# MECHANICAL ENGINEERING COURSE SYLLABI LIST

| # | **Course No** | **Course Name** |
|---|---|---|
| 1 | CCEN-101 | *Introduction to Engineering* |
| 2 | MECH-105 | *Computer Aided Graphics Lec & Lab* |
| 4 | CVEN-201 | *Engineering Mechanics-I* |
| 5 | CVEN-202 | *Engineering Mechanics-II* |
| 6 | MECH-205 | *Material Science* |
| 7 | CVEN-206 | *Mechanics of Solids Lec* |
| 8 | CVEN-207 | *Mechanics of Solids-Lab* |
| 9 | MECH-208 | *Thermodynamics* |
| 10 | MECH-222 | *Eng. Measurements Lec* |
| 11 | MECH-223 | *Eng. Measurements Lab* |
| 12 | MECH-381 | *Microcontrollers in ME* |
| 13 | MECH-321 | *Fluid Mechanics Lec* |
| 14 | MECH-322 | *Thermo/Fluid Lab* |
| 15 | MECH-341 | *Anal. & Synth. of Mechanisms* |
| 16 | CVEN-308 | *Applied Numerical Analysis for Engineers* |
| 17 | MECH-351 | *Heat Transfer Lec* |
| 18 | MECH-361 | *Machine Design* |
| 19 | MECH-371 | *Design of Control Sys Lec* |
| 20 | MECH-373 | *Design of Control Sys Lab* |
| 21 | MECH-406 | *Engineering Economics* |
| 22 | MECH-491/492 | *ME Capstone Sr. Design Proj I/II* |
| 23 | MECH-462 | *Design of Energy Systems Lec* |
| 24 | MECH-487 | *Photovoltaic and Solar Thermal Energy* |
| 25 | MECH-488 | *Fuel Cell Fundamentals & Technologies* |
| 26 | MECH-478 | *Mechatronics* |

**FOLLOWING PART IS COMMON TO ALL COURSE SYLLABI**
**GUIDELINES ABOUT THE COURSE AND UNIVERSITY POLICIES IS APPENDED AT THE END OF THE COURSE SYLLABI**

- Mechanical Engineering Students must adhere to the UDC's Conduct Code. Each student is expected to work independently on all exams including the take-home exams. Students may neither give nor receive assistance on examinations. All written material, including homework, term papers, reports, projects, etc. must be the student's original work. The bounds of original work and the degree of collaboration that will be allowed in the class will be established by the instructor. The work of others may be used with proper reference or acknowledgment.
- Attendance is expected at all class sessions. When an absence is expected, the instructor should be notified as soon as possible either by phone or e-mail.
- Missed exams may be made up at the discretion of the instructor.
- Late home assignments may be accepted only when approved prior to the due date.
- Schedule of exams will be on the ISCL (Instructor-Student Communication Leaflet) which will be distributed separately. ISCL is hard copy version of the Blackboard.
- The Policies on Academic Honesty are stated in the **UDC Student Handbook** on Page-68.
- UDC is an equal opportunity Institution and supports Affirmative Action principles.
- Any student with a documented disability (physical or cognitive) who requires academic accommodations should contact the Disability Resource Center at UD at (202) 274-6000 (voice) or (202) 274-6152 (TTY for users who are deaf or hard of hearing) as soon as possible to request an official letter outlining authorized accommodations.
- For the available university services, the students with Disabilities are referred to Page-19 of the **UDC Student Handbook.**

**All material is subject to change as circumstances warrant.**

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Common Course**
**SPRING 2013**

| | |
|---|---|
| **COURSE SYLLABUS:** | **CCEN-101, INTRODUCTION TO ENGINEERING [2 Credit Hr]** |
| **PRE/CO REQ:** | (none) |
| **COURSE TYPE:** | Required Course |
| **CATALOG DATA:** | This course introduces freshmen students interested in engineering disciplines to basic scientific principles and engineering concepts through hands-on experiments. These experiments will be designed to motivate the students to acquire the knowledge, skills and attitudes (KSA's) necessary to be successful in the pursuit of engineering disciplines. In addition, students in this course will learn how to analyze, interpret and present data using MATLAB. |
| **TEXT BOOK:** | MATLAB, **An Introduction With Applications**, Amos Gilat John Wiley & Sons, 4th Edition, 2011.<br>Course Handouts |
| **INSTRUCTORS:** | **Dr. Pawan Tyagi**<br>Assistant Professor, Mechanical Engineering<br>Building 42, Room 213E<br>Email: ptyagi@udc.edu<br>Phone: (202) 274-0068<br><br>**Dr. Sasan Haghani**<br>Assistant Professor, Electrical Engineering<br>Building 42, Room 109-H.<br>Email: shaghani@udc.edu<br>Phone: (202) 274-6595<br><br>**Dr. Lara Thompson**<br>Assistant Professor, Mechanical Engineering<br>Building 42 Room 213-M<br>E-mail: lara.thompson@udc.edu<br>Phone: 202-274-5046 |
| **OFFICE HOURS:** | Open door |
| **LECTURES:** | Wednesday, 12:30 – 3:00 pm 42-111A or computer lab<br>Friday, 12:30 – 3:00 pm 42-212 |

**COURSE OBJECTIVES:** The purpose of exposing the student to concepts, research ideas, and projects across various engineering disciplines, is to enable the student to choose the engineering career-path most suitable. In order to expose the students to a wide breadth of engineering topics, the course will be co-taught by three faculty representing different branches of engineering.

**INSTRUCTIONAL FORMAT**: Class Room Lecture and Lab

**STUDENT LEARNING TOPICS:**

***Mechanical Engineering: Renewable Energy—Dr. Tyagi***

- Semester long project: Part (a) Write a report on "Zero Energy Home" concept in Washington DC, California, Alaska, and Central Africa.
  (b) Design and build a sustainable home powered by solar energy, and energy efficient design. (* design guidelines are mentioned elsewhere in this syllabus)
  (c) Test your home under given conditions and give a presentation on your term paper.
- Experiments and reports:
  a. Solar electricity
  b. Solar Thermal and Geothermal
  c. Wind energy
  d. Biomass and hydrogen fuel cell

***Electrical Engineering: Basic Concepts— Dr. Haghani***

- Basics of Digital Logic Design and Experiments
- Data Processing: Students in this course will learn how to analyze, interpret and present data using MATLAB. Some topics include:
  a. basic arithmetic operations
  b. arrays and matrices, using scripts and managing data
  c. two and three dimensional plots
  d. defining functions and basic programming
  e. polynomials and curve fitting

***Broad Engineering—Dr. Thompson***

- Critical thinking and problem solving (some example projects below but subject to change):
  a. Given a set of design constraints, design a container to prevent an egg from breaking when dropped two stories.
  b. Given a set of constraints, modify and existing model rocket to meet design specifications
  c. Given a set of design constraints, design a slow sand filter to meet water filtration requirements
- Case studies/readings
- Guest lectures: to give students an overview of a wide variety of engineering applications, research, and technology

**GRADING STANDARD:**

| | |
|---|---|
| Attendance, in class participation | 20 % |
| Homework | 20 % |
| Lab reports | 30 % |
| Group project: Demo, presentation and final report | 30 % |

*Final grade will be based on:*

| | | |
|---|---|---|
| (100 - 90) | - | A |
| (89 - 70) | - | B |
| (69 - 65) | - | C |
| (64 - 55) | - | D |
| (50 - 0) | - | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2011**

**COURSE SYLLABUS:** **COMPUTER AIDED GRAPHICS [3 Credit Hr]**

**PRE/CO REQ:** None

**COURSE TYPE:** Required Course

**CATALOG DATA:** Development of skills to visualize and represent two and three dimensional objects graphically; pictorial drawing; technical drawing practices; computer aided drawing /graphics.

**TEXT BOOK:** George Omura, MasteringAutoCAD 2013 and AutoCAD LT 2013

**REFERENCES:** Bill Fane, AutoCAD 2013 for Dummies,
Donnie Gladfelter, AutoCAD 2013 and AutoCAD LT 2013: No experience required

**INSTRUCTOR:** Mr. Wilfred Lewis, CAD Professional

**OFFICE HOURS:** Mon and Wed – 11 AM to 12 Noon & Tue. – 10 AM to 2 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 11.00 – 12.15 PM | 42-114A |
| Wednesdays, | 11.00 – 12.15 PM | 42-114A |

**COURSE OBJECTIVES:**

This course is designed to give engineering students the skills necessary to visualize and represent two and three-dimensional objects graphically. The objective of this self-paced course is to give the students an opportunity to obtain the ability to read, sketch and reproduce engineering drawings using AutoCAD techniques.

**INSTRUCTIONAL FORMAT**: Computer Class room, Primarily lab format

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Have the ability to graphically represent technical designs, using accepted standard practices
- Communicate graphically, using sketches and CAD.
- Apply technical graphics principles to engineering disciplines
- Use the AUTODESK software for engineering drawing

**COURSE OUTLINE:**

1. Introduction to the AutoCAD Software (1 week)
2. Basic Construction Techniques (1 & ½ Weeks)
3. Basic Editing (1 Week)
4. Isometric Drawing See hand out. (1 & ½ weeks)
5. Geometric Construction (2 weeks)
6. 2-D Orthographic Drawing (2 weeks)
7. Dimensioning (1 & ½ weeks)
8. Sections and Auxiliary Views (2 weeks)
9. Introduction to Solid Modeling (2 weeks)

**GRADING STANDARD:**

| | |
|---|---|
| AutoCAD class assignments<br>(10 assignments – 10% each) | 100% |

*Final grade will be based on:*

| | |
|---|---|
| (100 - 90)- | A |
| (89 - 70)- | B |
| (69 - 65)- | C |
| (64 - 55)- | D |
| (50 - 0)- | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2013**

**COURSE SYLLABUS:** **CVEN-201, ENGINEERING MECHANICS I [3 Credit Hr]**

**PRE/CO REQ:** PHYS 201

**COURSE TYPE:** Required Course

**CATALOG DATA:** This course introduces students to engineering mechanics associated with non-accelerating (e.g., static) bodies. Basic principles and concepts will be learned through in-class lectures, reading assignments, homework sets and 3 in-class exams.

**TEXT BOOK:** R.C. Hibbler. Engineering Mechanics: Statics. Prentice Hall, 12th Edition, 2010.

**INSTRUCTOR:** Lara A. Thompson, Ph.D.
Building: 42/213M, Email: lara.thompson@udc.edu , Phone: 202-274-5046

**OFFICE HOURS:** Mon and Wed – 11 AM to 12 Noon & Tue. – 10 AM to 2 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42-209 |
| Wednesdays, | 12.30 – 1.50 PM | 42-209 |

**COURSE OBJECTIVES:**
- To utilize Newton's second law for non-accelerating bodies.
- To apply the concept of the free-body diagram to derive the equilibrium equations.
- To analyze two and three-dimensional systems.
- To learn how to determine internal and external reaction forces and moments on particles and rigid structures in equilibrium that are subject to prescribed loads.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**
Upon completion of the course the student will be able to:
- Apply Newton's 2nd Law for deriving the equilibrium equations
- Derive the free-body diagram (FBD)

- Calculate the forces algebraically from a system of equilibrium equations and moments using cross products
- Determine resultant force: 1) Using Parallelogram Rule (with Law of Sines and Law of Cosines) and 2) Vector Components
- Simplify force and couple systems and understanding support reactions and deriving the free-body diagram (FBD)
- Utilize Method of Sections/Method of Joints to analyze structures
- Determine Shear and Moment diagrams
- Follow logical procedures: 1) Simplifying force and couple systems, 2) assessing support reactions, 3) drawing the free-body diagram (FBD), 4) determining the equilibrium equations
- Understand basic principles of sustainable engineering practice.

**COURSE OUTLINE:**

1. Introduction and general principles (~1 week)
2. Equilibrium of Particles (~2 weeks)
3. Force Systems and Equilibrium of Rigid Bodies (~2.5 weeks)
4. Internal Forces and Moments (~2.5 weeks)
5. Structures (~ 2.5 weeks)
6. Friction (~ 0.5 weeks)
7. Method of Virtual Work (~0.5 weeks)
8. Centroids, centers of gravity, and moments of inertia (~ 2 weeks)
9. (Examinations: 1 week)

**GRADING STANDARD:**

Homework and in class participation 25%
Three Examinations 25 % each

*Final grade will be based on:*

| | | |
|---|---|---|
| (100 - 90) | - | A |
| (89 - 70) | - | B |
| (69 - 65) | - | C |
| (64 - 55) | - | D |
| (50 - 0) | - | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **CVEN-202, ENGINEERING MECHANICS II [3 Credit Hr]**

**PRE/CO REQ:** CVEN 201

**COURSE TYPE:** Required Course

**CATALOG DATA:** Covers kinematics and kinetics of a particle. Planar kinematics of a rigid body; planar kinetics of a rigid body including force and acceleration; work and acceleration; work and energy; impulse and momentum, and vibrations.

**TEXT BOOK:** R.C. Hibbler. Engineering Mechanics: Dynamics. Prentice Hall, 12th Edition, 2010.

**INSTRUCTOR:** Lara A. Thompson, Ph.D.
Building: 42/213M, Email: lara.thompson@udc.edu , Phone: 202-274-5046

**OFFICE HOURS:** Tuesday and Thursday – 11 am to 12:30 pm

**LECTURES:**

| | | |
|---|---|---|
| Tuesday, | 2:00 – 3:20 pm | 42-209 |
| Thursday, | 2:00 – 3:20 pm | 42-209 |

**COURSE OBJECTIVES:**
- To utilize Newton's second law for accelerating bodies.
- To apply the concept of the free-body diagram to derive the equilibrium equations.
- To analyze kinematics and kinetics of two and three-dimensional systems

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**
Upon completion of the course the student will be able to:
- Apply knowledge of mathematics to obtain solutions for motion of particles and rigid bodies (kinematics).
- Demonstrate knowledge of Newton's second law for particles and rigid bodies in motion (kinetics)
- Drawing the free-body diagram (FBD) and deriving the equations of motion
- Apply work-energy concepts as well as and impulse and momentum concepts

**COURSE OUTLINE:**

1. Introduction and General Principles (~1 week)
2. Kinematics of particles in rectangular, normal-tangential, and polar coordinates (~2 weeks)
3. Kinetics of particles (i.e., utilizing free-body diagrams to derive the equations of motion) (~2.5 weeks)
4. Kinematics of rigid bodies for translation, rotation about a fixed axis, or general plane motion (~2.5 weeks)
5. Kinetics of rigid bodies (i.e., utilizing free-body diagrams to derive the equations of motion) (~ 2.5 weeks)
6. Work and Energy Concepts (particles and rigid bodies) (~ 2 weeks)
7. Impulse and Momentum Concepts (particles and rigid bodies) (~ 2 weeks)

**GRADING STANDARD:**

| | |
|---|---|
| Homework and in class participation | 10 % |
| Two quizzes | 15 % each |
| Two exams | 30 % each |

*Final grade will be based on:*

| | | |
|---|---|---|
| (100 - 90) | - | A |
| (89 - 70) | - | B |
| (69 - 65) | - | C |
| (64 - 55) | - | D |
| (50 - 0) | - | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2013**

**COURSE SYLLABUS:** **MECH-205: MATERIALS SCIENCE LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: CHEM-111, 113 General Chemistry I Lec & Lab

**COURSE TYPE:** Required Course

**CATALOG DATA:** This course covers electronic structure, crystal structure, and imperfection; elastic and plastic deformations; deformation processes, mechanical failure, creep, fatigue, and fracture.

**TEXT BOOK:** Materials Science and Engineering, An Introduction, by W.D. Callister, Jr.,

8th Ed., Wiley, 2010 (ISBN 978-0-470-41997-7)
*Instructor will supplement with course notes*.
References: Virtual Materials Science & Engineering Website
(http://www.wiley.com/college/callister/0470125373/vmse/
Materials Today, open-access online and print journal published by Elsevier (available online http://www.materialstoday.com/)

**INSTRUCTOR:** Kate L. Klein, Ph.D.
Building: 42/213N, Email: kate.klein@udc.edu , Phone: 202-274-7131

**OFFICE HOURS:** M 3:30-5:30 PM, W 10:00 AM-12:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Monday | 2:00-3:20 PM | 32/A03 |
| Wednesday | 2:00-3:20 PM | 32/A03 |

**COURSE OBJECTIVES:**

Mechanical Engineers utilize materials which have been selected based on their properties. Therefore, ME students are well served in their careers by an understanding of the scientific foundations of materials that govern these properties. This objective of this course is to provide an introduction to engineering materials with an emphasis on how atomic and molecular bonding, crystal structure, composition and processing influence material properties.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Predict bond type based on electronic configuration/valence of elemental components in a solid
- Classify materials and their properties from their bonding and crystal structure; determination of density from atomic radius, crystal structure and atomic weight
- Sketch planes and directions from given indices and vice versa as well as determination of planar densities and atomic packing factor
- Comprehend steady-state vs non-steady state diffusion; application of the error function to solve Fick's 2$^{nd}$ Law
- Conduct a tensile test to generate a stress-strain curve; utilization of the stress-strain curve to determine elastic and plastic properties of materials
- Understand how to control strength and ductility by cold work (dislocations), heat treatment (grain size), and the addition of impurities
- Comprehend failure mechanisms and implications of ductile vs. brittle failure
- Predict solubility based on the Hume-Rothery criteria (atomic radius, crystal structure, electronegativity, valence)
- Determine phases, compositions, and weight fractions from phase diagrams; changing of mechanical properties by phase transformations
- Utilize tabulated data and plots to determine material properties and use this information to select materials for various applications and solve engineering design problems.
- Communicate ideas via a presentation and written scientific report

**COURSE OUTLINE:**

1. Introduction to Materials Science and Engineering (0.5 week)
2. Atomic Structure and Bonding (1.0 week)
3. Crystal Structure of Solids (1.5 week)
4. Imperfections (defects) in Solids and Diffusion (1.5 week)
5. Mechanical Properties of Metals: Elastic and Plastic Deformation (1.0 week)
6. Mechanical Properties of Metals: Dislocations & Strengthening Mechanisms (1.0 week)
7. Mechanical Properties of Metals: Failure (0.5 week)
8. Phase Diagrams and Phase Transformations (1.5 weeks)
9. Microscopy Techniques (0.5 week)
10. Structure, Properties, and Applications of Ceramics (1.0 week)
11. Structure, Properties, and Applications of Polymers (1.0 week)
12. Electrical and Thermal Properties (1.0 week)
13. Special Topics (Nanomaterials, Composites, Semiconductors) (1.0 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Midterm | 15% | A - 90 to 100 points |
| Final | 15% | B - 80 to 89 points |
| Homework | 30% | C - 70 to 79 points* (required) |
| Participation & Quizzes | 30% | D - 60 to 69 points |
| Material Report | 10% | F - Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **CVEN-206: MECHANICS OF SOLIDS LEC [3 Credit Hours]**

**PRE/CO-REQ:** Pre-req: CVEN-201 Engineering Mechanics & Co-req: CVEN-207 Mechanics of Solids Lab

**COURSE TYPE:** Required Course

**CATALOG DATA:** Mechanics of solids deals with the strength and physical performance of man-made or natural structures. This course covers axial forces, shear and moment, stress and axial loads, strain and axial deformation, torsion of shaft, stress in beams, columns, deflection of beams, energy methods, and elemental indeterminate problems. These concepts are essential for the design and analysis of all mechanical and structural systems.

**TEXT BOOK:** Mechanics of Materials, Brief SI Edition, by James M. Gere and Barry Goodno,
1st Edition, Cengage Learning, 2012, (ISBN 1-111-13603-3)
*Instructor will supplement with course notes*.
References: Mechanical Behavior of Materials by Norman E. Dowling, 2nd Ed., Prentice Hall, 1999
Mechanics of Materials, A.C. Ugural, McGraw–Hill, 1991

**INSTRUCTOR:** Kate L. Klein, Ph.D.
Building: 42/213N, Email: kate.klein@udc.edu , Phone: 202-274-7131

**OFFICE HOURS:** M 3:30-5:30 PM, W 10:00 AM-12:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Monday | 2:00-3:20 PM | 42/210 |
| Wednesday | 2:00-3:20 PM | 42/210 |

**COURSE OBJECTIVES:**

This course provides students with an understanding of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. This course lays foundation for engineering design.
Topics include:

- Mechanical properties of materials and Hooke's Law
- Axial Loading, Shear Loading, Torsion, and Bending

- Stress and Strain Transformations, Mohr's Circle
- Design of Beams and Shafts, Deflections of Beams
- Combined Loading and Statically Indeterminate Structures

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**
Upon completion of the course the student will be able to:

- Articulate the basic mechanical properties of engineering materials (elastic constants, yield strength, ultimate strength, and ductility)
- Derive mechanical properties of materials from stress-strain curves/data and utilize Hooke's Law to relate stress and strain
- Determine the internal stress and related strain in members subjected to axial loading, shear loading, torsion, and bending as well as a combined loading
- Compute the principal normal stresses and maximum shear stresses
- Compute the stress state both analytically and graphically (Mohr's Circle) at various orientation angles
- Utilize the loading on determinate structures to draw shear and bending moment diagrams and determine maximum shear, maximum bending, member deflections and curvature
- Calculate the normal and shear stresses in beams of various cross-sections
- Design simple structural members to withstand a specified allowable load or satisfy other practical constraints
- Solve statically indeterminate problems

**COURSE OUTLINE:**

1. Introduction and Normal Stress and Strain (1 week)
2. Mechanical Properties of Materials, Hooke's Law and Poisson's Ratio (1 week)
3. Shear Stress and Strain, Design for Allowable Loading (1 week)
4. Changes in length of axially loaded members (1 week)
5. Statically Indeterminate Structures, Thermal Effects, Misfits and Prestrains (1 week)
6. Stresses on Inclined Sections (0.5 week)
7. Uniform Torsion in Circular Bars, Non-Uniform Torsion (1 week)
8. Pure Shear, Relationship between moduli *E* & *G* (0.5 week)
9. Transmission of Power by Shafts, Statically Indeterminate Torsion (1 week)
10. Plane Stress and Principal Stress (0.5 week)
11. Max Shear and Mohr's Circle (1 week)
12. Hooke's Law for Plane Stress, Triaxial Stress, Pressure Vessels (0.5 week)
13. Beams, Loads, Reactions, Shear Force and Bending Moments (1 week)
14. Shear Force and Bending Moment Diagrams (1 week)
15. Pure Bending, Curvature, Strain & Normal Stress in Beams (1 week)
16. Design of Beams and Shear Stress for Different Cross-sections (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Midterm | 25% | A - 90 to 100 points |
| Final | 25% | B - 80 to 89 points |

| | | |
|---|---|---|
| Home Work | 25% | C-70 to 79 points |
| Attendance & Participation | 25% | D -60 to 69 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **CVEN-207: MECHANICS OF SOLIDS LAB [1 Credit Hours]**

**PRE/CO-REQ:** Co-req: CVEN-206 Lecture

**COURSE TYPE:** Required Course

**CATALOG DATA:** Covers introduction, purpose, scope, equipment/apparatus, interpreting results, errors, writing reports. Experiments include physical properties of and mechanical response of engineering materials, stress and strain measurement, torque, bending moment, and deflection of beams.

**TEXT BOOK:** Mechanics of Materials, Brief SI Edition, by James M. Gere and Barry Goodno,
1st Edition, Cengage Learning, 2012, (ISBN 1-111-13603-3)
References: Materials Science and Engineering, An Introduction, by W.D. Callister, Jr., 8th Ed., Wiley, 2010.

**INSTRUCTOR:** Kate L. Klein, Ph.D.
Building: 42/213N, Email: kate.klein@udc.edu , Phone: 202-274-7131

**OFFICE HOURS:** M 3:30-5:30 PM, W 10:00 AM-12:00 PM

**LECTURES:** Wednesday 2:00-3:20 PM 32/ C04C Mechanical Testing Lab

**COURSE OBJECTIVES:**

This lab provides students with hands-on testing of engineering materials and observation of the relationship between the external forces applied to a structure and the resulting behavior and deformation of the parts of that structure. Students will learn to collect data and write comprehensive lab reports. This course supplements the Mechanics of Solids Lecture (CVEN-206) and lays foundation for engineering design.

**INSTRUCTIONAL FORMAT**: Laboratory

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Measure specimen accurately using calipers and/or micrometer; understand the significance of uncertainty and the importance of repeated measurement
- Conduct virtual tensile tests using simulation software and determine elastic and plastic properties of materials
- Collect tensile data and utilize Hooke's Law to relate stress and strain; and derive mechanical properties of materials from stress-strain curves
- Comprehend the signs and implications of ductile vs. brittle failure
- Design and test various beam geometries to maximize stiffness and minimize bending
- Compare results to theoretical values, identify sources of error and justify any discrepancies
- Apply and articulate the fundamental concepts of Mechanics of Solids effectively in laboratory reports with appropriate data plots and format

**COURSE OUTLINE:**

1. Data collection, measurement, statistical analysis, and uncertainty
2. Virtual tensile testing and analysis of stress-strain curves
3. Hooke's Law for Springs and Tension Testing of Common Materials
4. Tensile Testing of Metals and Polymers
5. Thermal Expansion
6. Torsion
7. Centroids and Moments of Inertia
8. Bending Moment and Deflection of Beams
9. [Compression]

**GRADING STANDARD:**

| | | |
|---|---|---|
| Lab reports | 35% | A - 90 to 100 points |
| Worksheets | 35% | B - 80 to 89 points |
| Attendance & Participation | 30% | C - 70 to 79 points*(required) |
| | | D - 60 to 69 points |
| | | F - Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-208: THERMODYNAMICS [3 Credit Hours]**

**PRE/CO REQ:** Pre-req: PHYS-201 Physics II

**COURSE TYPE:** Required Course

**CATALOG DATA:** Covers thermodynamic concepts, zeroth law, thermodynamic properties, first law and second law analysis of closed and open systems; availability and irreversibility analysis; power and refrigeration cycles; mixture of gases and psychrometrics.

**TEXT BOOK:** Fundamentals of Thermodynamics by Claus Borgnakke and Richard E. Sonntag, 7th Edition, Wiley, 2009 (ISBN 978-0-470-04192-5)
*Instructor will supplement with course notes*.
References: Computer Aided Thermodynamic Tables (CATT3 software available with text), Wiley, 1996.
Thermodynamics, An Engineering Approach by Y.A. Cengel and M.A. Boles, **7th** Edition, McGraw-Hill, 2006.

**INSTRUCTOR:** Kate L. Klein, Ph.D.
Building: 42/213N, Email: kate.klein@udc.edu , Phone: 202-274-7131

**OFFICE HOURS:** M 3:30 – 5:30 PM, W 10:00 – 11:00 AM and 1:00 – 2:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Monday | 11:00- AM 12:20 PM | 42/210 |
| Wednesday | 11:00- AM 12:20 PM | 42/210 |

**COURSE OBJECTIVES:**

The main objective of this course is to provide a clear and rigorous introduction to classical engineering thermodynamics as well as the current relevance of thermodynamics. It will prepare students to understand, analyze and solve thermodynamic problems in a simple and logical manner.
Topics include:

- Properties of (pure) substances
- Conservation of mass and energy (1st Law of Thermodynamics)

- Entropy and the 2nd Law of Thermodynamics
- Vapor and gas power cycles and refrigeration cycles

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate the fundamental concepts of Thermodynamics
- Determine and articulate the properties of a pure substance
- Apply the 1st Law of Thermodynamics to open and closed system problems
- Apply the 2nd Law of Thermodynamics to systems and evaluate efficiency
- Analyze power and refrigeration cycles using the concept of entropy and the 2nd Law
- Read and understand thermodynamic tables and charts and utilize software programs in order to solve engineering problems
- Understand modern applications and challenges of thermodynamics

**COURSE OUTLINE:**

1. Introduction to Thermodynamics Applications and Fundamental Concepts (1 weeks)
2. Properties of a Pure Substance (2 weeks)
3. Work and Heat (1 week)
4. First Law of Thermodynamics (2 weeks)
5. First-Law Analysis for a Control Volume (2 weeks)
6. Second Law of Thermodynamics (2 weeks)
7. Entropy (1 week)
8. Second-Law Analysis for a Control Volume (1 week)
9. Irreversibility and Availability (1 week)
10. Power and Refrigeration Cycles (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Midterm | 15% | A - 90 to 100 points |
| Final | 15% | B - 80 to 89 points |
| Quizzes | 10% | C - 70 to 79 points* (required) |
| Homework | 25% | D - 60 to 69 points |
| Attend & Participation | 25% | F - Less than 60 points |
| Applications Paper | 10% | |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-222: ENGINEERING MEASURMENT LECTURE [3 Credit Hr]**

**PREREQUISITE:** MECH 221 Engineering Circuits I

**COREQUISITE:** MECH 224 Engineering Measurement Lab

**COURSE TYPE:** Required Course

**CATALOG DATA:** Teaches measuring systems, transducers, property measurements, signal conditioning, data output and analysis, measurement of temperature, pressure, load, statistical data analysis, computer aided data analysis.

**TEXT BOOK:** J. M. Dally W. F. Riley and K. G. McConnel,
Instrumentation for Engineering Measurements,2nd Ed, Wiley 1993
*Instructor will supplement with course notes*.

**REFERENCES:** R. S. Figliola, D. E. Beasley,

Theory and Design for Mechanical Measurements, 4th Ed Wile 2005

J P Holman,

Experimental Methods for Engineers, 7th Ed, McGraw Hill 2001

**INSTRUCTOR:** Jiajun Xu, Ph.D.
Building: 42/213O, Email: jiajun.xu@udc.edu , Phone: 202-274-5048

**OFFICE HOURS:** Tuesday: 2:00AM-3:00AM and Thursday: 2:00PM-3:00PM or by Appointment

**LECTURES:**

| | | |
|---|---|---|
| Tuesdays, | 11:00 – 12:20 PM | 42/107 |
| Thursdays, | 11:00 – 11:20 PM | 42/107 |

**COURSE OBJECTIVES:**

This course introduces students to important elements of engineering measurements and analysis of experimental data. The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course MECH 224. It prepares students to design and conduct experiments objectively to examine analytical findings and development of products.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate key processes of various engineering measurement techniques and explain how these measurement techniques work and their application in solving the engineering problems
- Perform engineering analysis and design of different engineering measurement systems modes with proficient mathematical and engineering skills.
- Solve practical applications through homework, exams, projects involving engineering measurement system designs and analysis
- Use state-of-the-art engineering measurement instrumentation and software

**COURSE OUTLINE:**

This course contributes 1/10 toward the 1.5 years of Engineering Sciences & Design

**TOPICS**

1. Introduction, Basic Concepts (1 week)
2. Review of DC Circuits, AC Circuits ( 2 weeks)
3. Analog Recording Instruments (1 5 weeks)
4. Digital Recording Instruments (1 week)
5. Sensors for transducers (2 week)
6. Signal Conditioning Circuits (1 5 weeks)
7. Statistical Data Analysis (1 week)
8. Temperature Measurements (1 week)
9. Strain Measurements (1 week)
10. Force, Torque, and Pressure Measurements (2 weeks)
11. Tests and Examinations (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 30% | A – 90 to 100 points |
| Final Test | 40% | B – 80 to 89 points |
| Quizzes, Assignment & Attendance | 10% | C – 70 to 79 points |
| Term Project and Presentation | 20% | D – 60 to 69 points |
| | | F Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-224: ENGINEERING MEASURMENT LABORATORY [3 Credit]**

**PREREQUISITE:** MECH-221 Engineering Circuits I

**COREQUISITE:** MECH-224 Engineering Measurement Lecture

**COURSE TYPE:** Required Course

**CATALOG DATA:** Teaches measuring systems, transducers, property measurements, signal conditioning, data output and analysis, measurement of temperature, pressure, load, statistical data analysis, and computer aided data analysis.

**TEXT BOOK:** J. M. Dally W. F. Riley and K. G. McConnel,
Instrumentation for Engineering Measurements,2nd Ed, Wiley 1993
*Instructor will supplement with course notes*.

**REFERENCES:** R. S. Figliola, D. E. Beasley,
Theory and Design for Mechanical Measurements, 4th Ed Wile 2005

LJCREATE Transducers and Instrumentation Laboratory Manuals

**INSTRUCTOR:** Jiajun Xu, Ph.D.
Building: 42/213O, Email: jiajun.xu@udc.edu , Phone: 202-274-5048

**OFFICE HOURS:** Tuesday: 2:00AM-3:00AM and Thursday: 2:00PM-3:00PM or by Appointment

**LECTURES:**

| | | |
|---|---|---|
| Tuesdays, | 12:30 – 1:50 PM | 32/C |
| Thursdays, | 12:00 – 1:50 PM | 32/C |

**COURSE OBJECTIVES:**

This course introduces students to important elements of engineering measurements and analysis of experimental data The students will learn the scope and limitations of the instruments and experiments through lecture and discussion and laboratory measurements in course MECH 222 and actual laboratory measurements.

**INSTRUCTIONAL FORMAT**: Laboratory

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate key processes of various engineering measurement techniques and explain how these measurement techniques work and their application in solving the engineering problems
- Perform engineering analysis and design of different engineering measurement systems modes with proficient mathematical and engineering skills.
- Solve practical applications through laboratory practice involving engineering measurement system designs and analysis
- Use state-of-the-art engineering measurement instrumentation and software

**COURSE OUTLINE:**

This course contributes 1/10 toward the 1.5 years of Engineering Sciences & Design

**TOPICS**

1. Calibration of a resistance position transducer (1 week)
2. Effect of circuit loading on the output voltage of a potentiometer (1 week)
3. Measurement of voltage and resistance using a Wheatstone bridge circuit (1week)
4. Signal analysis using an oscilloscope (1 week)
5. Statistical analysis of temperature fluctuations in a room over a period of time (1 week)
6. Calibration of a manometer and linear regression analysis of the results (1 week)
7. Temperature measurements using an RTD and a thermistor (1 week)
8. Calibration of a thermocouple (1 week)
9. Design manufacture and calibration of a beam type load cell (3 weeks)
10. Electronic data acquisition and data analysis (2 weeks)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Lab Report | 80% | A – 90 to 100 points |
| Attendance | 20% | B – 80 to 89 points |
| | | C – 70 to 79 points |
| | | D – 60 to 69 points |
| | | F Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-381: MICROCONTROLLERS IN ME LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: ELEC-221 Electric Circuits I & Junior Standing

**COURSE TYPE:** Required Course

**CATALOG DATA:** The course is an introductory level course on Microcontroller interface and applications. The course focuses on HC12 hardware, HC12 instruction set, instrumentations, and interface issues.

**TEXT BOOK:** Mechatronics System Design, by Devdas Shetty and Richard A. Kolk
ISBN -13 978-1-4390-6198-5
Third Edition, Cengage Learning 2012
*Instructor will supplement with course notes.*

**REFERENCES:** Software and Hardware Engineering, Motorola M68HC12, Fredrick M. Cady and James M. Sibigtroth, Oxford Press,
ISBN 0-19-512469-3
Oxford University Press, 2000

**INSTRUCTOR:** Dr. Esther T. Ososanya, Dr. Devdas Shetty
Building: 42/109, Email: eososanya@udc.edu. Phone: 202-274-5837

**OFFICE HOURS:** Mon and Wed – 11:30 AM -1:30 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 9:30 – 11.20 AM | 42/109 |
| Wednesdays, | 9:30 – 11:20 AM | 42/109 |

**COURSE OBJECTIVES:**

The main goals are to teach the fundamental concepts of digital logic analysis and synthesis, microcomputer architecture, assembly language programming, and basic hardware interface, and control of mechanical devices.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Apply Number systems, Arithmetic operations in Binary, Octal, and Hexadecimal. Use Code converters and application of Boolean algebra in the design of logic circuits.
- Use combinational circuits design procedure to design specified digital systems.
- Use computer-aided design and analysis software tools (LabView) for digital circuits design, and use of Microcontrollers digital input/output ports.

**COURSE OUTLINE:**

1. Digital Systems and Binary Numbers
2. Boolean Algebra and Logic Gates
3. Combinational Logic Design
4. Synchronous Sequential Logic
5. Registers and Counters
6. Electrical and Electronic devices
7. Measurement and Instrumentation
8. Typical Microcomputer and Microcontroller systems architecture
9. HC12 overview: System Configuration, Addressing modes, instruction set, and Interface devices

**GRADING STANDARD:**

| | |
|---|---|
| Design Projects 100% | A – 90 to 100 points |
| | B – 80 to 89 points |
| | C – 70 to 79 points |
| | D – 60 to 69 points |
| | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2013**

**COURSE SYLLABUS:** **MECH-321: FLUID MECHANICS LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MATH-254 Differential Equations; MECH-208 Thermodynamics

**COURSE TYPE:** Required Course

**CATALOG DATA:** This course covers fluid properties, fluid statics, fluid dynamics, finite control volume analysis, Bernoulli Equation, differential control volume equations, Euler equation, Navier-Stokes equation, viscous flows, boundary layer concepts, stream functions, potential flows, dimensional analysis and similitude.

**TEXT BOOK:** Fluid Mechanics, by Frank M. White
ISBN 978-0-07-352934-9
Seventh Edition, McGraw-Hill
*Instructor will supplement with course notes*.

**REFERENCES:** Fundamental of Fluid Mechanics, Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, J. Wiley, ISBN 0-471-57958-0

**INSTRUCTOR:** Abiose O. Adebayo, Ph.D.
Building: 42/213R, Email: aadebayo@udc.edu, Phone: 202-274-5039

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42/107 |
| Wednesdays, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

The main objectives of this course are to provide students with the skills and ability to understand, analyze, and solve fluid mechanic problems in a logical manner with emphasis on fluid statics and Archimedes principles; fluid kinematics and Reynolds Transport Theorem; inviscid and viscous flows; and dimensional analysis.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate and solve problems in relation to fluid properties, such as density, surface tension, bulk modulus, and viscosity
- Use fluid static principles to solve manometry problems; determine forces on submerged surfaces; apply Archimedes principle to floatation and stability of floating bodies
- Articulate the Bernoulli principle, use the Bernoulli equation for flowrate measurement; apply Eulerian and Lagragian methods for velocity and acceleration analysis
- Apply conservation of mass, conservation of energy and conservation of momentum principles to solve fluid problems to determine, velocity, force, and torque in a system
- Use the differential continuity relation and vorticity equation to analyze simple basic flows
- Apply potential flow equation to analyze basic flows and develop solutions to simple viscous flow problems
- Use Pi Theorem to obtain functional relation applicable to a given flow problem
- Articulate the use of dimensional analysis for planning experiment and analysis of experimental data
- Use simplified Navier-Stokes equation to analyze pipe flow problems
- Use the Moody Chart to solve direct and indirect pipe flow problems

**COURSE OUTLINE:**

1. Fluid properties – introduction and definitions (1.0 week)
2. Fluid Statics (1.0 week)
3. Basic equation of fluid statics – Newton's Law; pressure in a static fluid (2.0 week)
4. Forces on plane and curved surfaces – center of pressure (2.0 week)
5. Archimedes Principle and Stability of Floatation – Bouyancy, metacentric center (1.0 weeks)
6. Kinematics of Fluid – Eulerian and Lagragian approach to velocity and acceleration analysis (1.0 week)
7. Fluid Dynamics – flow charcteristics, inviscid flow (1.0 week)
8. Conservation equations, potential flows (2.0 weeks)
9. Viscous flows – Navier-Stokes equation, laminar and turbulent flows, boundary layer and pipe flows (2.0 weeks)
10. Dimensional Analysis – Non-dimensional fluid equations, Pi theorem, dimensional similitude (1.0 week)
11. Tests and Examinations (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 40% | A – 90 to 100 points |
| Final Test | 40% | B – 80 to 89 points |
| Assignment & Attendance | 20% | C – 70 to 79 points |
| | | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2013**

**COURSE SYLLABUS:** **MECH-322: THERMO AND FLUID MECHANICS LAB [1 Credit Hr]**

**PRE/CO REQ:** Pre-Req: MECH-208 Thermodynamics; Co-Req: MECH-321 Fluid Mechanics

**COURSE TYPE:** Required Course

**CATALOG DATA:** This course examine methods of experimental fluid mechanics and covers laboratory experiments in thermodynamics and fluid mechanics.

**REFERENCES:** Instrumentation for Engineering Measurements, by James W. Dally, William F. Riley, and Kenneth G. McConnel
ISBN 0471045489
Second Edition, John Wiley; Fluid Mechanics, By Frank M. White
ISBN978-0-07-352934-9
Seventh Edition, McGraw-Hill
*Instructor will supplement with course notes*.

**INSTRUCTOR:** Abiose O. Adebayo, Ph.D.
Building: 42/213R, Email: aadebayo@udc.edu, Phone: 202-274-5039

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LABORATORY:** Mondays, 12.30 – 1.50 PM 42/107

**COURSE OBJECTIVES:**

The main objectives of this course are to explore and familiarize engineering students with: sensors and instrumentations used in thermodynamics and fluid measurements; application of probability and statistics methods in data and error analysis; and hands-on experience in data measurements and processing.

**INSTRUCTIONAL FORMAT**: Laboratory sessions and instructions

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate sources of errors and different types of errors in experimentation
- Apply methods of probability and statistics to estimate errors
- Use experiments to verify certain theories and principles of thermodynamics and fluids
- Articulate different classes of pressure and velocity/flow measurements
- Use different instruments to measure temperature
- Perform various experiments
- Write laboratory reports with data analysis and conclusion

**COURSE OUTLINE:**

1. Introduction to methods of experimentation (1.0 week)
2. Review of fundamental properties of fluid (1.0 week)
3. Errors and use of probability and statistics in error analysis (2.0 week)
4. Pressure measurement using manometers and transducers (1.0 week)
5. Measurement of temperature using thermocouples and thermistors (1.0 weeks)
6. Verification of Bernoulli Principle(1.0 week)
7. Force on a plane submerged surface; center of pressure (1.0 week)
8. Forced vortex free surface profile (1.0 weeks)
9. Fluid friction and losses in pipe flows (1.0 weeks)
10. Archimedes principle and metacentric center(1.0 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Completed Lab Reports | 80% | A – 90 to 100 points |
| Attendance | 20% | B – 80 to 89 points |
| | | C – 70 to 79 points |
| | | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Civil Engineering**
**FALL 2013**

**COURSE SYLLABUS:** **MECH-341: ANALYSIS AND SYNTHESIS OF MECHANISM [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: 202 Engineering Mechanics II (Dynamics)

**COURSE TYPE:** Required Course

**CATALOG DATA:** Teaches kinematics and dynamics of mechanisms; analysis of mechanisms, including linkage, cam, gear; synthesis of mechanism for prescribed performances; and computer-aided design of mechanisms.

**TEXT BOOK:** C. E. Wilson and J. P. Sadler, **Kinematics and Dynamics of Machinery,**
Harper Collins 2003
ISBN 0-201-35099-8
Third Edition, Pearson Education, New Jersey
*Instructor will supplement with course notes*.
Reference Book: J. J. Wicker, G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms , 3rd Ed., Oxford University Press, 2003

**INSTRUCTOR:** Jiajun Xu, Ph.D.
Building: 42/213O, Email: jiajun.xu@udc.edu , Phone: 202-274-5048

**OFFICE HOURS:** Tuesday: 11:00AM-12:00AM and Wednesday: 4:00PM-5:00PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12:30 – 1:50 PM | 42/208 |
| Wednesdays, | 12:30 – 1:50 PM | 42/208 |

**COURSE OBJECTIVES:**

The course is intended to familiarize the students with various mechanisms used in machines. The static and dynamic characteristics and design of mechanisms are discussed. It enables students to (a) analyze position velocity acceleration and jerk in mechanisms (b) design mechanisms with given performance characteristic and (c) use of computers in analysis and design.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate key processes of various mechanisms and explain how these mechanisms work and their application in solving the engineering problems
- Perform statistical and dynamic analysis and design of different mechanisms with proficient mathematics, i.e. :
  - apply knowledge of Linear Algebra
  - complete standard matrix manipulations.
  - use matrices for solving systems of linear equations

  and engineering skills, e.g. :
  - Analysis of position, velocity and acceleration kinematics of mechanisms
  - Analysis of inverse dynamics of mechanisms
  - Basic analysis of cams and gears
- Solve practical applications through homework, exams, projects involving engineering designs and analysis
- Use engineering software, mathematics software and user-written programs to solve problem and to present the results in plotted or tabulated form

**COURSE OUTLINE:**

1. Introduction (1 week)
2. Different types of mechanisms (1 week)
3. Displacement analysis and synthesis (1 week)
4. Velocity analysis of mechanisms (1 week)
5. Acceleration analysis of mechanisms (1 week)
6. Cam analysis and design (1 week)
7. Spur gears analysis and design (2 weeks)
8. Helical worm and bevel gears (1 week)
9. Drive trains analysis and design (2 weeks)
10. Static force analysis (1 week)
11. Dynamic force analysis (1 week)
12. Balancing of machinery (1 week)
13. Tests and examination (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 30% | A – 90 to 100 points |
| Final Test | 30% | B – 80 to 89 points |
| Quizzes, Assignment & Attendance | 20% | C – 70 to 79 points |
| Term Project | 20% | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

| | |
|---|---|
| **COURSE SYLLABUS:** | **CVEN 308 APPLIED NUMERICAL ANALYSIS FOR ENGINEERS [3 Credit Hr]** |
| **PRE/CO REQ:** | MATH 260 |
| **COURSE TYPE:** | Required Course |
| **CATALOG DATA:** | Covers modeling and error analysis, roots of equations; systems of linear algebraic equations, curve fitting; numerical differentiation and integration; ordinary differential equations; partial differential equations. |
| **TEXT BOOK:** | Chapra and Canale, Applied Numerical Methods with MATLAB for Engineers and Scientists, 3rd Editon. McGraw Hill, NY, 2012. |
| **REFERENCE:** | Chapra and Canale, Numerical Methods for Engineers, 6th Editon. McGraw Hill, NY, 2010. |
| **INSTRUCTOR:** | Lara A. Thompson, Ph.D.<br>Building: 42/213M, Email: lara.thompson@udc.edu , Phone: 202-274-5046 |
| **OFFICE HOURS:** | Tuesday and Thursday – 11 am to 12:30 pm |
| **LECTURES:** | Tuesday, 9:30 - 10:50am 42-210<br>Thursday, 9:30 - 10:50am 42-210 |

**COURSE OBJECTIVES:**

The course objective is to apply numerical techniques in the context of engineering applications. Example problems and problems sets will be solved using computer-based tools (e.g., spreadsheet and computational/symbolic processing software packages).

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**
Upon completion of the course the student will be able to:

- Articulate the basic concepts of the math methods covered in the course
- Utilize appropriate software and tools (e.g., MATLAB and Excel) as aids for problem solving
- Understand and utilize numerical root-finding methods
- Solve systems of linear algebraic equations
- Utilize and apply knowledge of numerical integration and numerical differentiation
- Understand and apply knowledge of time-frequency domain analyses (e.g., Laplace Transform methods to solve ordinary differential equations)
- Perform statistical analyses (e.g., determining mean, standard deviation, and other measures) on data sets
- Perform and understand the utility of linear regression analyses on sets of data
- Understand the "big picture" of real-life scenarios and engineering applications of mathematical methods

**COURSE OUTLINE:**

1. Introduction
2. Linear Algebraic Equations
3. Root finding and Optimization
4. Curve fitting, linear regression, and Interpolation
5. Numerical Integration
6. Numerical Differentiation
7. Ordinary Differential Equations
8. Laplace Transform Methods
9. Solution to engineering problems using symbolic computer coding

**GRADING STANDARD:**

| | |
|---|---|
| Homework and in class participation | 10 % |
| Two projects | 15 % each |
| Two exams | 30 % each |

*Final grade will be based on:*

| | | |
|---|---|---|
| (100 - 90) | - | A |
| (89 - 70) | - | B |
| (69 - 65) | - | C |
| (64 - 55) | - | D |
| (50 - 0) | - | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**Spring 2014**

**COURSE SYLLABUS:** **MECH-351: HEAT TRANSFER [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MECH 208 Thermodynamics
MECH 321 Fluid Mechanics
MATH 260 Differential Equations with Linear Algebra

**COURSE TYPE:** Required Course

**CATALOG DATA:** Teaches Heat conduction equations -- steady and unsteady state; Heat Conduction problems, Principles of Heat Convection -forced, and free; and Boiling Heat Transfer; Radiative Heat Transfer, and Heat Exchangers.

**TEXT BOOK:** Fundamentals of Heat and Mass Transfer, 7th Edition
Authors: Theodore L. Bergman, Adrienne S. Lavine, Frank P Incropera, David P. DeWitt
Publisher: John Wiley & Sons, Inc
*Instructor will supplement with course notes*.

**INSTRUCTOR:** Jiajun Xu, Ph.D.
Building: 42/213O, Email: jiajun.xu@udc.edu , Phone: 202-274-5048

**OFFICE HOURS:** Monday: 11:00AM-12:00AM and Wednesday: 4:00PM-5:00PM or by Appointment

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12:30 – 1:50 PM | 42/208 |
| Wednesdays, | 12:30 – 1:50 PM | 42/208 |

**COURSE OBJECTIVES:**

The main objective of this course is to equip mechanical engineering students with a fundamental understanding of the mechanism and mathematics of heat transfer, ability to formulate, analyze, and solve problems involving heat transfer (a) Heat Conduction and Numerical Methods for 1&2D Problems (b) Convective Heat Transfer, Heat Transfer Coefficient (c) Boiling Heat Transfer (d) Radiative Heat Transfer and Heat Exchangers

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate key processes of various heat transfer mechanisms and explain how these mechanisms work and their application in solving the engineering problems
- Perform engineering analysis and design of different heat transfer modes with proficient mathematics, i.e.:
    - to apply knowledge of ordinary and partial differential equations
    - to solve ordinary differential equations.
    - to solve special partial difference equations

  and engineering skills, e.g. :
    - Internalize the meaning of the terminology and physical principles associated with heat transfer subject
    - Delineate pertinent transport phenomena for any process or system involving heat transfer
    - Use requisite inputs for computing heat transfer rates and/or material temperatures
    - Develop representative models of real processes and systems and draw conclusions concerning process/system design or performance from attendant analysis

**COURSE OUTLINE:**
[Letter(s) in [ ] represents ABET Criteria student outcomes]

1. Introduction (0.5 week)
2. Introduction to heat conduction (0.5 week)
3. 1D Steady Heat Conduction (1week)
4. 2D Steady Heat Conduction (1 week)
5. Transient Conduction (1.5 week)
6. Introduction to Convection (1 week)
7. External Flow (2 week)
8. Internal Flow (2 week)
9. Free Convection (1 week)
10. Boiling and Condensation (1.5 week)
11. Heat Exchanges (1 week)
12. Radiation (1 week)
13. Radiation Exchange between Surfaces (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 30% | A – 90 to 100 points |
| Final Test | 30% | B – 80 to 89 points |
| Quizzes, Assignment & Attendance | 10% | C – 70 to 79 points |
| Term Project | 20% | D – 60 to 69 points |
| Simulation Project | 10% | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-361: MACHINE DESIGN LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MECH-205 Material Science; CVEN-206 Solid Mechanics

**COURSE TYPE:** Required Course

**CATALOG DATA:** This course covers the engineering design process, fundamentals of mechanical design, theories of failure, design of machine elements including flexible drives, gears, shaft, bearings, coupling, fasteners, tolerances, and use of statistics in machine design

**TEXT BOOK:** Machine Elements in Mechanical Design, by Robert L. Mott
ISBN 0-13-841446-7
Fourth Edition, Prentice Hall
*Instructor will supplement with course notes*.

**REFERENCES:** Mechanical Engineering Design, By Joseph E. Shigley, Charles R. Mischke
ISBN 0-07-056899-5, Fifth Edition, McGraw-Hill
Machine Design: An Integrated Approach, by Robert L. Norton
ISBN 0-13-897802-6, Second Edition, Prentice Hall

**INSTRUCTOR:** Abiose O. Adebayo, Ph.D.
Building: 42/213R,
Email: aadebayo@udc.edu,
Phone: 202-274-5039

**OFFICE HOURS:** Tue and Thur. – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Tuesday, | 12.30 – 1.50 PM | 42/107 |
| Thursday, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

The main objectives of this course are to introduce students of mechanical engineering to the engineering design process including design constraints, design requirements, material selection and manufacturing considerations, and the application of design theories in the design of basic machine elements.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Formulate the engineering design process and specify design constraints and requirements
- Conduct case study in stress and deflection analysis
- Articulate the basis for the use of different design theories – static and fatigue theories of failure
- Select appropriate fatigue theory of failure in the design of specific machine element for different stress cycles
- Study and make oral presentation on assigned Case Study
- Design of various machine elements
- Implement a project on the design of a speed reducer

**COURSE OUTLINE:**

1. Review of stress and deflection analysis, and materials properties (1.0 week)
2. Machine design methodology, design codes and standards (1.0 week)
3. Introduction to static and fatigue theories of failure (2.0 week)
4. Design of machine elements, flexible drives, gears, shafts, bearings, brakes and clutches, power screw, bolts, rivets, welding, etc (2.0 week)
5. Tolerances and Fits
6. Springs (1.0 week)
7. Design of speed reducers (1.0 week)
8. Project (2.0 weeks)
9. Case Studies (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Case Studies Homework | 20% | A – 90 to 100 points |
| Design Assignments | 30% | B – 80 to 89 points |
| Design of a Speed Reducer | 40% | C – 70 to 79 points |
| | | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-371: DESIGN OF CONTROL SYSTEMS LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MATH-254 Differential Equations

**COURSE TYPE:** Required Course

**CATALOG DATA:** Models for mechanical, electrical, fluid, electromechanical, thermo-fluid systems, signal transducers, types of controllers, performance of feedback systems, simulation, root locus and frequency response methods for design of automatic control.

**TEXT BOOK:** Feedback Control Systems, by C.L. Phillips, and R.D. Harbor
ISBN 978-0-07-352934-9
Fourth Edition, Prentice Hall
*Instructor will supplement with course notes.*

**REFERENCES:** Modern Control Systems, R.C. Dorf, and R.H. Bishop
ISBN
Seventh Edition, Addison-Wesley

**INSTRUCTOR:** Calvin Brooks, Adjunct Faculty
Building: 42/213Q, Email: cbrooks@udc.edu. Phone: 202-274-5045

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42/107 |
| Wednesdays, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

This course is designed to provide junior mechanical engineering students with understanding of control systems simulation, including analysis and design. Emphasis is placed on the feedback design theory, analytical, graphical and numerical methods of achieving optimum stable response of a system.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Solve linear ODE models for both free and forced responses using Laplace transform
- Describe the structure and operation of common feedback control systems using block diagrams and transfer functions
- Apply standard predictors and measures to estimate or specify the dynamic performance of a system
- Develop differential equations models for mechanical, electrical, electromechanical, fluid and thermal systems
- Analyze simple rotating unbalance and vibration isolation systems
- Use MATLAB and Simulink to simulate dynamic systems response
- Demonstrate an understanding of signal flow graphs using Mason's formula and state variable modeling
- Perform stability analysis of various engineering systems
- Use Roth Hurwitz criterion to analyze various mechanical systems
- Use Root-locus principles in the design of engineering systems
- Use frequency responses diagrams (Bode, Nyquist, Nichols) to design system compensation techniques

**COURSE OUTLINE:**

1. System Modeling: electrical, mechanical, thermo-fluid systems; block diagram (1.0 week)
2. Signal flow graph, Mason's formula, and system identification (1.0 week)
3. State variable modeling, solution of state equations (1.0 week)
4. Transfer functions, digital and analog simulation (1.0 week)
5. Time response of first and second order systems (1.0 weeks)
6. Frequency response reduced order-models (1.0 week)
7. Control system characteristics (1.0 week)
8. Stability analysis (1.0 week)
9. Root-locus principles and techniques (1.0 week)
10. Root-locus design, analytical PID design (1.0 week)
11. Frequency response analysis: Bode, Nyquist and Nichols diagrams (1 week)
12. Frequency response design (1 week)
13. Compensation techniques (1 week)
14. Digital control systems (1 week)
15. Analysis and design of digital control systems (1 week)
16. Tests and Examinations (1 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| | | A – 90 to 100 points |
| Examinations | 25% | B – 80 to 89 points |
| Mid-term project report | 25% | C – 70 to 79 points |
| Final project report | 50% | D – 60 to 69 points |
| | | F– less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-373: DESIGN OF CONTROL SYSTEMS LAB [1 Credit Hr]**

**PRE/CO REQ:** Pre Req: MATH-254 Differential Equations; CoReq: MECH-371 Design of Control Systems

**COURSE TYPE:** Required Course

**CATALOG DATA:** Experiments include simulation of continuous time and discrete time feedback control systems, such as modeling, performance measures, transfer functions, generalized error coefficient, introduction to state-space methods, stability, controllability and observability, root locus frequency domain analysis, compensation methods, state feedback and pole placements, and control system design.

**TEXT BOOK:** Control Systems Engineering, Norman S. Nise
ISBN 978-0-470-91373-4
Sixth Edition, John Wiley & Sons, Inc. 2011 Hoboken, NJ
*Instructor will supplement with course notes*.

**REFERENCES:**

**INSTRUCTOR:** Wagdy Mahmoud, Associate Professor
Building: 42/109, Email: wmahmoud@udc.edu. Phone: 202-274-5239

**OFFICE HOURS:** Mon and Wed – 9:00 – 10:00 AM

**LABORATORY:** Mondays, 10:00 – 11:20 AM 42/109

**COURSE OBJECTIVES:**

The main objectives of the course are to provide students with requisite skills to used MATLAB and the Symbolic Math Toolbox to verify the behavior of closed-loop systems; generate and manipulate polynomials and transfer function; perform partial fraction expansions; find Laplace transforms for time functions, etc. In addition, students should be able to use Simulink to evaluate the effects of pole location upon the time-response systems; evaluate the effect of additional poles and zeros upon the time-response of second order systems, etc.

**INSTRUCTIONAL FORMAT**: Laboratory Sessions

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Solve linear ordinary differential equation models for both free and forced responses using Laplace transform
- Describe the structure of common feedback control systems using block diagram and transfer functions.
- Able to design experiments and analyze results using appropriate (graphical) tools.
- Able to design control systems to meet desired needs and realistic constraints such as stability and performance (settling time, overshoot, and damping ratio)
- Develop state space models for electrical and mechanical systems.
- Use resources such as published literature and/or MathWorks (MATLAB, Simulink, tool boxes) manuals and tutorials to learn new materials not taught in class.
- Use MATLAB, Simulink and control toolbox to simulate control system response.

**COURSE OUTLINE:**

1. Introduction (Chapter 1)
2. Modeling in the frequency domain (chapter 2)
3. Modeling in the time domain (Chapter 3)
4. Time response (Chapter 4)
5. Reduction of multiple subsystems (Chapter 5)
6. Stability (Chapter 6)
7. Steady-State errors (chapter 7)
8. Root Locus Techniques (Chapter 8)
9. Digital Control Systems (Chapter 13)

**GRADING STANDARD:**

| | | |
|---|---|---|
| | | A – 90 to 100 points |
| Examinations | 25% | B – 80 to 89 points |
| Mid-term project report | 25% | C – 70 to 79 points |
| Final project report | 50% | D – 60 to 69 points |
| | | F – less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-406: ENGINEERING ECONOMICS [3 Credit Hr]**

**PRE/CO REQ:** MECH-151 Fluid Mechanics, Senior standing

**COURSE TYPE:** Required Course

**CATALOG DATA:** Studies the application of economic principles to engineering problems and their effect on engineering decision-making

**TEXT BOOK:** Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, "Engineering Economic Analysis", Latest Edition, Oxford University Press.

**INSTRUCTOR:** Stephen Arhin, Ph.D., P.E., PTOE,
Assistant Professor, Building 42/213D
Tel: 202-274-6600 Email: sarhin@udc.edu

**OFFICE HOURS:** Upon request

**COURSE OBJECTIVES:**

The objective of Engineering Economics course is to prepare an engineering student to use economic principles and cost analysis of engineering projects. The student will learn interest formulas, how to compare different engineering projects using present worth method, future value method, annual payment method and benefit-cost technique. The student will also be able to calculate depreciation of an asset and its effect on after tax cost.

**INSTRUCTIONAL FORMAT**: Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to apply economic principles to engineering problems.

**COURSE OUTLINE:**

1. Introduction, cost estimation and engineering economics terminology
2. Interest and Equivalence
3. Equivalence for Repeated Cash Flows
4. Present Worth Analysis
5. Annual Cash Flow Analysis
6. Rate of Return Analysis
7. Choosing the Best Alternative
8. Benefit-Cost Analysis
9. Depreciation
10. Selection of Minimum Attractive Rate of Return

**GRADING STANDARD:**

Attendance and/or homework: 10%
Examination # 1: 22.5%
Mid-term examination: 22.5%
Examination # 2: 22.5%
Final examination: 22.5%

*Final grade will be based on:*

| | | |
|---|---|---|
| (100 - 90) | - | A |
| (89 - 70) | - | B |
| (69 - 65) | - | C |
| (64 - 55) | - | D |
| (50 - 0) | - | F |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**FALL 2013/SPRING 2014**

**COURSE SYLLABUS:** **MECH-491/492: SENIOR DESIGN PROJECT LEC [3 + 3 Credit Hr]**

**PRE/CO REQ:** Senior Standing

**COURSE TYPE:** Required Course

**CATALOG DATA:** Creative design, problems formulation, recognition of need, design constraints and requirements, structure of open-ended design solution processes in system design, familiarization with production processes and manufacturing technology, feasibility assessment, project management, safety and reliability in design, group project.

**TEXT BOOK:** The Engineering Design Process, by Atila Ertas, Jesse C. Jones
ISBN 0-471-51796-8
John Wiley
*Instructor will supplement with course notes and various references.*

**REFERENCES:** Engineering Design: From Art to Practice, Joseph W. Walton
ISBN 0-314-76551-4
West Publishing Company

**INSTRUCTOR:** Abiose O. Adebayo, Ph.D.
Building: 42/213R, Email: aadebayo@udc.edu, Phone: 202-274-5039

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42/107 |
| Wednesdays, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

These two-part two-semester courses aim to broaden student's concept of engineering design with emphasis on the design process, feasibility studies and failure analysis by employing fundamental principles of thermal sciences, materials science, and mechanical systems. The second semester is focused on a project design involving real-world projects, including assessment of need, establishing objectives and criteria, design constraints, prototyping, report preparation and oral presentation.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Analyze needs to produce problem definition for mechanical systems
- Carry out design process (synthesis, modeling, feasibility evaluation, iteration) to satisfy project requirements
- Work within realistic constraints, (such as economic, environmental, societal, manufacturability, safety, ethical) in realizing systems
- Share responsibilities and information on schedule with others on team
- Participate fully in the development and selection of design problem
- Evaluate ethical issues that may occur in professional practice using professional codes of ethics
- Produce progress reports, memos, project reports both formal and informal , recording and maintaining an engineering journal
- Plan, prepare, and deliver well-organized, logical oral presentations
- Recognize the societal and global changes that engineering innovations may cause
- Use design software for engineering applications

**COURSE OUTLINE:**

1. The engineering design process; problem definition, design constraints and requirements (2.0 weeks)
2. Project management techniques (1.0 week)
3. System modeling and simulation (2.0 week)
4. Design analyses for material selection and production technology (2.0 weeks)
5. Optimization in design, statistics in design and design for reliability (2.0 weeks)
6. Safety, environmental considerations and the 'ability' factors (1.0 week)
7. Ethics in engineering practice (2.0 week)
8. Project definition and team selection (2.0 week)
9. Literature survey, alternate design solutions (2.0 weeks)
10. Preliminary design and detailed design (10.0 weeks)
11. Report preparation (2.0 weeks)
12. Oral presentation (1.0 week)

**GRADING STANDARD:**

| | | |
|---|---|---|
| Oral Presentation | 20% | A – 90 to 100 points |
| Project Report | 60% | B – 80 to 89 points |
| Assignment & Attendance | 20% | C – 70 to 79 points |
| | | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-462: DESIGN OF ENERGY SYSTEMS LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MECH-351 Heat Transfer

**COURSE TYPE:** Required Course

**CATALOG DATA:** Design of ducting and piping systems; design of heat exchangers and fluid/rotor energy converters; characteristics of pumps, fans, compressors, turbines; computer-aided design of energy systems; simulation of energy systems

**TEXT BOOK:** Fluid Analysis and Design of Energy Systems, by B.K. Hodge, Robert P. Taylor

ISBN 978-0-07-352934-9
Third Edition, Prentice Hall
*Instructor will supplement with course notes*.

**REFERENCES:** Compact Heat Exchangers, Kays & London
ISBN 0-471-57958-0

**ASME Codes for Boilers and Pressure Vessels**

**Computer Programs for the Analysis and Design of Piping Networks, Heat Exchangers, and Simulation of Energy Systems**

**INSTRUCTOR:** Calvin Brooks, Adjunct Faculty,
Building: 42/213Q, Email: cbrooks@udc.edu. Phone: 202-274-5045

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42/107 |
| Wednesdays, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

The main objectives of this course is to introduce mechanical engineering seniors to design of energy systems and systems components using fundamental principles of fluid mechanics and heat transfer, and computer-aided energy systems design computer software.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Ability to apply basic principles of series-parallel piping systems using a generalized computer program
- Perform the analysis and design of a generalized series-parallel network piping system using the Hardy-Cross method
- Analyze and design shell-tube, and cross flow heat exchangers using appropriate analytical methods
- Perform the analysis and design of a shell-tube heat exchanger using computer software
- Perform the analysis and design of a cross-flow heat exchanger using computer software
- Determine the characteristics and performance of prime movers
- Perform analysis and design of series-parallel pumping systems

**COURSE OUTLINE:**

1. Review of fluid mechanics equation and pressure losses in piping systems (1.0 week)
2. Series piping systems; parallel piping systems; generalized system computer program. Series-Parallel networks – Hardy-Cross methods and analysis (2.0 weeks)
3. Introduction to Heat Exchangers – Method of Analysis (2.0 weeks)
4. Heat Exchanger II – Shell and tube heat exchanger design strategy (2.0 weeks)
5. Cross flow heat exchanger design strategy (3.0 weeks)
6. Prime movers – pump characteristics and performance; series and parallel systems, cavitation mitigation, pump performance analysis (2.0 weeks)
7. Modeling, uncertainty and simulation (2.0 weeks)
8. Design projects assignment

**GRADING STANDARD:**

Design Projects 100%

A – 90 to 100 points
B – 80 to 89 points
C – 70 to 79 points
D – 60 to 69 points
F – Less than 60 points

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**Fall 2013**

**COURSE SYLLABUS:** **MECH 487, PHOTOVOLTAIC AND SOLAR THERMAL ENERGY SYSTEMS [3 Credit Hr]**

**PRE/CO REQ:** ELEC-221 and 223 Electric Circuits I (Lec and Lab)

**COURSE TYPE:** Elective Course

**CATALOG DATA:** Sustainable energy resources are crucial for human survival. Solar energy is present around the globe and already playing major role in developing sustainable energy conversion using solar cells and solar thermal energy systems. This course focuses on science and technology of photovoltaics cells (PV) and solar thermal water heating systems.

**TEXT BOOK:** Solar Cell Technology and Applications
A.R. Jha
CRC PRESS, Taylor and Francis Group
ISBN 978-1-4200-8177-0

**INSTRUCTOR:** Pawan Tyagi, Ph.D.
Building: 42/213E, Email: ptyagi@udc.edu , Phone: 202-274-6601

**OFFICE HOURS:** Tuesday and Thursdays 1:00-3:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 3.30 PM – 4.50 PM | 42/213G |
| Wednesdays, | 3.30 PM – 4.50 PM | 42/213G |

**COURSE OBJECTIVES:**

The objective of this course is to educate student about the underlying principles of fuel cells. Thermodynamic mechanism and electrochemistry will be used to define fuel cell fundamentals. We will closely study the materials and design aspect of fuel cells. A number of common fuel cells will be discussed individually.

**INSTRUCTIONAL FORMAT**: Class Room Discussions and Demonstrations

**STUDENT LEARNING OUTCOMES:**
Upon completion of the course the student will be able to:

- Articulate, global warming and its relation to nature of energy resources and how it can be solved using renewable energies like solar energy.
- Explain the sun intensity versus wavelength graph, and sun radiation, dependence on air mass, declination angle, and latitude.
- Design solar thermal water heating system and analyze the impact of system parameters like heat loss factor, heat removal factor, mass flow rate etc. using Hottel-Whittler model.
- Design complete solar electricity system for day and night and articulate the role of charge controller, inverter, battery bank, solar tracking system, series and parallel connection of cell modules and microscopic structure of a unit cell.
- Articulate the mechanism of p-n junction solar cell, by explaining charge separation concept using band diagram, doping, light absorption in different region of the solar cells, and recombination process.
- Interpret current-voltage data to calculate solar cell efficiency, fill factor, open circuit voltage, saturation current, and model the experimental current-voltage data with solar cell mathematical model.

**COURSE OUTLINE:**

1. Overview of energy resources and justification for using solar energy. (1 week)
2. Facts and fundamentals of solar radiation: Intensity versus wavelength graph of sun radiation, physics behinds sun radiation, solar declination angle, air mass. Solar tracking system. (1 week)
3. Introduction of common solar energy harvesting approaches: Photovoltaics cells and solar thermal energy systems. (1 week)
4. Solar thermal heating systems: Passive and active systems Science and engineering of solar thermal water heaters. (2 week)
5. Test-1
6. Introduction to various components of a complete PV system and components of an individual solar cell. Design complete AC and DC producing solar electricity system for day and night and articulate the role of charge controller, inverter, battery bank, solar tracking system, series and parallel connection of cell modules and microscopic structure of a unit cell. (2 week)
7. Science of photovoltaics: Band diagram, modifying band diagram using doping, p-n junction band diagram attributes, light absorption in different region of the solar cells, recombination process. (3 week)
8. Test-2
9. Connection between semiconductor parameters and solar cell open circuit voltage. (1 week)
10. Interpreting current-voltage data of a solar cell to calculate the following: cell efficiency, fill factor, open circuit voltage, and saturation current. Model the experimental current-voltage data with solar cell mathematical model. Relation between solar cell mathematical model and the factors associated with the design of a solar cell. (1 week)
11. Final exam and presentation

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 20% | A – 90 to 100 points |
| Final Test | 20% | B – 80 to 89 points |
| Quizzes, Assignment | 30% | C – 70 to 79 points |
| In class activities and attendance | 20% | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-488 FUEL CELL FUNDAMENTALS & TECHNOLOGIES [3 Credit Hr]**

**PRE/CO REQ:** ELEC-221 and 223 Electric Circuits I (Lec and Lab)

**COURSE TYPE:** Elective Course

**CATALOG DATA:** Fuel cells are introduced as a renewable energy resource.
This course covers the concepts and fundamentals of fuel cells through student active learning and hands on activities. Various types of fuel cells will be discussed to give in-depth understanding of practical fuel cell device.

**TEXT BOOK:** Fuel cell fundamentals,
2nd ed, Ryan O'Hayre et al. ,
John Wiley & Sons, 2009

**INSTRUCTOR:** Pawan Tyagi, Ph.D.
Building: 42/213E, Email: ptyagi@udc.edu , Phone: 202-274-6601

**OFFICE HOURS:** Tuesday and Thursdays 1-3PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 2.00 PM – 3.20 PM | 42/213G |
| Wednesdays, | 2.00 PM – 3.20 PM | 42/213G |

**COURSE OBJECTIVES:**

Objective of this course is to educate student about the underlying principles of fuel cells. Thermodynamic mechanism and electrochemistry will be used to define fuel cell fundamentals. We will closely study the materials and design aspect of fuel cells. A number of common fuel cells will be discussed individually.

**INSTRUCTIONAL FORMAT**: Class Room Discussions and Demonstrations

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

- Articulate, global warming and its relation to nature of energy resources and how it can be solved by using renewable energy technologies, especially Fuel cell systems.
- Demonstrate the understanding of the basic components and various types of fuel cells systems and have the ability to decide the suitability of these fuel cells for different applications,
- Explain the thermodynamics concepts behind conversion of chemical energy into electrical voltage.
- Demonstrate understanding of the electrode reaction kinetics and its connection with current generation from a fuel.
- Ability to design fuel cell components like electrodes and electrolytes to improve fuel cells,
- Ability to characterize fuel cell systems and electrodes experimentally using fuel cell trainer and cyclic voltammetry
- Ability to communicate in writing and orally the science and engineering concepts pertinent to fuel cell science and technology calculations

**COURSE OUTLINE:**

1. Introduction of global warming and its relation to nature of energy resources and how it can be solved by using renewable energy technologies, especially Fuel cell systems. (1 week)
2. Introduction of the basic components and various types of fuel cells systems and their suitability for different applications, (1.5 week)
3. Thermodynamics of voltage generation in fuel cell by converting chemical energy into electrical energy (2 weeks)
4. Test-1
5. Electrode reaction kinetics and its connection with current generation from a fuel (2.5 weeks).
6. Design of fuel cell components like electrodes and electrolytes to improve fuel cells, (2.5 weeks)
7. Test-2
8. Experiment for the characterization of fuel cell systems and electrodes experimentally using fuel cell trainer and cyclic voltammetry (1 week)
9. Final exam and Presentations

**GRADING STANDARD:**

| | | |
|---|---|---|
| Mid-term Test | 20% | A – 90 to 100 points |
| Final Test | 20% | B – 80 to 89 points |
| Quizzes, Assignment | 30% | C – 70 to 79 points |
| In class activities and attendance | 20% | D – 60 to 69 points |
| | | F – Less than 60 points |

**UNIVERSITY OF THE DISTRICT OF COLUMBIA**
**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**
**SPRING 2014**

**COURSE SYLLABUS:** **MECH-478: MECHATRONIS LEC [3 Credit Hr]**

**PRE/CO REQ:** Pre Req: MECH-381 Microcontrollers in ME and Senior Standing

**COURSE TYPE:** Required Course/Elective Course

**CATALOG DATA:** Fundamental concepts in mechatronics including instrumentation, integration of mechanical, electronics, and control engineering. Operating principles of electromechanical actuators, motors, sensors, drives, and analog motion control. Modeling, simulation, analysis, virtual prototyping and visualization of mechanical systems, and Applications of microprocessors, and microprocessor interfacing to eletromechanical systems.

**TEXT BOOK:** Mechatronics System Design, By Devdas Shetty, Richard A. Kolk
ISBN 13978-1-4390-6198-5
Third Edition, Cengage Learning, 2011
*Instructor will supplement with course notes*.

**REFERENCES:** Software and Hardware Engineering, Fredrick M. Cady, James M. Sibigroth
ISBN 0-19-512469-3
Oxford University Press, 2000

**INSTRUCTOR:** Esther T. Ososanya, Devdas Shetty
Building: 42/109, Email: eososanya@udc.edu. Phone: 202-274-5837

**OFFICE HOURS:** Mon and Wed – 2:00 – 4:00 PM

**LECTURES:**

| | | |
|---|---|---|
| Mondays, | 12.30 – 1.50 PM | 42/107 |
| Wednesdays, | 12.30 – 1.50 PM | 42/107 |

**COURSE OBJECTIVES:**

This course provides an opportunity for students to participate in a multidisciplinary design project and learn how mechanical, electrical and computer engineering technologies can be combined to produce a micro-processor-controlled electro-mechanical robot. Students will be exposed to the process for designing, programming and testing devices.

**INSTRUCTIONAL FORMAT**: Class Room Lecture

**STUDENT LEARNING OUTCOMES:**

Upon completion of the course the student will be able to:

Outcome A: An ability to apply knowledge of mathematics, science, and engineering

- A-1 Understands the use of modeling, analysis, and control dynamics of physical systems.
- Determine the solutions of the differential equation of a Mass-Spring-damper system and validate solutions with simulation output.

Outcome B: An ability to design and conduct experiment, analyze and interpret data.

- B-1 Identifies the constraints, assumptions, and models for the experiment
- Identify constraints, assumptions and models appropriate for a physical system operation.
- B-2 Uses appropriate equipment and techniques for data collections.
- Use appropriate data acquisition instrument and control software to acquire real-time data, monitor, and control a physical system
- B-3 Analyzes experimental data using appropriate tools.
- Use appropriate engineering data processing tools and simulation package to analyze data, interrupt the data and draw conclusions based on the results, and generate plots.

Outcome C: an ability to design a system, component, or process to meet desired needs within realistic constraints.

- C-3 Can work within realistic constraints, (such as economical, environmental, social, political, ethical, health and safety, manufacturability, and sustainability) in realizing systems
- Carry out a real life mechatronics project with realistic constraints such as operability, economic, and safety factor.
- Carry out experiments on actual systems involving monitoring and control.(One example involves the application of electronic damping for Mass-spring-damper system)

Outcome D: An ability to function on multidisciplinary team

- D-1 Shares responsibilities and information on schedule with others on the team
- Knowledge of other disciplines and contribution to ideas

**COURSE OUTLINE:**

1. Microcontroller architecture
2. Assembly Language Programming: M68HC12 Instruction Set
   M68HC12 Parallel I/O, Timer, A/D converters, Interrupts
3. Mechatronics System Design Process, Mechatronics Key Elements, and Applications
4. Modeling and Simulation of Physical Systems
5. Block Diagrams, Manipulations, and Simulation
6. Block Diagram Modeling, Direct Method and Analogy Approach

7. Electrical Systems, Mechanical Translational and Rotational systems
8. Sensors and Actuators
9. Signal Conditioning and Real Time Interface
10. Case Studies

a. Outcomes of instruction
   i. **Learn assembly language programming**
      Student can program a microcontroller, wrote assembly language codes, develop, debug, and implement real-time software for a specific application
   ii. **Learn microcontroller architecture**
      Student can complete the real-time interface design to a microcontroller for the control of a specific peripheral device, perform data acquisition, and control the system.
   iii. **Be able to identify the appropriate sensors and actuators for a specific application**
      1. Students learn the basics of sensor and actuator theory, design, and application.
      2. Students can understand the selection and use of appropriate transducers and actuators for a specific application
   iv. **Learn Modeling and Simulation of Physical Systems**
      1. Students understand mechatronics design process and learn the basics of digital electronics and mechatronic system elements.
      2. Students understand modeling and simulation of physical systems, using the notion of Transfer Functions, Direct and Analog Block Diagram Modeling
      3. Students understand the connection between the mathematical model and physical system
      4. Gain experience designing and controlling basic mechatronic systems
      5. perform model based control system design and implementation using visual programming (VisSim), and
      6. Perform real time control of mechanical system using NI Compact-DAQ devices with Labview or the Quarc Control software, and microcontrollers.
   v. **Learn the capabilities and limitations of other disciplines.**

**GRADING STANDARD:**

| | | |
|---|---|---|
| | | A – 90 to 100 points |
| Examinations | 25% | B – 80 to 89 points |
| Mid-term project report | 25% | C – 70 to 79 points |
| Final project report | 50% | D – 60 to 69 points |
| | | F – less than 60 points |