and generators, principles of sensing, actuation, and control.
b. Prerequisites: MATH 1312: Calculus II
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be able to:

a. Analyze simple DC circuits using ohm's law, Kirchhoff's current and voltage laws.
b. Analyze DC circuits containing independent sources using node-voltage & mesh-current methods.
c. Understand difference between ideal sources and practical sources.
d. Understand Thevenin and Norton equivalent circuits, superposition, and source transformation techniques.
e. Analyze steady state response of basic AC circuits.
f. Understand logic circuits.
g. Understand fundamental properties of three-phase power.
h. Gain basic insight into transformer fundamentals, electric motors and generators.

i. Understand the principles of sensing, actuation, and controls.

This class significantly addresses the following ABET Objectives:

Program Outcomes
A[3]
C[2]
E[2]
K[3]

VII. Brief List of Topics to be Covered

a. Definition of voltage, current, and Ohm's law and resistance, and Kirchhoff's law.
b. Resistive circuits
c. Inductance and capacitance
d. First order circuits
e. Steady-state analysis
f. Introduction to logic circuits
g. Instrumentation
h. Semiconductors (diodes, op amps)
i. Magnetic circuits
j. DC Machines
k. AC Machines
l. Introduction to mechatronics: sensors and actuators

I. Course Number and Name

MECH 2351: Engineering Analysis I

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Mohammod Noor-A-Alam

IV. Text Book, Title, Author, and Year

Bronson, R. & Costa, G. (2006). *Schaum's Outline of Differential Equations*. 3rd Edition. McGraw-Hill
Lipschutz, S. & Lipson, M. (2008). *Schaum's Outline of Linear Algebra*. 4th Edition. McGraw-Hill

V. Specific Course Information

a. Description: Introduction to basic applications of mathematical principles and computational techniques to analyze and solve engineering problems; basics of differential equations; uses of mathematical software and programming languages for modeling and solving engineering problems.
b. Prerequisite: MATH 1312: Calculus II
c. Required

VI. Specific Goals for the Course

Introduction to ordinary differential equations with a focus on the engineering applications of first and second order linear and nonlinear differential equations (ODEs) with constant coefficients, both homogeneous and inhomogeneous

a. Students should have a very firm understanding of the differences in the responses of the two types of ODEs;
b. An introduction to basic linear algebra. The students need to be able to pose a large system of algebraic equations as a matrix vector system;
c. The students should have an understanding of what constitutes an over constrained and under constrained system of equations without the need to get too much intro rank and span concepts. This is concepts line number of equations

number of unknowns, linear dependency and its manifestation and a singular system.

d. A basic introduction to an advanced programming tool (e.g. Mathematica and others); the students at the end of the class should be comfortable solving calculus based problems in both programs.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]

VII. Brief List of Topics to be Covered

a. Introduction to basic Engineering Analysis
b. Introduction to an advanced programming tool (e.g. Mathematica)
    i. Mathematica environment
    ii. Mathematica notebook
    iii. Basic calculus problems with Mathematica
    iv. D operator
    v. Line graphs
    vi. Equations vs. assignment
c. Ordinary Differential Equation (ODE) Basics
    i. Some basic mathematical models with ODEs
        1. By hand
        2. With Mathematica
    ii. Direct integration solution
    iii. ODE classification
d. Solving first order ODEs
    i. Separation of variables
    ii. Heat conduction (linear)
        1. By hand
        2. With Mathematica
        3. Solve nonlinear 1^{st} order ODEs with Mathematica (nonlinear convection)
e. Solving second order ODEs
    i. Solution of second order linear, homogeneous with constant coefficients
        1. Characteristic equation
        2. Complex roots
    ii. Free vibration
        1. By hand

        2. With Mathematica
    iii. Solution of inhomogeneous, linear 1st order ODEs with constant coefficients
        1. Method of undetermined coefficients
f. Introduction to partial differentiation equations (Optional)
g. Linear Algebra
    i. Matrix algebraic operations
        1. Addition
        2. Multiplication
        3. Determinant
        4. Inverse
        5. Eigenvalues and eigenvectors (eig in Matlab)
    ii. Writing a system of linear algebraic equations as a matrix vector system
    iii. Gaussian elimination
    iv. Solving in Mathematica
    v. Truss problems
        1. By hand
        2. In Mathematica
    vi. Piping problems
        1. By hand
        2. In Mathematica
    vii. Over-constrained and under-constrained systems
        1. Singular matrix
        2. Linear dependency
        3. Least squares (Mathematica only)*
    viii. Eigenvalues problem
        1. By hand
        2. Mathematica
        3. Principle values (Mohr's circle)
        4. Modal analysis

I. Course Number and Name

MECH 3312: Thermodynamics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Evgeny Shafirovich

IV. Text Book, Title, Author, and Year

Cengel, Y. & Boles, M. (2010).*Thermodynamics an Engineering Approach*. 7^{th} Edition. McGraw Hill

V. Specific Course Information

a. Description: Continuation of MECH 2311. Application of principles of cycles and reactive systems; energy relationships and equilibrium requirements.
b. Prerequisite: MECH 2311: Introduction to Thermo-Fluid Science
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be able:

a. To present a comprehensive and rigorous treatment of classical thermodynamics while retaining an engineering perspective
b. To lay the groundwork for subsequent thermal-fluid science sequence courses.
c. To prepare the student to effectively use thermodynamics in the practice of engineering.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]
E[3]

VII. Brief List of Topics to be Covered

a. Properties of a pure substance

b. First Law of Thermodynamics: Closed Systems
c. First Law of Thermodynamics: Control Volumes
d. Second Law of Thermodynamics
e. Entropy: A Measure of Disorder
f. Exergy: Measure of Work Potential
g. Gas Power Cycles
    i. Carnot Cycle
    ii. Otto Cycle
    iii. Diesel Cycle
    iv. Brayton Cycle
h. Vapor Cycles
    i. Rankine cycle
i. Refrigeration
j. Gas Mixtures
k. Psychometrics
l. Combustion

I. Course Number and Name

MECH 3313: Thermo-Fluid Lab

II. Credits and Contact Hours

3 Credit Hours

III. Instructor’s or Course Coordinator’s Name

TBD

IV. Text Book, Title, Author, and Year

None

V. Specific Course Information

a. Description: A continuation of the Mechanical Engineering Lab series with practical measurement problems in the thermo-fluid area.
b. Prerequisite: MECH 2311: Introduction to Thermo-Fluid Science
c. Required

VI. Specific Goals for the Course

This course will provide students with hands-on experience dealing with practical issues in thermal and fluid engineering experiments. In this lab students should leave with the ability to:

a. Take the basic measurements of well-known phenomenon
b. Analyze data, taking into account various sources of error and uncertainty in the setup
c. Construct a professional lab report

This class significantly addresses the following ABET Objectives:

Program Outcomes

B[3]
G[3]

VII. Brief List of Topics to be Covered

a. Basic Measurements
    i. Temperature measurement
    ii. Pressure measurement and calibration
    iii. Viscosity measurement
    iv. Velocity measure and study of aerodynamic forces (drag/lift) acting on various geometric bodies
b. Heat Transfer
    i. Conduction heat flow through solid materials for one-dimensional steady flow of heat
    ii. Combined (Convection + Radiation) heat transfer under natural convection
c. Cycles and Pump
    i. Concept of cavitation and performance study of a centrifugal pumping system
    ii. Performance study of a Rankine cycle stream turbine power system
    iii. Performance study of a gas turbine power system
d. Each student submits one report on each experiment, even if the experiments are done in groups. The page limit of each report is typically four. This page limit includes all necessary figures and tables in the report with suitable captions. Reports contain:
    i. An Introductory section describing the background and objectives of the experiment
    ii. Experimental setup and procedure section where students should give a brief description of the equipment and setup used including what was done and what data was collected
    iii. Result section displaying results (tabular and graphical). Show at least one set of sample calculation
    iv. Conclusion section where you should discuss the measurement errors and uncertainties and conclusions that you gained from the experiment.

I. Course Number and Name

MECH 3314: Fluid Mechanics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

V. Kumar

IV. Text Book, Title, Author, and Year

Cengel, Y.A. & Cimbala, J. M. (2006). *Fluid Mechanics Fundamental and Applications*. 2^{nd} Edition. McGraw-Hill Inc.

V. Specific Course Information

a. Description: Fluid properties, fluid statics, fluid flow concepts and basic equations, dimensional analysis and dynamic similitude, viscous effects, fluid resistance, laminar and turbulent boundary layers, flow-through pipes.
b. Prerequisite: MECH 2311: Introduction to Thermo-Fluid Science
c. Required

VI. Specific Goals for the Course

The goal of this course is to give you an understanding of the physical mechanisms involved in fluid flows including predictions of flows and resulting forces. This course covers fundamental concepts of fluid mechanics with a broad range of engineering and technological applications. An understanding of the fluid mechanics is necessary since fluid dynamical processes are an important part of the design processes of vehicles, power plants, chemical processing units, buildings, bridges, and among other things.

The student should leave with a knowledge of physical quantities important to fluid flow, have an ability to apply fundamental laws in control volume form to engineering situations, obtain a knowledge of fluid flows in pies and around objects, and have an ability to apply basic laws of fluid mechanics to compute various quantities.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]

E[3]

VII. Brief List of Topics to be Covered

a. Review of basic concepts: properties, kinematics, statics
b. Mass, Bernoulli, and energy equations
c. Momentum analysis of flow systems
d. Dimensional analysis and modeling
e. Internal flow
f. Differential analysis of fluid flow
g. External flow: drag and lift
h. Turbomachinery

I. Course Number and Name

MECH 3323: Solid Mechanics Lab

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

TBD

IV. Text Book, Title, Author, and Year

None

V. Specific Course Information

a. Description: Displacement, velocity, acceleration, force, torque, strain, and stress measurements. Data acquisition, processing, and analysis. Statistical analysis of experimental data.
b. Prerequisite: MECH 2322: Mechanics of Materials
c. Required

VI. Specific Goals for the Course

This course will provide students with hands-on experience dealing with practical issues in engineering experiments. The main objective is to give students some exposure and reinforcement to several concepts of strength of materials and dynamics in an experimental context. In this lab students should leave with the ability to:

a. Take the basic measurements of well-known phenomenon
b. Analyze data, taking into account various sources of error and uncertainty in the setup
c. Construct a professional lab report

This class significantly addresses the following ABET Objectives:

Program Outcomes

B[3]
G[3]

VII. Brief List of Topics to be Covered

a. True structures lab lessons 2: I-beam in bending
b. True structures lab lesson 3: Hollow shaft (tube) analysis
c. True structures lab lesson 4: Wind strain analysis
d. TM 16 Experiments 1: Simple pendulum
e. TM 16 Experiments 2: Compound pendulum
f. TM 16 Experiments 5: Bifilar suspension
g. TM 16 Experiments 6: Mass-spring systems
h. TM 16 Experiments 7: Torsional oscillations of a single rotor
i. TM 16 Experiments 8: Torsional oscillations of a single rotor with viscous damping
j. TE 15 Experiments 1: Energy absorbed at fracture experiment

I. Course Number and Name

MECH 3334: Mechanical Design

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Noe Vargas Hernandez

IV. Text Book, Title, Author, and Year

Budynas, R. G., & Nisbett, J. K. (2010). *Shigley's Mechanical Engineering Design*. 9th Edition. McGraw-Hill

V. Specific Course Information

a. Description: Stress analysis, deflection analysis, and strength of mechanical elements; design of screws, fasteners, and joints; clutches, brakes, couplings, and shafting.
b. Prerequisites: MECH 2331: Materials and Manufacturing Processes; MECH 2322: Mechanics of Materials.
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be well prepared in the following areas:

1. Understand the Basics of Mechanical Design such as Materials, Load and Stress Analysis, Deflection and Stiffness.
2. Comprehend the principles of Failure prevention resulting from Static and Variable Loading
3. Be able to design simple Mechanical Elements such as shafts, screws, springs, gears, etc.

This class significantly addresses the following ABET Objectives:

Program Outcomes
C [3]

D [3]

VII. Brief List of Topics to be Covered

Below is a list of the detail topics and subtopics to be covered in this class

1.	Introduction to Mechanical Engineering Design	(Chapter 1)
2.	Materials	(Chapter 2)
3.	Load and Stress Analysis	(Chapter 3)
4.	Deflection and Stiffness	(Chapter 4)
5.	Failures Resulting From Static loading Torsion	(Chapter 5)
6.	Fatigue Failure Resulting From Variable Loading	(Chapter 6)
7.	Shafts and Shaft Components	(Chapter 7)
8.	Screws, Fasteners and the Design of Nonpermanent Joints	(Chapter 8)
9.	Mechanical Springs	(Chapter 10)
10.	Gears	(Chapter 13, 14, 15)
11.	Mechanical Design Project	

I. Course Number and Name

MECH 3345: System Dynamics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

I. Shabib

IV. Text Book, Title, Author, and Year

Close, C., Newell, J. C., & Frederick, D. K. (2001). *Modeling and Analysis of Dynamic Systems.* 3rd Edition.Wiley

V. Specific Course Information

a. Description: Kinematics of single and multiple degrees of freedom systems; vibrations, kinematic simulation software, and an introduction to control systems.
b. Prerequisite: MECH 2340: Dynamics, MECH 2342: Electro-Mechanical Systems
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be able to do the following for dynamic systems:

a. Given a description of the system, construct a simplified version using idealized elements and define a suitable set of variables.
b. Use the appropriate laws to obtain a mathematical model of the system.
c. For linear systems, solve the mathematical models to find the time response of the system.
d. Analyze stability of linear systems and where appropriate, evaluate time constants, damping ratios, and undamped natural frequencies.
e. Use computer tools to obtain the response of a system, and to study the influence of changing system parameters on the system response.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]

E[3]

VII. Brief List of Topics to be Covered

a. Standard forms for system models
b. Translational mechanical systems
c. Rotational mechanical systems
d. Electrical systems
e. Transform solution of linear models
f. Transfer function analysis
g. Developing a linear model
h. Block diagrams for dynamic systems
i. Modeling, analysis, and design tools

I. Course Number and Name

MECH 3352: Engineering Analysis II

II. Credits and Contact Hours

3 Credit Hours

III. Instructor’s or Course Coordinator’s Name

Vinod Kumar

IV. Text Book, Title, Author, and Year

Chapra, S. C. (2011). *Applied Numerical Methods with MATLAB for Engineers and Scientist.* 3rd Edition. McGraw Hill

V. Specific Course Information

a. Description: Concepts and modeling of ordinary and partial differential equations for a variety of engineering phenomena using finite difference, finite volume, and finite element techniques. Introduction to statistics, data analysis, and probability theories.
b. Prerequisite: MECH 2351: Engineering Analysis I
c. Required

VI. Specific Goals for the Course

The Primary goal is to provide mechanical engineering majors with a basic knowledge of numerical methods including: root-finding, elementary numerical linear algebra, solving systems of linear equations, curve fitting, and numerical solution to ordinary differential equations, curve fitting, and numerical integration. An advanced programming tool (e.g. MATLAB) will be used for implementation and application of these numerical methods. The numerical techniques learned in this course enable the students to work with mathematical models of technology and systems.

By the end of this course, the students should be able to do the following:

a. Structured programming: Understand basic structured programming concepts involving decision making, loops, functions, and parameter passing implemented within the MATLAB programming environment.

b. Numerical methods: Understand the most common numerical methods used in engineering analysis, when to use each method, and how to implement basic methods in a structured manner using MATLAB's programming language.
c. Numerical accuracy: Estimate the amount of error inherent in different numerical methods.
d. Numerical efficiency: Assess the efficiency of a selected numerical method when more than one option is available to solve a certain class of problem.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[3]
E[2]
K[3]

VII. Brief List of Topics to be Covered

a. Introduction to Advanced Engineering Analysis
    i. Complex engineering problems
b. Basics to Programming (Matlab)
    i. Matlab environment
    ii. Mathematical Operators, M-File
    iii. Plotting
    iv. Program flow control (If and Switch statement, While loop, For loop, etc)
    v. Built-in functions, User-defined functions
c. Roundoff and Truncation Errors
d. Root finding
    i. Bracketing methods
    ii. Open methods
e. Solution to linear systems
    i. Gaussian elimination
    ii. LU factorization
f. Curve fitting and Interpolation
    i. Linear Regression
        1. Fundamentals and by hand
        2. In MS Excel and in Matlab
    ii. Polynomial Regression
        1. Fundamentals and by hand
        2. In MS Excel and in Matlab
    iii. Interpolation

        1. Fundamentals and by hand
        2. In MS Excel and in Matlab
    iv. Case Study
g. Differential Equations
    i. Euler's Method
        1. Fundamentals and by hand
        2. In MATLAB
    ii. Modified Euler
        1. Fundamentals and by hand
        2. In Matlab
    iii. Runge Kutta
        1. Fundamentals and by hand
        2. In Matlab
    iv. Higher Order Differential Equations in MATLAB
    v. Case Study
h. Numerical Integration
    i. Trapezoid Rule
        1. Fundamentals and by hand
        2. In Matlab
    ii. Simpson's Rule
        1. Fundamentals and by hand
        2. In Matlab
    iii. Case Study

I. Course Number and Name

MECH 4315: Heat Transfer

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Ahsan Choudhuri

IV. Text Book, Title, Author, and Year

Cengel, Y. & Ghajar, A. J. (2011). *Heat and Mass Transfer*. 4th Edition. McGraw Hill.

V. Specific Course Information

a. Description: Introduction to heat transfer by conduction, convection, and radiation; steady and transient states; steady periodic states; heat transfer in engineering apparatus and quality assurance.
b. Prerequisites: MECH 3314: Fluid Mechanics; MECH 3312: Thermodynamics
c. Required

VI. Specific Goals for the Course

At the end of this class the typical students should be able:

1. To present a comprehensive and rigorous treatment of classical heat transfer while retaining an engineering perspective.
2. To encourage creative thinking and the development of an intuitive feel for heat transfer.
3. To prepare the student to effectively use heat transfer in the practice of engineering.

This class significantly addresses the following ABET Objectives:

Program Outcomes
A [2]
E [3]

VII. Brief List of Topics to be Covered

Below is a list of the detail topics and subtopics to be covered in this class:

1. Heat Conduction Equation
    a. One dimensional heat conduction
    b. Heat generation in a solid
2. Steady Heat Conduction
    a. Plane Walls
    b. Thermal Resistance Models
    c. Cylinders and Spheres
    d. Critical Radius of Insulation
    e. Finned Surfaces
3. Transient Heat Conduction
    a. Lumped System Analysis
    b. Large Plane Walls, Long Cylinders, and Spheres
    c. Semi-infinite solids
4. External Forced Convection
    a. Flow over flat plates
    b. Flow across cylinders and spheres
    c. Flow across tube banks
5. Internal Forced Convection
    a. Mean velocity and temperature
    b. Entrance region
    c. Thermal Analysis (Constant heat flux, Constant Surface temp)
    d. Laminar/Turbulent Flow in tubes
6. Natural Convection
    a. Grashof number
    b. Natural convection over surfaces
    c. Natural convection from finned surfaces
    d. Natural and Forced Convection Combined
7. Radiation Heat Transfer
    a. Radiative Properties (emissivity, Absorptivity, Reflectivity, Transmitivity)
    b. View Factor
    c. Black Surfaces

I. Course Number and Name

MECH 4316: Thermal System Design

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Ahsan Choudhuri

IV. Text Book, Title, Author, and Year

Janna, W. (2009). *Design of Thermal Fluid Systems*. 3rd Edition. CL Engineering.

V. Specific Course Information

a. Description: Design, analysis, and optimization of fluid flow, heat transfer and energy processes of ducts and piping, heat exchangers, fluid machinery, power generation and environmental control systems. Use of computational fluid dynamics (CFD) tools to synthesize thermo-fluid system designs.
b. Prerequisite: MECH 4351: Heat Transfer
c. Required

VI. Specific Goals for the Course

The course is a capstone type of course in the energy systems (or thermal sciences) area. It corresponds to the machine design course in the Mechanical systems area. The course is intended for senior Mechanical Engineering students who intend to practice in the fluid/thermal area.

This class significantly addresses the following ABET Objectives:

Program Outcomes

- C[3]
- I[3]
- J[3]
- K[3]

VII. Brief List of Topics to be Covered

a. Fluid Properties
b. Piping Systems
c. Piping Systems II
d. Pumps and Pipes
e. Heat Transfer Fundamentals
f. Double Pipe Heat Exchanger
g. Shell and Tube Heat Exchanger
h. Frame/Plate and Cross Flow HX

I. Course Number and Name

MECH 4326: Applied Finite Element Analysis

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

John F. Chessa

IV. Text Book, Title, Author, and Year

Cook, R. D. (1995). *Finite Element Modeling for Stress Analysis*. John Wiley & Sons, Inc.

V. Specific Course Information

a. Description: Introduction to finite element methods, discretization of governing equations and solution algorithms. Analysis of solid mechanics and structural problems using existing FEA computer programs.
b. Prerequisite: MECH 3334: Mechanical Design
c. Required

VI. Specific Goals for the Course

Students should be able to:

a. Understand the basic approach in finite element analysis
b. Be able to build finite element models with shell, continuum and beam/rod elements in a commercial finite element program (NASTRAN)
c. Know how to assemble and solve simple 1D finite element models by hand
d. Understand the mathematical differences in various finite elements (shell, bar, axisymmetric, etc.)
e. The ability to perform some simple checks on the results from a finite element model
f. Understanding of various errors in a finite element model

This class significantly addresses the following ABET Objectives:

Program Outcomes

E[3]

I[3]

K[3]

VII. Brief List of Topics to be Covered

a. Basic finite element terminology nodes, elements d.o.f.s etc
b. Bar elements stiffness matrix
c. Beam element stiffness matrix
d. Solution of Kd=f with essential boundary conditions
e. NASTRAN input file
f. Strain displacement relations
g. The B-Matrix
h. Plane stress vs. plane strain and their associated C-matrices
i. Constant and linear strain triangles
j. Quad 4 and quad 8 elements
k. Quad 6 element and the NASTRAN QUADR element
l. Distributed loads
m. Sparsity, bandwidth and Kd=f solution methods
n. Coordiant transformations
o. Isoparametric transformation
p. Quadrature
q. Reduced integration and stability
r. Shear locking and volumetric locking
s. Symmetry
t. Substructuring
u. Constraints (Lagrange multiplier and penalty methods)
v. Patch test
w. Element tests
x. Error in boundary conditions
y. Errors in material models
z. Theoretical convergence
aa. Mesh refinement (h and p)
bb. Hexahedral and tetrahedral elements
cc. 3D elasticity equations
dd. Axisymmetric elements and formulation
ee. Plate and shell kinematics
ff. Mindlin, Kirchhoff and DKE formulations
gg. Shear and membrane locking
hh. Shell element pathologies (MacNeal Harder test)

ii. Basic finite element dynamics equations
jj. Difference between implicit and explicit finite element codes
kk. The mass matrix
ll. Modal analysis
mm. Damping (Mass and stiffness proportional damping)
nn. Modal analysis
oo. Harmonic Response
pp. Direct Dynamic response

I. Course Number and Name

MECH 4336: Principles of Engineering Design

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Noe Vargas Hernandez

IV. Text Book, Title, Author, and Year

Each team must have 3 text books:

1. Beer, D. & McMurrey, D. (2005). *A Guide to Writing as an Engineer*. 2^{nd} Edition. Wiley and Sons.
2. Pahl, G. & Beitz, W. (2007). Engineering Design: A Systematic Approach. 3^{rd} Edition. Springer
3. And one of the following:
    - 3.1. Shigley's "Mechanical Engineering Design"
    - 3.2. Collins' "Mechanical Design of Machine Elements and Machines"
    - 3.3. Norton's "Machine Design: An Integrated Approach"

V. Specific Course Information

Course Description:
Design process and methodology from concept through analysis, layout, and report. Types of design problems, human element in design, computer aid in design, specification development, concept generation, concept evaluation, product generation, function and performance evaluation, design for manufacturing, design for assembly, design for life-cycle, sustainability, final product, documentation, ethics, safety, and economics.

a. Prerequisites: MECH 3334: Mechanical Design, MECH 4326: Finite Element Analysis

VI. Specific Goals for the Course

At the end of this class the typical students should be well prepared in the following areas:

- Students will understand the importance of a structured design process.
- Students will understand and be able to implement the phases of a structured design process.
- Students will be able to implement the key tools of a structured design process.
- Student will gain experience in working on self-managed teams.
- Students will gain confidence in their abilities to deliver an engineering solution from need to parts (completed project in MECH 4366 Senior Design)

Approximately half of the course is devoted to learn the Design Process Strategies and Tools, through theory and hands-on projects. The other half of the course is devoted to the development of a proposal and initial concept for a project to be completed in MECH 4366 Senior Design course.

This class significantly addresses the following ABET Objectives:

Program Outcomes

C [3]
F [3]
G [3]
H [3]
J [3]

VII. Brief List of Topics to be Covered

Below is a list of the detail topics and subtopics to be covered in this class

1. The Systematic Design Process
    1.1. Introduction to Engineering Design (Open Ended Problems)
    1.2. NASA Capstone Design Model
    1.3. Project Reviews
2. Proposal Preparation
    2.1. Team Organization (Teamology, Personality, Skills, Roles, Conflict Resolution, Ethics)
    2.2. Project Description (Structuring Un-structured Problems)
    2.3. Defining Design Constraints (Requirement List, Design Specification)
    2.4. Project Planning (Gantt chart, Critical Path Analysis, Resources, Budgeting)
    2.5. Proposal Report (Document Format, Writing, Effective Presentations)
    2.6. Project Concept Review (PCR)
    2.7. Proposal Preparation Mini Project (Hands-On, Minds-On)

3. Conceptual Design
    3.1. Overview (Design Strategy, Crux of the Problem)
    3.2. Functions (Overall Function, Functional decomposition)
    3.3. Function Resolution (Design Space Exploration, Searching for Alternatives)
    3.4. Types of Design (Novel, Evolutionary, Component, Parametric)
    3.5. Creativity (Ideation Methods)
    3.6. Design of Concepts (Concept Sketches, Cost Calculation, Patent Searches)
    3.7. Systems Requirement Review (SRR)
    3.8. Evaluation of Concepts (Pugh Matrix, Technology Assessment, Benchmarking)
    3.9. Concept Report (Document Format, Writing, Effective Presentations)
    3.10. Systems Design Review (SDR)
    3.11. Conceptual Design Mini Project (Hands-On, Minds-On)
4. Embodiment Design (Parameter Level Design)
    4.1. Overview (Design Strategy, Analysis/Synthesis Model)
    4.2. Analysis and Synthesis Tools
        4.2.1. Quality Function Deployment (QFD)
        4.2.2. CAD (Layout Design, Engineering Drawings, BOM)
        4.2.3. Finite Element Method.
        4.2.4. Kinematic Analysis (Motion Simulation)
        4.2.5. Failure Mode and Effect Analysis (FMEA), Critical Thinking, Safety Factors
        4.2.6. Human Factors (Ergonomics, Product Perception)
        4.2.7. Material Selection (Physical Properties, Environment, Cost)
        4.2.8. Product Life Cycle (DfX -Sustainability, Manufacturing, Assembly, Disassembly, maintenance, Safety, Recycling)
        4.2.9. Parameter Analysis
        4.2.10. Functional Testing
    4.3. Design Objectives Review (DOR)
    4.4. Product Design Review (PDR)
    4.5. Embodiment Design Mini Project (CAD, FEA, FMEA)
5. Detail Design
    5.1. Prototyping (CAM, Machine Shop Safety)
    5.2. Tolerances, Surface Finishing, Manufacturing Process Selection
    5.3. Final Design Documentation (Detailed Drawings, Manuals of Operation)
    5.4. Reviews: Critical Design Review (CDR), Product Readiness Review (PRR), Test Readiness Review (TRR), System Acceptance Review (SAR), Operational Readiness Review (ORR)
6. Design Innovation
    6.1. Intellectual Property (Patents)
    6.2. Business Plan, Marketing Plan

I. Course Number and Name

MECH 4346: Mechatronics

II. Credits and Contact Hours

3 Credit Hours

III. Instructor's or Course Coordinator's Name

Ishraq Shabib

IV. Text Book, Title, Author, and Year

Bolton, W. (2009). *Mechatronics*. 4^{th} Edition. Prentice Hall.

V. Specific Course Information

a. Description: The integration of electronics and use of digital controls and microcontroller technology with mechanical systems; microprocessor control, control theory, actuators, and sensors.
b. Prerequisite: MECH 3345: System Dynamics
c. Required

Mechatronics is commonly defined as the synergistic integration of mechanical engineering with electronics and intelligent computer control in the design and manufacture of products and processes. Mechatronics is complex due to its interdisciplinary nature and its system integration. Therefore, in order to understand it, one has to experience building a mechatronic product/device in addition to studying the relevant theoretical materials. Consequently, a course on mechatronics will have to deal with complex theoretical subject matters as well as the complexity of design, building and testing of a mechatronic device such as robot as a class project. This course contains one credit hour of basic mathematics.

VI. Specific Goals for the Course

The goal of this course is that students acquire theoretical knowledge and hands on experience in integration of mechanical engineering with electronics and intelligent computer control in the design and manufacturing of product and process. The objectives are:

- Acquiring multidisciplinary knowledge (Mechanical system, Electrical system, Sensors, Actuators, Microcontrollers and control principles)

- Improving skills of problem solving and decision making
- Developing critical and creative thinking abilities
- Acquiring systematic thinking approach to design of Mechatronics device/process
- Developing teamwork skills
- Experiencing design, development and testing of a Mechatronics device/product, with time and budget restrictions
- Improving students' perception of technology
- Students will study Boolean Algebra and apply it to the control of PLC machines.
- Students will learn to use Laplace Transforms to compute transient and steady state responses.
- Students will learn and use the Final Value Theorem.
- Students will learn Series Expansions and their applications to system response predictions.
- Students will learn to draw and interpret Bode Plots, Root Loci and use stability theorems such as the Routh Hurwitz Process to design and analyze systems.
- Students will learn about Digital Sampling of continuous systems and the Fourier Sampling Theorem.

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[2]
B[3]
E[3]
K[3]

VII. Brief List of Topics to be Covered

a. Introduction to Mechatronic Systems
b. Electrical Circuits and components
c. Digital and analogue signals and their processing
d. System dynamics and system response
e. Control principles and design
f. Actuators
g. Sensors
h. Microprocessor/Microcontroller

I. Course Number and Name

MECH 4346 Laboratory: Taken concurrently with MECH 4346

II. Credits and Contact Hours

N/A

III. Instructor's or Course Coordinator's Name

Ishraq Shabib

IV. Text Book, Title, Author, and Year

No Textbook

V. Specific Course Information

N/A

VI. Specific Goals for the Course

At the end of this class the typical student should be able to:

a. Understand how to perform a controls experiments
b. Be able to report findings in a professional lab report
c. Identify the main components of a control system

This class significantly addresses the following ABET Objectives:

Program Outcomes

A[2]
B[3]
E[3]
K[3]

VII. Brief List of Topics to be Covered:

a. Nonlinear Simulation and Controller Design for an Inverted Pendulum
    i. Modeling of electronic motor

   ii. Modeling of carriage and pendulum arm
   iii. Modeling od the complete system
   iv. Analysis of the Transient and steady state response of the servo system
   v. Servo controller design

b. 1 Degree of Freedom Yaw Control of Twin Rotor MIMO System (TRMS) using PID controller
   i. Develop model plant
   ii. Design the PID Controllers
   iii. Use the root locus tool to select proper PID parameters
   iv. Change the Signal frequency and the values of the proportional (P), integral (I), and derivative (D) gains and see how it influences the tracking of the desired value.

c. 1 Degree of Freedom (1 DoF) pitch control of twin rotor Mimo System (TRMS) using principal
   i. Develop model plant
   ii. Design the PID controllers
   iii. Change the sinusoidal signal frequency and see how the system responds
   iv. Identify the proportional (P), integral (I), and derivative (D) gains for a smooth control of the TRMS unit

I. Course Number and Name

MECH 4366: Senior Design

II. Credits and Contact Hours

3 Credit Hours

III. Instructor’s or Course Coordinator’s Name

Noe Vargas Hernandez

IV. Text Book, Title, Author, and Year

None

V. Specific Course Information

a. Description: Conceptual preliminary and final design solutions to engineering problems by students in teams
b. Prerequisites: MECH 4336: Principles of Engineering Design; Must be in the last full semester; Must have a 2.0 GPA or better in major.
c. Required

VI. Specific Goals for the Course

As a continuation from MECH 4336, students will continue the design project working in teams to take the proposed concepts to complete its Design, Build and Test.

This class significantly addresses the following ABET Objectives:

Program Outcomes

- B [3]
- C [3]
- D [3]
- F [3]
- G [3]
- H [3]
- I [3]
- J [3]
- K [3]

VII. Brief List of Topics to be Covered

In this course, students receive on-demand support instead of general lectures.

1. Course instructor
   1.1. Provides strategic design advice
   1.2. Facilitates on-demand design tools (training on methods, hardware, software)
   1.3. Coordinates project resources (funding, materials, tools, hardware, software)
2. Project Mentor (Typically a faculty member)
   2.1. Provides advice on project-related technical areas
3. Project Client (Typically from Industry)
   3.1. Provides design requirements
   3.2. Provides all necessary support (information, access, samples, technical advice)