Appendix A: Syllabi

Engineering Physics

Bachelor of Science in Engineering Physics

Self-Study Report

New Mexico State University

Engineering Physics Program
(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Physics Courses

Course Number and Name: Physics 213, Mechanics

Credits and Contact Hours: 3 credits (two 75-minute classes each week); an additional 2 contact hours each week (during office hours); optional 1 credit supplemental instruction.

Instructor or Course Coordinator Name: Michael Engelhardt

Textbook: H. D. Young, R. A. Freedman and A. L. Ford, *University Physics with Modern Physics*, Pearson, 14th edition, 2016

a) other supplemental materials: MasteringPhysics for Young and Freedman, 14th edition.

Specific Course Information:

a) **catalog description:** Newtonian mechanics

b) **prerequisites or co-requisites:** MATH 191G

c) This course, or its alternative PHYS 215G, *Engineering Physics I,* is required for majors in Physics and Engineering Physics

Specific Goals of the Course:

a) **specific outcomes of instruction:** This course sets the foundation for the undergraduate physics and engineering physics curricula. It provides the fundamental ideas underlying classical mechanics, the application of these ideas to quantitative physics problems, and the relationship between models physicists use and real-world phenomena.

b) related ABET Outcomes: PHYS 213 addresses Program Outcome a) Scientific Expertise: *an ability to apply knowledge of mathematics, science, and engineering.*

Brief List of Topics Covered:

The course covers material from Chapters 1-11, 13-15 of Young and Freedman's textbook.

1. Chapter 1: Units, Physical Quantities, and Vectors, Sec. 1-10
2. Chapter 2: Motion Along a Straight Line, Sec. 1-5
3. Chapter 3: Motion in Two or Three Dimensions, Sec. 1-4
4. Chapter 4: Newton's Laws of Motion, Sec. 1-6
5. Chapter 5: Applying Newton's Laws, Sec. 1-5
6. Chapter 6: Work and Kinetic Energy, Sec. 1-4
7. Chapter 7: Potential Energy and Energy Conservation, Sec. 1-5
8. Chapter 8: Momentum, Impulse, and Collisions, Sec. 1-5
9. Chapter 9: Rotation of Rigid Bodies, Sec. 1-5
10. Chapter 10: Dynamics of Rotational Motion, Sec. 1-6
11. Chapter 11: Equilibrium and Elasticity, Sec. 1-3
12. Chapter 13: Gravitation, Sec. 1-5
13. Chapter 14: Periodic Motion, Sec. 1-5
14. Chapter 15: Mechanical Waves, Sec. 1-5

Prepared by Michael Engelhardt, Fall 2017.

Course Number and Name: Physics 213L, Experimental Mechanics, Fall 2017

Credits and Contact Hours: 1 credit (one 2-1/2 hour lab per week).

Instructor's or Course Coordinator's Name: Stefan Zollner

Textbook: The lab materials were developed by Dr. Steve Kanim (emeritus) of the NMSU Department of Physics. They are distributed on the course learning management system (Canvas). Lab 1 is printed out for the students; students are responsible for printing out other lab and homework materials. We also use RAT/CAT forms to test the students' knowledge before and after the lab completion.

Specific Course Information:

a) catalog description: Laboratory experiments associated with the material presented in PHYS 213.

b) prerequisites or co-requisites: PHYS 213 *(pre- or co-requisite)*.

c) This course is the companion laboratory to Physics 213, Mechanics and is required by all physics and engineering physics majors. EP majors can also take PHYS 215GL instead.

Specific Goals of the Course:

a) specific outcomes of instruction: Students in this course perform a series of experiments that apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 213.

b) related ABET Outcomes: PHYS 213L addresses program outcome *b) an ability to design and conduct experiments.*

Brief List of Topics Covered:

Experiments are performed, data collected and analyzed encompassing: kinematics, dynamics, energy, work, momentum, and their conservation concepts and rotational motion and extended body problems. Below is the list of labs covered over the course of the semester:

1. Buoyancy
2. Description of motion in one dimension
3. Acceleration in one dimension
4. Projectile motion in two dimensions
5. Description of motion in two dimensions
6. Forces
7. Addition of forces
8. Newton's second law
9. Change in energy
10. Conservation of momentum
11. Rotational motion
12. Torque
13. Simple harmonic motion
14. Standing waves

Prepared by Stefan Zollner, Fall 2017.

- **Course Number and Name:** Physics 214, Electricity and Magnetism

- **Credits and Contact Hours:** 3 credits (three 50-minute classes each week); an additional 2 contact hours each week (during office hours); optional 1 credit supplemental instruction

- **Instructor's or Course Coordinators Name:** Michaela Burkardt

Textbook: D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th edition, Pearson Addison-Wesley, 2016

a) other supplemental materials: Mastering Physics for Young and Freedman, 14th edition, numerous handouts distributed as paper copies or via Canvas course management system

- **Specific Course Information:**
- **a) catalog description:** Charges and matter; electric field; Gauss law; electric potential; magnetic field, Amperes law; Faradays law; electric circuits; AC currents, Maxwell's equations; electromagnetic waves
- **b) prerequisites:** PHYS 213 or PHYS 215G
  prerequisites or co-requisites: MATH 192G
- **c)** This course is required for majors in Physics and Engineering Physics as well as Chemistry; (alternative: PHYS216G, *Engineering Physics II*)

- **Specific Goals of the Course:**

a) specific outcomes of instruction: This course teaches the fundamental ideas underlying electricity and magnetism, the interplay between these ideas of physics and mathematics, and the application of these ideas to quantitative physics problems and real-world phenomena.

b) related ABET Outcomes: PHYS 214 addresses the following Program Outcome:

a) *Apply knowledge of math, science and engineering.*

- **Brief List of Topics Covered:**
- *The course covers material from Chapters 21-32 of Young and Freedman's textbook. Number of lectures spend on each section are indicated.*

1. Chapter 21: Electric Charge and Electric Field, Sec. 1-7: (7 lectures)
2. Chapter 22: Gauss's Law, Sec. 1-5: (2 lectures)
3. Chapter 23: Electric Potential, Sec. 1-5: (3 lectures)
4. Chapter 24: Capacitance and Dielectrics, Sec. 1-6: (3 lectures)
5. Chapter 25: Current, Resistance and Electromotive Force, Sec. 1-6: (2 lectures)
6. Chapter 26: Direct-Current Circuits, Sec. 1-5: (3 lectures)
7. Chapter 27: Magnetic Field and Magnetic Forces, Sec. 1-9: (4 lectures)
8. Chapter 28: Sources of Magnetic Fields, Sec. 1-8: (3 lectures)
9. Chapter 29: Electromagnetic Induction, Sec. 1-8: (4 lectures)
10. Chapter 30: Inductance, Sec. 1-6: (2 lectures)
11. Chapter 31: Alternating Current, Sec. 1-6: (3 lectures)
12. Chapter 32: Electromagnetic Waves, Sec. 1-4: (2 lectures)
13. Review (2 lectures)

- 3 Midterm Exams, 1 Comprehensive Final Exam

- ***Prepared by Michaela Burkardt, Spring 2017.***

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Course Number and Name: Physics 214L, Electricity and Magnetism Laboratory, Spring 2018

Credits and Contact Hours: 1 credit (one 2-1/2 hour lab per week).

Instructor's or Course Coordinator's Name: Stefan Zollner

Textbook: Tutorials in Introductory Physics and Homework Package, by McDermott and Shaffer, Addison-Wesley, 2002.

Specific Course Information:

a) **catalog description:** Laboratory experiments associated with the material presented in PHYS 214.

b) **prerequisites or co-requisites:** a C- or better in PHYS 213L or PHYS 215GL *(pre-requisites)* and PHYS 214 *(pre- or co-requisite)*.

c) This course is the companion laboratory to Physics 214, Electricity and Magnetism. It is required by all physics and engineering physics majors. Engineering Physics majors can satisfy the requirement by taking PHYS 216GL instead.

Specific Goals of the Course:

a) **specific outcomes of instruction:** Students in this course perform a series of experiments that apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 214.

b) related ABET Outcomes: PHYS 214L addresses program outcome *b) an ability to design and conduct experiments.*

Brief List of Topics Covered:

Experiments are performed, data collected and analyzed encompassing: electrostatics, electric circuits, magnetism, electromagnetism and light, including geometrical and physical optics. Below is the list of labs covered over the course of the semester:

1. Charge
2. Oscilloscope
3. Electric field and flux
4. Gauss's Law
5. Electric potential difference
6. Circuits I
7. Circuits II
8. Capacitance
9. RC circuits
10. Magnets and magnetic fields
11. Measurement of e/m
12. Magnetic interactions
13. Lenz's law
14. Faraday's law

Prepared by Stefan Zollner, Spring 2018.

Course Number and Name: Physics 215G, Engineering Physics I

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional contact hour each week (during office hours). Evening review sessions before exams. Tutoring room assistance and supplemental instruction also available (optional).

Instructor or Course Coordinator Name: Stephen Pate

Textbook: H.D. Young and R.A. Freedman, *University Physics*, 14th edition, Pearson, 2016

a) other supplemental materials: available at https://learn.nmsu.edu

Specific Course Information:

a) catalog description: Calculus-level treatment of kinematics, work and energy, particle dynamics, conservation principles, simple harmonic motion.

b) prerequisites or co-requisites: MATH 191G *(pre-requisite)*

c) This course (or the equivalent PHYS 213) is required for all majors in the College of Engineering (except Eng. Tech.), all Physics majors and some Chemistry majors.

Specific Goals of the Course:

a) specific outcomes of instruction: PHYS 215 introduces students to the discipline of problem-solving using the elementary principles of mechanics. We will study the motion of masses in 1, 2 and 3 dimensions, including the important case of rotation about a fixed axis. Students will learn to understand and manipulate the fundamental concepts of energy, linear momentum, and angular momentum.

b) related ABET Outcomes: This course supports ABET outcome a) *an ability to apply knowledge of mathematics, science, and engineering.*

Brief List of Topics Covered:

The course covers the following chapters in the Young & Freedman textbook. The number of lectures spent on each section are indicated.

1. Chapter 1, Sec. 1-10: Units, physical quantities and vectors (2 lectures)
2. Chapter 2, Sec. 2-5: Motion along a straight line (2 lectures)
3. Chapter 3, Sec. 1-4: Motion in two or three dimensions (2 lectures)
4. Chapter 4, Sec. 1-6: Newton's laws of motion (2 lectures)
5. Chapter 5, Sec. 1-5: Applying Newton's laws (3 lectures)
6. Chapter 6, Sec. 1-4: Work and kinetic energy (2 lectures)
7. Chapter 7, Sec. 1-5: Potential energy and energy conservation (3 lectures)
8. Chapter 8, Sec. 1-5: Momentum, impulse, and collisions (2 lectures)
9. Chapter 9, Sec. 1-5: Rotation of rigid bodies (2 lectures)
10. Chapter 10, Sec. 1-6: Dynamics of rotational motion (2 lectures)
11. Chapter 11, Sec. 1-3: Equilibrium and statics (1 lecture)
12. Chapter 13, Sec. 1-5: Gravitation (1 lecture)
13. Chapter 14, Sec. 1-5: Periodic motion (2 lectures)
14. Chapter 15, Sec. 1-4: Mechanical waves (1 lecture)

Prepared by Stephen Pate, Spring 2018.

- **Course Number and Name:** Physics 215GL, Engineering Physics I Laboratory
- **Credits and Contact Hours:** 1 credit (one 2-1/2 hour lab per week, up to 12 labs).
- **Instructor or Course Coordinators Name:** Thomas Hearn
- **Textbook:** The lab materials were developed by Dr. Steve Kanim of the NMSU Physics Department. They are distributed on the on the course website. Lab one is printed out for the students; students are responsible for printing out other lab and homework materials
- **Specific Course Information:**
- **a) catalog description:** Laboratory experiments associated with the material presented in PHYS 215G. Co-requisite: PHYS 215G. Students wishing to use the PHYS 215G-216G sequence to satisfy the basic natural science general education requirement must register for either PHYS 215GL or PHYS 216GL.
- **b) prerequisites or co-requisites:** PHYS 215 *(pre/co-requisite)*.
- **c)** This course is the companion laboratory to Physics 215, Engineering Physics I. It is required by all engineering majors, with the exception of Engineering Technology.
- **Specific Goals of the Course:**
- **a) specific outcomes of instruction:** Students in this course perform a series of experiments that apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 215.
- **b) related ABET Outcomes:** PHYS 215L addresses program outcome *b) an ability to design and conduct experiments.*
- **Brief List of Topics Covered:**
- *Experiments are performed, data collected and analyzed encompassing: kinematics, dynamics, energy, work, momentum, and their conservation concepts and rotational motion and extended body problems. Below is the list of labs covered over the course of the semester:*

1. Descriptions of motion
2. Acceleration in one dimension
3. Motion in two dimensions
4. Forces
5. Addition of forces
6. Newton's second law
7. Energy
8. Conservation of momentum
9. Rotational motion
10. Torque
11. Simple harmonic motion
12. Standing waves

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- ***Prepared by Tom Hearn, Spring 2018.***

Course Number and Name: Physics 216G, Engineering Physics II

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Lauren Waszek

Textbook: Young and Freedman, University Physics with Modern Physics, 14th Ed.

a) other supplemental materials: *Mastering Physics* online homework for Young and Freedman, 14th edition.

Specific Course Information:

a) catalog description: A calculus-level treatment of topics in electricity, magnetism, and optics.

b) prerequisites or co-requisites: PHYS 213 or 215G, MATH 192G *(pre-reqs)*.

c) This course is required for most engineering disciplines, except Engineering Technology and Survey Engineering. It can also substitute PHYS214 for Engineering Physics majors.

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides a calculus-based introduction to electricity, magnetism, basic electronic circuits, and basic optics. PHYS 215G and PHYS 216G prepare students for upper-division courses in engineering and physical sciences.

b) related ABET Outcomes: PHYS 216G addresses Program Outcome a - an ability to apply knowledge of mathematics, science, and engineering.

Brief List of Topics Covered:
The course covers all of the material from Chapters 21-35 of the textbook. Approximate numbers of lectures spent on each chapter are indicated.

1. Chapter 21: Electric Charge and Electric Field, 3
   Chapter 22: Gauss' Law, 3
2. Chapter 23: Electric Potential, 3
   Chapter 24: Capacitance and Dielectrics, 3
   Chapter 25: Current, Resistance, and Electromotive Force, 3
3. Chapter 26: Direct-Current Circuits, 3
4. Chapter 27: Magnetic Field and Magnetic Forces, 3
5. Chapter 28: Sources of Magnetic Field, 3
   Chapter 29: Electromagnetic Induction, 3
6. Chapter 30: Inductance, 1
7. Chapter 31: Alternating Current, 1
8. Chapter 32: Electromagnetic Waves, 2
9. Chapter 33: The Nature and Propagation of Light, 3
10. Chapter 34: Geometric Optics, 3
11. Chapter 35: Interference, 1
12. Examination review sessions: 4

Mid-terms: 2

Prepared by Lauren Waszek, Fall 2017.

Course Number and Name: Physics 216GL, Engineering Physics II Laboratory

Credits and Contact Hours: 1 credits (one 2-1/2 hour lab per week).

Instructor or Course Coordinator Name: Heinz Nakotte

Textbook: Tutorials in Introductory Physics and Homework Package, by McDermott and Shaffer, Addison-Wesley Publishers, 2002.

Specific Course Information:

a) catalog description: Laboratory experiments associated with the material presented in PHYS 216G.

b) prerequisites or co-requisites: PHYS 213L or 215GL *(pre-requisites)* and PHYS 216G *(co-requisite)*.

c) This course is the companion laboratory to PHYS 216G, Engineering Physics II. It is required by all engineering majors, with the exception of Engineering Technology. EP majors can satisfy this requirement by taking PHYS 214L instead.

Specific Goals of the Course:

a) specific outcomes of instruction: Students in this course perform a series of experiments that apply the principles and concepts highlighting the main objectives covered in the coursework for PHYS 216G.

b) related ABET Outcomes: PHYS 216GL addresses program outcome *b) an ability to design and conduct experiments.*

Brief List of Topics Covered:

Experiments are performed, encompassing: electrostatics, electric circuits, magnetism, electromagnetism and light, including geometrical and physical optics. Below is the list of labs offered over the course of the semester; students will typically perform 12 out of these 14 labs:

1. Charge
2. Electric field and flux
3. Gauss's Law
4. Electric potential difference
5. Circuits I
6. Circuits II
7. Magnets and fields
8. Magnetic interactions
9. Measurement of e/m
10. Lenz's law
11. Faraday's law
12. Plane and curved mirrors
13. Ray diagrams and convex lenses
14. Interference and Diffraction

Prepared by Heinz Nakotte, Fall 2017.

Course Number and Name: Physics 217: Heat, Light, and Sound

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours); optional 1 credit supplemental instruction.

Instructor or Course Coordinator Name: Michaela Burkardt

Textbook: D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th edition, Pearson Addison-Wesley, 2016

a) other supplemental materials: numerous handouts distributed as paper copies or via Canvas course management system

Specific Course Information:

a) catalog description: Calculus-level treatment or thermodynamics, geometrical and physical optics, and sound.

b) prerequisites or co-requisites: PHYS 213 or 215G *(pre-req)*

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: Students should become familiar with the concepts of waves (on a string, sound, and light), wave propagation and interference, and the description of these phenomena. Fundamentals of ray optics are discussed with applications. The section on thermodynamics in the course discusses the laws or thermodynamics and their use to describe thermal processes in engineering applications.

b) related ABET Outcomes: PHYS 217 addresses the following Program Outcomes: *a) Apply knowledge of math, science, and engineering*

Brief List of Topics Covered:

The course covers material from Chapters 14 (review), 15-20, 32-36, 39 (in part) of the Young and Freedman textbook. The number of lectures spent on each section are indicated.

1. Chapter 14: Review Periodic Motion (2)
2. Chapter 15: Mechanical Waves (4)
3. Chapter 16: Sound and Hearing (6)
4. Chapter 32: Electromagnetic Waves, Sec.1, 3-5 (1)
5. Chapter 33: Nature and Propagation of Light (2)
6. Chapter 34: Geometric Optics (4)
7. Chapter 35: Interference (2)
8. Chapter 36: Diffraction (2)
9. Chapter 39: Particles Behaving as Waves (1) Sec. 2, 3, 5 (Quantization of Energy, Photons)
10. Chapter 17: Temperature and Heat (3)
11. Chapter 18: Thermal Properties of Matter (3)
12. Chapter 19: First Law of Thermodynamics (3)
13. Chapter 20: Second Law of Thermodynamics (4)
14. Review (3)

Prepared by Michaela Burkardt, Fall 2017.

Course Number and Name: Physics 217L: Experimental Heat, Light, and Sound

Credits and Contact Hours: 1 credit (one 150-minute lab each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Michaela Burkardt

Textbook: The lab manuals were developed in the NMSU Department of Physics for this course. Descriptions were updated and new laboratories developed by Dr. Michaela Burkardt.

a) other supplemental materials: assignments files and (optional) multimedia resources distributed via Canvas course management system

Specific Course Information:

a) catalog description: Laboratory experiments associated with the material presented in PHYS 217.

b) prerequisites or co-requisites: PHYS 217 *(pre/co-requisite)*

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: Students should become familiar with the experimental exploration of basic phenomena in nature, data analysis, and the preparation of laboratory reports.

b) related ABET Outcomes: PHYS 217L addresses the following Program Outcomes (*b) design and conduct experiments, as well as to analyze and interpret data, (c) an ability to design a system, component, or process to meet desired needs with realistic constraints, (d) an ability to function in multi-disciplinary teams,* and *(g) an ability to communicate effectively,*

Brief List of Topics Covered:

The students perform 14 experiments during the semester, and each student writes an individual assignment report for each experiment. All assignments require analysis and interpretation of data. In addition, each assignment focusses on components of writing lab reports.

1. Measuring and Uncertainty Analysis
2. Vibrations of a String
3. Properties of Sound
4. Resonance Modes in a Tube
5. Linear Polarization
6. Reflection and Mirrors
7. Refraction and Lenses
8. Interference
9. Bragg Reflection
10. Statistics
11. Thermal Expansion
12. Thermal Radiation
13. Ideal Gas Laws
14. Calorimetry

Prepared by Michaela Burkardt, Fall 2017.

Course Number and Name: Physics 303V, Energy and Society

Credits and Contact Hours: 3 credits (online asynchronous 150 minutes each week); an additional contact hour each week (during online office hours)

Instructor or Course Coordinator Name: Edwin Fohtung

Textbook: Roger A. Hinrichs, Merlin H. Kleinbach Energy: Its Use and the Environment

a) other supplemental materials: none

Specific Course Information:

a) catalog description: Traditional and alternative sources of energy. Contemporary areas of concern such as the state of depletion of fossil fuels; nuclear energy, solar energy, and other energy sources; environmental effects; nuclear weapons; and health effects of radiation. Discussion of physical principles and impact on society. Focus on scientific questions involved in making decisions in these areas. No physics background required.

b) prerequisites or co-requisites: None

c) This course is an elective in Engineering Physics for students with Electrical and Mechanical concentrations.

Specific Goals of the Course:

specific outcomes of instruction: In this course, we will discuss topics as diverse as Home Energy Conservation, Solar Energy, Energy from Fossil Fuels, Air Pollution and Energy Use, Global Warming and Thermal Pollution, Electricity from Solar, Wind, and Hydro, Nuclear Power: Fission and Fusion, Biomass: From Plants to Garbage, and Geothermal Energy.

related ABET Outcomes: f) an understanding of professional and ethical responsibility; h) the broad education necessary to understand impact of engineering solutions in global, economic, environmental and societal context; i) a recognition of the need for, and the ability to engage in lifelong learning; j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The course covers material from Chapters 1-19 Roger A. Hinrichs' and Merlin H. Kleinbach's book.

1. General Introduction
2. Energy Mechanics.
3. Conservation of Energy.
4. Heat and Work.
5. Home Energy Conservation and Heat-Transfer Control.
6. Solar Energy: Characteristics and Heating.
7. Energy from Fossil Fuels.
8. Air Pollution and Energy Use.
9. Global Warming and Thermal Pollution.
10. Electricity: Circuits and Superconductors.
11. Electromagnetism and the Generation of Electricity.

12. Electricity from Solar, Wind, and Hydro.
13. The Building Blocks of Matter:
14. Nuclear Power: Fission.
15. Effects and Uses of Radiation.
16. Future Energy Alternatives: Fusion.
17. Biomass: From Plants to Garbage.
18. Tapping the Earth's Heat: Geothermal Energy.
19. A National and Personal Commitment.

Prepared by Edwin Fohtung, Spring 2018.

Course Number and Name: Physics 305V, Search for Water in the Solar System

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional 2 contact hours each week (during office hours).

Instructor or Course Coordinator Name: Tom Hearn

Textbook: none required

a) other supplemental materials:

C.H. Langmuir and W, Broecker, *How to build a habitable planet: The story of the Earth from the big bang to humankind*, 2012, ISBN: 978-0602240063

T. Encrenaz, *Searching for water in the universe*, 2007, ISBN: 978-0-387-34174-3.

Specific Course Information:

a) catalog description: Examines the formation, abundance, and ubiquity of water in our Solar System stemming from comets, Martian and Lunar poles, Earth's interior and into the outer reaches of the Solar System. Topics will include nuclear synthesis, Solar System formation, remote sensing, as well as past, present and future NASA missions for water.

b) prerequisites or co-requisites: Viewing a Wider World courses and should be taken in a student's junior and/or senior year.

c) This course is not required for majors in Physics and Engineering Physics, but may be used as an elective.

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides an overview of water on Earth, in the solar system, and in the universe. This includes formation of the solar system and universe. Students should become proficient in combining diverse sources of knowledge and information to discuss interdisciplinary topics including nuclear synthesis, Solar System formation, remote sensing, as well as past, present and future NASA missions for water.

b) related ABET Outcomes: f) Professional Responsibility, h) Societal Impact, i) Lifelong Learning, j) Contemporary Issues.

Brief List of Topics Covered:

1. Scales; Big Bang
2. Nucleosynthesis; Periodic Table
3. Rocky Bodies; Water on terrestrial planets
4. The Solar System: Gas Giants; The Solar System: Icy Giants
5. Planet Formation/Accretion; Newtons Laws
6. Celestial Mechanics; Composition of Atmospheres
7. Elements of planets; Minerals.
8. Rocks; Water Properties.
9. Lakes and Oceans; Ecology.
10. Humans and Water; Habitable Zone.
11. Urey Miller; Chemical Bonding.
12. Vibrations; Detection.
13. Past NASA; Current NASA.
14. Brain Storming; Moon.
15. Mars; Extrasolar.

16. Ice, Snow, and Water on Earth; Water in the Mantle.
17. Water Terrestrial; Outer Solar System.
18. Water and Climate; Life.
19. Pollution.
20. Conservation; Food.
21. Security; Water Security.
22. Student Papers
23. Student Presentations

Prepared by Tom Hearn, Fall 2017.

Course Number and Name: Physics 315 – Intermediate Modern Physics, 3 credits

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Matthias Burkardt

Textbook: H. D. Young & R. A. Freedman, *University Physics with Modern Physics*, Pearson/Addison Wesley

a) other supplemental materials: handouts

Specific Course Information:

a) catalog description: an introduction to relativity and quantum mechanics with applications on atoms, molecules, solids, nuclei, and elementary particles.

b) prerequisites or co-requisites: *Prerequisite*: Phys 214 or 216G and Math 291G; *Corequisite*: none

c) This course is required for majors in Physics, Engineering Physics and Chemistry.

Specific Goals of the Course:

a) specific outcomes of instruction: In this course you will learn the key ideas of modern physics which were mostly developed during the 20^{th} century. In addition to discussing how these ideas shaped modern physics, applications to real-life problems are emphasized.

b) related ABET Outcomes: This course addresses Program Outcomes (a) an ability to apply knowledge to physics problems, (f) an understanding of ethical and professional responsibilities, (h) an understanding of the impact of engineering and physics solutions in a global, economic, environmental, and societal context, (i) a recognition of the need for and an ability to engage in life-long learning, and (j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The Michelson Morley experiment (1); The Lorentz transformation (2);

Relativistic momentum and energy (2); General relativity (1);

Blackbody radiation (1); Photoelectric effect (1);

Compton effect and pair creation (1); Rutherford experiment (1);

Atomic spectra, Bohr model, de Broglie waves (1); Schroedinger equation (3);

Chemical Bonds, properties of solids (3); Fermi gas (2);

Radioactivity (1); Nuclear landscape (2);

Nuclear reactions (2); Nuclear reactors. Cerenkov radiation (2);

Nuclear accidents (2); Biological effects of radiation (2);

Standard model of elementary particles and cosmology (3).

Prepared by Matthias Burkardt, Spring 2018.

Course Number and Name: Physics 315L, Experimental Modern Physics

Credits and Contact Hours: 3 credits (two 150-minute labs each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Stephen Pate

Textbook: no textbook

a) other supplemental materials: available at https://learn.nmsu.edu

Specific Course Information:

a) catalog description: Elementary laboratory in modern physics which supports the subject matter in PHYS 315.

b) prerequisites or co-requisites: PHYS 214L or 216L *(pre-req)*; PHYS 315 *(co-req)*

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: Students perform a series of classic experiments in quantum physics and apply techniques of measurement, interpretation, and presentation of experimental data.

b) related ABET Outcomes: PHYS 315L addresses the following Program Outcomes:

b) Design and conduct experiments, as well as analyze and interpret data

c) Design a system, component, or process to meet desired needs within realistic constraints

d) Function on multidisciplinary teams

f) Have an understanding of professional and ethical responsibilities

g) Communicate effectively

k) Use techniques, skills and modern tools necessary for engineering and physics practice

Brief List of Topics Covered:

The students work in teams of 3-4 people. Each team performs 8 experiments over the course of the semester. The first experiment concerns the uncertainties in counting experiments, and all students write a report on this measurement. Then comes a series of 6 short experiments; individual students are assigned to write a report for the whole team; each student writes two reports in total. Then comes a final longer experiment, lasting several weeks. The team writes a design report for this experiment, then performs the measurement, analyses the data, and makes presentation to the entire class during the last few lab meetings.

The First Experiment (done by all teams; all students write an individual report)

1. Counting Statistics

Short Experiments (each team does 6 of these; team reports written by individual members)

2. Atomic Spectroscopy
3. Electron Diffraction
4. Planck's Constant – Photoelectric Effect
5. The Speed of Light
6. Quantization of Atomic Energy Levels – Franck-Hertz Experiment
7. Nuclear Magnetic Resonance
8. Electrical Conductivity of Metals and Semi-conductors

9. Ruckardt's Tube – specific heat ratio in gases

Long Experiments (done by one team only; requires design report, and final results presentation, done by the whole team)

10. The Hall Effect
11. X-Ray Diffraction
12. Charge of the Electron – Millikan Oil Drop Experiment
13. The Zeeman effect
14. Gamma-Ray Spectroscopy
15. Rutherford Scattering and the Range of Alpha Particles in Matter

Prepared by Stephen Pate, Spring 2018.

Course Number and Name: Physics 395, Intermediate Mathematical Methods of Physics

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Stephen Pate

Textbook: HELM Workbooks, available at https://learn.nmsu.edu

a) other supplemental materials: available at https://learn.nmsu.edu

Specific Course Information:

a) catalog description: Introduction to the mathematics used in intermediate-level physics courses. Topics include vector calculus, curvilinear coordinates, matrices, linear algebra, function spaces, partial differential equations, and special functions.

b) prerequisites or co-requisites: MATH 291 *(pre-req)*, MATH 392 *(pre/co-req)*

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: Students should become proficient at these advanced mathematical topics so that they will easily understand the interplay between the mathematical tools and physics concepts. The advanced mathematics should become an aid to understanding, and not a barrier.

b) related ABET Outcomes: PHYS 395 addresses Program Outcome k) *use techniques, skills and modern tools necessary for engineering and physics practice.*

Brief List of Topics Covered:

The course will cover four major topic areas:

1. Vector Calculus -- HELM Chapters 28,29 (11 lectures)
2. Complex Numbers -- HELM Chapter 10 (2 lectures)
3. Linear Algebra -- HELM Chapters 7, 22 (9 lectures)
4. Differential Equations – HELM Chapter 25 (5 Lectures)

Prepared by Stephen Pate, Spring 2018.

Course Number and Name: Physics 451, Intermediate Mechanics I

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Lauren Waszek

Textbook: Fowles and Cassiday, Analytical Mechanics 7th Edition, Brooks and Cole

Specific Course Information:

a) catalog description: Vector calculus, Lagrangian and Hamiltonian formulations of Newtonian mechanics. Topics include central force motion, dynamics of rockets and space vehicles, rigid body motion, noninertial reference frames, oscillating systems, relativistic mechanics, classical scattering, and fluid mechanics.

b) prerequisites or co-requisites: PHYS 213 or 215G, MATH 291G *(pre-reqs);* MATH 392 *(pre-/co-reqs)*

c) This course is required for Physics and Engineering Physics (EP) majors with Electrical and Chemical concentrations and is a possible elective for Mechanical or Aerospace Concentrations.

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides a more comprehensive understanding of the fundamental ideas underlying classical mechanics, including Newton's laws and conservation laws. It incorporates mathematical techniques for application of these ideas to solving problems, and alternative formulations of these basic principles (Lagrangian and Hamiltonian) based on the principle of least action and on the calculus of variations.

b) related ABET Outcomes: PHYS 451 addresses Program Outcomes (e) develop an ability to identify, formulate, and solve engineering problems, (f) an understanding of ethical and professional responsibilities, (h) an understanding of the impact of engineering and physics solutions in a global, economic, environmental, and societal context, (i) a recognition of the need for and an ability to engage in life-long learning, and (j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The course covers all material from Chapters 1-10 of the textbook. Approximate numbers of lectures spent on each chapter are indicated.

1. Chapter 1: Fundamental Concepts: Vectors, 2.5
2. Chapter 2: Newtonian Mechanics: Rectilinear Motion of a Particle, 4
3. Chapter 3: Oscillations, 3
4. Chapter 4: General Motion of a Particle in Three Dimensions, 2.5
5. Chapter 5: Non-Inertial Reference Systems, 2.5
6. Chapter 6: Gravitation and Central Forces, 4.5
7. Chapter 7: Dynamics of Systems and Particles, 3.5
8. Chapter 8: Mechanics of Rigid Bodies: Planar Motions, 4
9. Chapter 9: Motions of Bodies in Three Dimensions, 4
10. Chapter 10: Lagrangian Mechanics, 5
11. Examination review sessions: 4
12. Mid-terms: 2

Prepared by Lauren Waszek, Fall 2017.

Course Number and Name: Physics 454, Intermediate Modern Physics I

Credits and Contact Hours: 3 credits (two 75-minute classes each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Michael Engelhardt

Textbook: J. S. Townsend, *A Modern Approach to Quantum Mechanics*, University Science Books, 2nd edition, 2012.

a) other supplemental materials: none

Specific Course Information:

a) catalog description: Introduction to quantum mechanics, focusing on the role of angular momentum and symmetries, with application to many atomic and subatomic systems.

b) prerequisites or co-requisites: PHYS 315 *(pre-req.)*, PHYS 395 *(co-req.)*, and MATH 392 *(co-req.)*

c) This course is required for majors in Physics and Engineering Physics

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides foundations of quantum mechanics and related phenomena. It is an integral part of the upper-division physics core, which includes PHYS 451, 454&455, 461&462, and PHYS 480. Students should become proficient in solving a wide range of problems based on a quantum state vector description of systems, an operator formulation of observables, and Schrödinger's equation, including intrinsic spin and motion in one dimension.

b) related ABET Outcomes: PHYS 454 addresses Program Outcome e) Problem Solving: *an ability to identify, formulate, and solve engineering and physics problems*.

Brief List of Topics Covered:

The course covers material from Chapters 1-7 of Townsend's textbook.

1. Chapter 1: Stern-Gerlach Experiments, Sec. 1-6
2. Chapter 2: Rotation of Basis States and Matrix Mechanics, Sec. 1-8
3. Chapter 3: Angular Momentum, Sec. 1-8
4. Chapter 4: Time Evolution, Sec. 1-4,6,7
5. Chapter 5: A System of Two Spin-1/2 Particles, Sec. 1-3,7,8
6. Chapter 6: Wave Mechanics in One Dimension, Sec. 1-11
7. Chapter 7: One-Dimensional Harmonic Oscillator, Sec. 1-11

Prepared by Michael Engelhardt, Fall 2017.

Course Number and Name: Physics 455 – Intermediate Modern Physics II, 3 credits

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional 2 contact hours each week (during office hours)

Designation: Required for undergraduate Physics and Engineering Physics majors.

Instructor or Course Coordinator Name: Matthias Burkardt

Textbook: J.S. Townsend: A Modern Approach to Quantum Mechanics, University Science Books 2000.

a) other supplemental materials: none

Specific Course Information:

a) catalog description: continuation of subject matter of PHYS 454. Specific topics include rotation and translation in three dimensions, solution of central potential problems, perturbation theory, physics of identical particles, scattering theory, and the interaction between photons and atoms.

b) prerequisites or co-requisites: *Prerequisite*: PHYS 454

c) This course is required for majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: In this course you will learn how to apply the postulates of quantum mechanics to solve simple quantum mechanics problems.

b) related ABET Outcomes: Students should develop an ability to identify, formulate, and solve engineering problems that involve quantum phenomena.

Brief List of Topics Covered:

1. The postulates of quantum mechanics (2)
2. One-dimensional Schroedinger equation; particle in a box (3)
3. The harmonic oscillator (4)
4. The two-body problem (3)
5. Three-dimensional Schroedinger equation; Central potentials (4)
6. Approximate methods; perturbation theory, variational method (4)
7. The chemical bond; properties of solids (3)
8. Identical particles (2)
9. Review (1)

Three midterm quizzes; two-hour final quiz during exam week.

Prepared by Matthias Burkardt, Spring 2018.

Course Number and Name: Physics 461, Intermediate Electricity and Magnetism I

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Heinz Nakotte

Textbook: D.J. Griffiths, *Introduction to Electrodynamics*, 4th edition, Prentice Hall, 2013

a) other supplemental materials: C.A. Balanis, *Advanced Engineering Electromagnetics*,

2nd edition, John Wiley & Sons, 2012.

Specific Course Information:

a) catalog description: The first part of a two-course sequence in classical electrodynamics. Covered topics include static electric and magnetic fields, Laplace's and Poisson's equations, electromagnetic work and energy, Lorentz force, Gauss's, Biot-Savart, and Ampere's laws, Maxwell's equations, as well as electric and magnetic fields in matter.

b) prerequisites or co-requisites: PHYS 214 or 216G or equivalent and MATH 291G *(pre-reqs);* MATH 392 and PHYS 395 *(pre-/co-reqs)*

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides the fundamental knowledge of electrodynamics and related phenomena. It is an integral part of the upper-division physics core, which includes PHYS 451, 454&455 and 461&462. Students should become proficient in a wide range of problems of electro- and magnetostatics, including dielectrics and magnetic materials.

b) related ABET Outcomes: PHYS 461 addresses Program Outcomes (e) develop an ability to identify, formulate, and solve engineering problems, (f) an understanding of ethical and professional responsibilities, (h) an understanding of the impact of engineering and physics solutions in a global, economic, environmental, and societal context, (i) a recognition of the need for and an ability to engage in life-long learning, and (j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The course covers all of the material from Chapters 1-6 of Griffiths' textbook, and it provides occasional supplemental material from Balanis' textbook. Number of lectures spend on each section are indicated.

Chapter 1: Vector Analysis (3)

1.1. Vector Algebra *(1/2 lecture)*

1.2. Differential Calculus *(1/2)*

1.3. Integral Calculus *(1/2)*

1.4. Curvilinear Coordinates *(1/2)*

1.5. The Dirac Delta Function *(1/2)*

1.6. The Theory of Vector Fields *(1/2)*

Chapter 2: Electrostatics (7)

2.1. The Electric Field *(1)*

2.2. Divergence and Curl of Electrostatic Field *(2)*

2.3. Electric Potential *(1)*

2.4. Work and Energy in Electrostatics *(1)*
2.5. Conductors *(2)*
Chapter 3: Special Techniques (6)
3.1. Laplace's Equation *(1)*
3.2. The Method of Images *(1)*
3.3. Separation of Variables *(2)*
3.4. Multipole Expansion *(2)*
Chapter 4: Electric Fields in Matter (7)
4.1. Polarization *(1)*
4.2. The Field of a Polarized Object *(1)*
4.3. The Electric Displacement *(2)*
4.4. Dielectrics *(3)*
Chapter 5: Magnetostatics (5)
5.1. The Lorentz Force Law *(1)*
5.2. The Biot-Savart Law *(2)*
5.3. The Divergence and Curl of B *(1)*
5.4. Magnetic Vector Potential *(2)*
Chapter 6: Magnetic Fields in Matter (6)
6.1. Magnetization *(1)*
6.2. The Field of a Magnetized Object *(1)*
6.3. The Auxiliary Field H *(2)*
6.4. Linear and Nonlinear Media *(2)*
Student Presentations (4)

Prepared by Heinz Nakotte, Fall 2017.

Course Number and Name: Physics 462, Intermediate Electricity and Magnetism II

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Robert Cooper

Textbook: D.J. Griffiths, *Introduction to Electrodynamics*, 4th edition, Prentice Hall, 2013

a) other supplemental materials: R.K. Wangsness, *Electromagnetic Fields*, 2nd edition, John Wiley & Sons, 1986.

C.A. Balanis, *Advanced Engineering Electromagnetics*, 2nd edition, John Wiley & Sons, 2012.

Specific Course Information:

a) catalog description: Continuation of subject matter of PHYS 461. Covered topics include Maxwell's equations and their applications, electromagnetic waves, reflection, refraction, dispersion, radiating systems, interference and diffraction, as well as Lorentz transformations and relativistic electrodynamics. May be repeated up to 3 credits.

b) prerequisites or co-requisites: C- or better in PHYS 461.

c) This course is required for all majors in Physics and Engineering Physics.

Specific Goals of the Course:

a) specific outcomes of instruction: This is a required course for physics and engineering physics student, and it is a continuation of topics introduced in PHYS 461: Introduction to Electricity and Magnetism I. In this course, the effect of moving charges will be explored in electromotive force, induction, Maxwell's equations, conservation laws, electromagnetic waves in vacuum and in matter, absorption and dispersion, waveguides, dipole radiation, and relativistic electrodynamics. Due to the compounding use of advanced mathematics, a secondary objective to this course is to continue developing the use of mathematics in practical physics problems.

b) related ABET Outcomes: This course addresses Program Outcomes (e) develop an ability to identify, formulate, and solve engineering problems, and possibly (f) an understanding of ethical and professional responsibilities, (h) an understanding of the impact of engineering and physics solutions in a global, economic, environmental, and societal context, (i) a recognition of the need for and an ability to engage in life-long learning, and (j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The course covers the material from Chapters 7-12 of Griffiths' textbook, and it provides occasional supplemental material from Balanis' and Wangsness' textbooks. The number of lectures spent on each section are indicated.

Chapter 7: Electrodynamics (3)

7.1. Electromotive Force *(1/2 lecture)*

7.2. Electromagnetic Induction *(1)*

7.3. Maxwell's Equations *(1-1/2)*

Chapter 8: Conservation Laws (2)

8.1. Charge and Energy *(1/2)*

8.2. Momentum *(1/2)*

8.3. Magnetic Forces Do No Work *(1)*

Chapter 9: Electromagnetic Waves (5)

9.1. Waves in One Dimension *(1)*

9.2. Electromagnetic Waves in Vacuum *(1)*

9.3. Electromagnetic Waves in Matter *(1)*

9.4. Absorption and Dispersion *(1)*

9.5. Guided Waves *(1)*

Chapter 10: Potentials and Fields (3)

10.1. The Potential Formulation *(1)*

10.2. Continuous Distributions *(1)*

10.3. Point Charges *(1)*

Chapter 11: Radiation (4)

11.1. Dipole Radiation *(2)*

11.2. Point Charges *(2)*

Chapter 12: Relativity (4)

12.1. The Special Theory of Relativity *(1-1/2)*

12.2. Relativistic Mechanics *(1)*

12.3. Relativistic Electrodynamics *(1-1/2)*

Student Presentations (2)

Chapters 1-6 Review (2)

Exam Reviews (3)

Midterm (1)

ETS MFT post-testing (1)

Prepared by Robert Cooper, Spring 2018.

Course Number and Name: Physics 468, Intermediate X-ray Diffraction, Fall 2017

Credits and Contact Hours: 3 credits (two 75-minute lectures each week; lectures are cancelled occasionally to give students an opportunity for hands-on experiments in x-ray diffraction).

Instructor's or Course Coordinator's Name: Stefan Zollner

Textbook: Choose one: (1) Powder x-ray diffraction: Cullity & Stock, Elements of X-Ray Diffraction, 3rd edn, Pearson, 2001 (2) X-ray reflectance and reciprocal space maps: Holy, Pietsch & Baumbach, High-Resolution X-Ray Scattering: From Thin Films to Lateral Nanostructures, 2nd edn, Springer, 2004 (3) Crystallography: Rohrer, Structure and Bonding in Crystalline Materials, Cambridge University Press, 2001.

a) other supplemental materials: Hand-outs from the instructor and various sources, especially Wikipedia. American Institute of Physics Style Manual. Selected original research journal articles. These materials are made available to students on the course learning management system (Canvas).

Specific Course Information:

a) catalog description: Introduction to x-ray diffraction and reflectivity spectra. Topics include X-ray sources and detectors, atomic spectra, characteristic x-rays, thermionic emission, synchrotron radiation, instrument components, and beam conditioners.

b) prerequisites or co-requisites: a C- or better in PHYS 315 and PHYS 315L *(pre-req.)*

c) This course is a possible technical elective for majors in Physics and Engineering Physics with any of the concentrations. In general, it is cross-listed with PHYS 568, a slightly more advanced course taken by physics graduate students. The class material covered in PHYS 468 and PHYS 568 is the same for both undergraduate and graduate students; however, graduate students are required to do additional (more difficult) assignments. This course is also cross-listed as CHME 488/588, a technical elective for students in chemical and materials engineering.

Specific Goals of the Course:

a) specific outcomes of instruction: This course introduces instrumentation and measurement concepts for both powder and high-resolution x-ray diffraction. It also provides a basic introduction into crystallography, including crystal symmetry and reciprocal space. Students gained hands-on experience with modern equipment, were introduced to the original research literature, performed experiments, presented their results in class, and wrote a report formatted like an article in a research journal.

b) related ABET Outcomes: PHYS 468 addresses Program Outcomes: b) *an ability to design and conduct experiments, as well as to analyze and interpret data*, d) *an ability to function on multidisciplinary teams*, f) *an understanding of professional and ethical responsibility*, g) *an ability to communicate effectively (orally, written)*, k) *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*

Brief List of Topics Covered:

Below is the list of topics covered over the course of the semester. The number of lectures for each group of topics is given in parentheses.

1. Syllabus, course overview, pretest, photoelectric effect (1)
2. Rubric for final report and in-class presentations (1)
3. Spectroscopy, thermionic emission, Schottky emission, Bremsstrahlung, Bohr model, characteristic x-rays, core levels, x-ray absorption, x-ray tubes (2)
4. Optical constants in the x-ray regime, experimental setup for powder diffraction, Huygens' principle, Bragg's Law, Du Mond diagram, beam conditioners, diffraction methods, diffractometers and reflectometers (2)
5. Linear algebra, groups, fields, vector spaces, inner product, dual space, dual basis, reciprocal space (2)
6. Miscibility, phase diagrams, two-dimensional lattices, chemical bonding, radius ratio, packing density (2)
7. Crystal=lattice+basis, Bravais lattices, rhombohedral and hexagonal lattice, crystal structures, points, Miller indices, directions (2)
8. Space and point groups, Wyckoff positions, Bilbao crystallographic server (1)
9. Structure factors, intensities of power diffraction peaks, examples (rutile, perovskite, zinc blende, rocksalt), atomic form factor, Lorentz-polarization factor, Debye-Waller factor, multiplicity (4)
10. Pseudomorphic layers, stress and strain, symmetric and asymmetric reflections, reciprocal space maps (4)
11. Presentations from students about their experiments (2)
12. Experiments (equivalent to seven class periods)

Prepared by Stefan Zollner, Fall 2017.

Course Number and Name: Physics 471, Modern Experimental Optics, Fall 2016

Credits and Contact Hours: 3 credits (two 150-minute lab sessions each week).

Instructor's or Course Coordinator's Name: Stefan Zollner

Textbook: Harland G. Tompkins and James N. Hilfiker, *Spectroscopic Ellipsometry: Practical Application to Thin Film Characterization,* Momentum Press, New York, 2016 (ISBN-13: 978-1606507278).

a) other supplemental materials: Hand-outs from the instructor and various sources, especially Wikipedia. American Institute of Physics Style Manual. Selected original research journal articles. These materials are made available to students on the course learning management system (Canvas).

Specific Course Information:

a) catalog description: Advanced laboratory experiments in optics related to the material presented in PHYS 473 (Introduction to Optics).

b) prerequisites or co-requisites: a C- or better in PHYS 315 and PHYS 315L *(pre-req.)*

c) This course is a possible technical elective for majors in Physics and Engineering Physics with any of the concentrations. In general, it is cross-listed with PHYS 571, a slightly more advanced course taken by physics graduate students. The class material covered in PHYS 471 and PHYS 571 is the same for both undergraduate and graduate students; however, graduate students are required to do additional (more difficult) assignments. This course meets the advanced laboratory requirement for some degree options.

Specific Goals of the Course:

a) specific outcomes of instruction: Students perform a series of experiments covering a broad range of physics topics, especially using optical spectroscopy, x-ray diffraction, and x-ray reflectance instruments. Students apply the principles and concepts covered in their upper-division physics coursework. The purpose of this laboratory is to illustrate the physical principles discussed in lectures, to gain skill in asking and answering scientific questions, and in using scientific reasoning. Students will also develop experimental and teamwork skills and demonstrate professional responsibility. Students will research topics online, in textbooks and journals, and on the internet (Wikipedia), write reports (written like physics journal articles) and give presentations with slides (similar to a conference presentation). This course provides a culminating major design experience (for physics majors) based on the knowledge and skills acquired in earlier course work that incorporates appropriate standards and multiple constraints. Students will solve open-ended and ill-posed problems and present their findings.

b) related ABET Outcomes: PHYS 471 addresses Program Outcomes: (c) An ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline. (b) An ability to develop and conduct appropriate experimentation, analyze, and interpret data, and use engineering judgment to draw conclusions. (g) An ability to communicate effectively with a range of audiences. (f) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. (i) An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge. (d) An ability to function effectively as a member or leader of a team and (k) an ability to achieve the goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment,

Brief List of Topics Covered:

Below is the list of experiments offered to students over the course of the semester. Students are required to perform three individual short experiments and three team-based long experiments

Short experiments:

- Transmission and reflection of glasses (NIR/visible/QUV)
- Transmission and reflection of glasses (infrared)
- Powder x-ray diffraction of rocksalt crystals
- Determine the thickness of SiO_2 on Si using spectroscopic ellipsometry
- Reflectance of a gold mirror (NIR/VIS/QUV)
- Reflectance of Si and Ge (NIR/VIS/QUV)
- Phonon reststrahlen band of LiF (MIR)
- Phonon reststrahlen band of spinel (MIR)

Long experiments:

- X-ray reflectance
- High-resolution (004) x-ray diffraction
- High-resolution x-ray diffraction for different materials
- Low-temperature ellipsometry and critical-point analysis
- Thermal oxidation of Si by rapid thermal annealing
- Infrared ellipsometry of thick SiO_2 on Si

Prepared by Stefan Zollner, Fall 2016.

Course Number and Name: Physics 475, Advanced Laboratory, Spring 2018

Credits and Contact Hours: 3 credits (two 150-minute lab sessions each week).

Instructor's or Course Coordinator's Name: Jacob Urquidi

Textbook: Practical Electronics for Inventors, 3rd ed. by Paul Scherz and Simon Monk.
ISBN-13: 978-0071771337

> **a) other supplemental materials:** Hand-outs supplemental to the course material including NASA's definitive guide to soldering techniques, data sheets for electronic components, material on radiation detectors, etc.

Specific Course Information:

- **a) catalog description:** Advanced laboratory experiments involving experiments in atomic, molecular, nuclear, and condensed matter physics.
- **b) prerequisites or co-requisites:** a C- or better in PHYS 315 and PHYS 315L *(pre-req.)*
- **c)** This course is cross-listed with PHYS 575, a more advanced course taken by physics graduate students. The class material covered is the same for both undergraduate and graduate students, however, graduate students are required to be more insightful, thorough, and deliver at a higher level of technical difficulty. This course meets the advanced laboratory requirement for some degree options.

Specific Goals of the Course:

- **a) specific outcomes of instruction**: The course focuses on the reality that typical problems are not very well characterized and are almost always open-ended in nature when taken from a scientific point of view. The course addresses the reality that such advanced lines of experimental investigation are not clear-cut nor are the experiments involved typically standardized. This means that experiments need to be designed and many times the ancillary equipment, data collection, and reduction protocols are unique to a given experimental design and desired outcome. To this end, the course focuses on practical experimental design beyond the user's manual, basic electronics techniques, the application of physical computing techniques, using microcontrollers, to control and manage the experimental environment, and data acquisition. A typical example would involve the need of controlling the temperature of a sample during a spectroscopy experiment requiring ancillalry equipment that gives careful ramping, equilibration, and data acquisition that is unique to each region; perhaps even control of the main instrumentation system as well.

- **b) related ABET Outcomes:** PHYS 475 addresses Program Outcomes: *(b) experimental training (c) design abilities (d) teamwork (f) professional responsibility and (k) technical know-how*

Brief List of Topics covered:

- Spectroscopic methods and techniques using EM-radiation of different wavelengths
- Diffraction methods and techniques using X-rays

- The role of computer modeling
- Introduction to Physical Computing; controlling your environment
- Introduction to Micro-controllers and applied electronics for controlling experimental parameters
  - Theory
  - Programming
  - Practical Techniques and designs
  - Implementation

The laboratory environment for PHYS 475 is collaborative and team-work based. The students are presented with a combination of hands-on lectures, short term projects, term projects. The students are teamed up with another student at their bench but must do individual work. The class as a whole is strongly encouraged to cross collaborate. This helps with students solidifying their knowledge, learning not to be shy about asking questions, and helps with the development of unique solutions. The instructor also performs the tasks assigned so that the students can experience first-hand that things do not always go smoothly. Experience does not exempt one from frustrating difficulties. The different threads include the following:

- The students are required to keep a proper research notebook of all progress and it is checked and commented upon regularly in order to develop proper techniques and discipline in keeping track of scientific/technical progress.
- The students are presented with increasingly difficult small projects which allow them to develop the skill to measure, keep track of, and manipulate experimental parameters like temperature, pressure, vacuum, distance, etc. The projects must be built, demonstrated, and the student must field questions from the students and instructor. The students' notebook section on the project is also taken into account.
- The students are presented with a choice of a technical Term Project which must be designed, built, integrated, then presented/demonstrated at the end of the semester in front of the class.
- Each student must come up with an individual project (instructor approved) that incorporates and demonstrates in a novel way some of the techniques learned in class. This project must be completely self-designed, built, and then presented/demonstrated at the end of the semester in front of the class.

Prepared by Jacob Urquidi, Spring 2018.

Course Number and Name: Physics 476, Computational Physics

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); one additional contact hour each week (during office hours)

Instructor or Course Coordinator Name: Boris Kiefer

Textbook: M. Hjorth-Jensen, *Computational Physics*, University of Oslo, 2012

other supplemental materials: W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, *Numerical Recipes in Fortran. The Art of Scientific Computing, 2nd Edition*, Cambridge University Press, 1992. M. Abramowitz and I. A. Stegun, *Handbook of Mathematical Functions*, Dover Publications, Inc. 1965. Additional in-depth materials are available as needed as pdf files on the file server for the course.

Specific Course Information:

a) catalog description: An introduction to finite difference methods, Fourier expansions, Fourier integrals, solution of differential equations, Monte Carlo calculations, and application to advanced physics problems.

b) prerequisites or co-requisites: PHYS 150 or equivalent and MATH 392 *(pre-reqs)*.

c) This is a required course for majors in Physics and Engineering Physics (EP) with the Electrical Engineering concentration. It is a possible elective for other EP concentrations.

Specific Goals of the Course:

a) specific outcomes of instruction: a) specific outcomes of instruction: Students should become proficient in the higher-level methods of treating physics problems with a computer. The course provides an in-depth study of computational physics.

related ABET Outcomes: c) develop the ability to design a system, component, or process to meet desired needs within realistic constraint such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. k) develop the ability to use techniques, skills, and modern engineering tools necessary for engineering practices.

Brief List of Topics Covered:

The course covers all of the material from Chapters 1-11 of Hjorth-Jensen, and it provides occasional supplemental material from Numerical Recipes and The Handbook of Mathematical Functions and reading material for later chapters. Number of lectures spend on each section are indicated.

Chapter 1: Introduction (1)
Paradigms of scientific programming *(1/2)*
Scientific visualization *(1/2)*
Chapter 2: Numbers on Computers (1)
2.3. Machine numbers and round-off errors (1)
2.4. Computation of exp(-x).
Chapter 3: Interpolation (1)
3.2. Interpolation/extrapolation *(1/2)*
3.1. Finite Differences *(1/2)*
Chapter 5: Linear Algebra (2)
6.4. Linear systems *(1)*
6.5. Spline interpolation *(1/2)*
5.6. Iterative methods *(1/2)*

Chapter 4: Root Finding (2)
4.3. Secant, bisection, bracketing *(1)*
4.4. Brent, Dekker, Newton-Raphson method, multi-dimensions *(1)*
Chapter 5: Integration (2)
5.1. Classical quadrature *(1/2)*
5.2 Adaptive time step *(1/2)*
5.3 Gaussian Quadrature *(1)*
Chapter 7: Eigensystems (2)
7.2. Eigensystem problems *(1/2)*
7.4. Jacobi method, sparse matrices *(1/2)*
Supplementary topic QR/QL algorithm *(1)*
Chapter 8: Ordinary Differntial Equations (2)
8.3. Leapfrog algorithm, conservation laws (1)
8.4. Runge-Kutta method, time step control, classical dynamical systems *(1)*
Chapter 9: Two point boundary value problems (2)
9.2. Shooting method *(1)*
9.3. Numerical implementation; matching *(1)*
Chapter 10: Partial Differential Equations (2)
10.2. FTCS, BTCS, Crank-Nicholson, Numerical stability *(1)*
10.3. Laplace and Poisson's equation *(1/2)*
Supplementary topic: time-dependent Schroedinger equation *(1/2)*.
Chapter 11: Monte Carlo Method (4)
11.3. Random number generators, radioactive decay *(1)*
11.2. Integration, error estimates *(1)*
11.4. Sampling theorem, rejection and acceptance techniques *(1)*
12.5. Metropolis algorithm, 1-D ideal gas; multidimensional integrals *(1)*
Data Description and Modelling (2)
Supplementary topic: Linear models *(1)*
Supplementary topic: Non-linear models; Levenberg-Marquardt *(1)*
Min/Max and Global Minimization (2)
Supplementary topic: Brent's algorithm, Conjugate gradient; steepest descent, BFGS *(1)*
Supplementary topic: Simulated annealing *(1)*
Fast-Fourier Transform (2)
Supplementary topic: Nyquist frequency, sampling theorem, aliasing *(1)*
Supplementary topic: Interpolation *(1)*
Introduction to Machine Learning (1)
Supplementary topic: Pattern recognition, neural nets, applications *(1)*

Prepared by Boris Kiefer, Spring 2018.

Course Number and Name: Physics 480, Thermodynamics

Credits and Contact Hours: 3 credits (three 50-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Stephen Pate

Textbook: Kittel and Kroemer, *Thermal Physics*, 2nd edition, Freeman, 1980

a) other supplemental materials: available at https://learn.nmsu.edu

Specific Course Information:

a) catalog description: Thermodynamics and statistical mechanics. Basic concepts of temperature, heat, entropy, equilibrium, reversible and irreversible processes. Applications to solids, liquids, and gases.

b) prerequisites or co-requisites: PHYS 217, PHYS 315, MATH 291 *(all pre-reqs)*

c) This course is required for all majors in Physics, and those in Engineering Physics with concentration in Electrical Engineering. It is an elective for majors in Engineering Physics with a concentration in Aerospace, Chemical or Mechanical Engineering.

Specific Goals of the Course:

a) specific outcomes of instruction: PHYS 480 is an introduction to thermodynamics and statistical physics. The material is taught from the point of view of quantum mechanics from the very beginning, but the knowledge of quantum mechanics required of the student is in fact very slight. We will cover the fundamental topics of equilibrium thermodynamics -- entropy, temperature, energy, heat, reversible and irreversible processes -- and see applications to some simple systems.

b) related ABET Outcomes: This course addresses Program Outcomes (e) develop an ability to identify, formulate, and solve engineering problems, and possibly (f) an understanding of ethical and professional responsibilities, (h) an understanding of the impact of engineering and physics solutions in a global, economic, environmental, and societal context, (i) a recognition of the need for and an ability to engage in life-long learning, and (j) a knowledge of contemporary issues.

Brief List of Topics Covered:

The course covers material from Chapters 1-10 of the Kittel and Kroemer textbook. The number of lectures spent on each section are indicated.

1. Chapter 1: States of a Model System (4)
2. Chapter 2: Entropy and Temperature (3)
3. Chapter 3: Boltzmann Distribution and Helmholtz Free Energy (4)
4. Chapter 4: Thermal Radiation and Planck Distribution (5)
5. Chapter 5: Chemical Potential and Gibbs Distribution (3)
6. Chapter 6: Ideal Gas (5)
7. Chapter 7: Fermi and Bose Gases (5)
8. Chapter 8: Heat and Work (4)
9. Chapter 9: Gibbs Free Energy and Chemical Reactions (3)
10. Chapter 10: Phase Transformations (5)

Prepared by Stephen Pate, Spring 2018,

Course Number and Name: Physics 488, Introduction to Condensed Matter Physics

Credits and Contact Hours: 3 credits (two 75-minute lectures each week); an additional 2 contact hours each week (during office hours)

Instructor's or Course Coordinator's Name: Edwin Fohtung

Textbook:

N. W. Ashcroft and N. D. Mermin, Solid State Physics, Thomson Publishing, 1976 *(required)*; Charles Kittel, *Introduction to Solid State Physics*, 8th ed., John Wiley & Sons, 2005 *(recommended)*

a) other supplemental materials: own hand-outs or hand-outs from other sources

Specific Course Information:

a) catalog description: crystal structure, X-ray diffraction, energy band theory, phonons, cohesive energy, conductivities, specific heats, p-n junctions, defects surfaces, and magnetic, optical, and low-temperature properties.

b) prerequisites or co-requisites: PHYS 315*(pre-req)*

c) This course is a possible technical elective for undergraduate majors in Physics and Engineering Physics with any of the concentrations. Moreover, it is cross-listed with PHYS 588, a slightly more advanced course taken by physics graduate students. The class material covered in PHYS 488 and PHYS588; however, graduate students are required to do additional (more difficult) assignments.

Specific Goals of the Course:

a) specific outcomes of instruction: This course provides a general introduction to solid state physics, such as crystal structures, diffraction techniques, type of chemical bonding, energy-band theory, phonons, electronic (transport, thermal, optical and magnetic) properties.

b) related ABET Outcomes: PHYS 488 is expected to address some or all of the following Program Outcomes: e) Problem Solving, f) Professional Responsibility, h) Societal Impact, i) Life-long Learning, and j) Contemporary Issues.

Brief List of Topics Covered:

The course covers material from the following topics. Each module is covered in about one week.

1. Module 1: Crystal Structure
2. Module 2: Coherent X-ray Diffraction Imaging
3. Module 3: Classification of Solids
4. Module 4: Free-Electron Theory of Metals
5. Module 5: Band Structure of Solids
6. Module 6: Lattice Vibrations
7. Module 7: Semiconductors
8. Module 8: Optical Properties
9. Module 9: Magnetic Properties
10. Module 10: Defects in Crystals
11. Module 11: Topological Defects
12. Module 12: Noncrystalline Solids

Prepared by Edwin Fohtung, Fall 2016.

Course Number and Name: Physics 489, Introduction to Modern Materials, Spring 2018

Credits and Contact Hours: 3 credits (two 75-minute lectures each week; lectures are cancelled occasionally to give students an opportunity for hands-on experiments in optical spectroscopy).

Instructor's or Course Coordinator's Name: Stefan Zollner

Textbook: Required: Mark Fox, Optical Properties of Solids, 2nd edition, 2010, Oxford University Press (ISBN-13: 978-0199573370).

a) other supplemental materials: Hand-outs from the instructor and various sources, especially Wikipedia. American Institute of Physics Style Manual. Selected original research journal articles. These materials are made available to students on the course learning management system (Canvas).

Specific Course Information:

a) catalog description: structure and mechanical, thermal, electric, and magnetic properties of materials; modern experimental techniques for the study of materials properties.

b) prerequisites or co-requisites: PHYS 315 *(pre-req.)*

c) This course is a possible technical elective for majors in Physics and Engineering Physics with any of the concentrations. In general, it is cross-listed with PHYS589, a slightly more advanced course taken by physics graduate students. The class material covered in PHYS 489 and PHYS589 is the same for both undergraduate and graduate students; however, graduate students are required to do additional (more difficult) assignments. This course is also cross-listed as CHME 489/589, a technical elective for students in chemical and materials engineering.

Specific Goals of the Course:

a) specific outcomes of instruction: This course is usually customized by the instructor based on personal experience and skills. For this offering (spring 2018), the course focused on the connection between the microscopic structure of materials (atoms, electrons, and their excitations, such as lattice vibrations or electronic bands) and their optical properties (especially the complex refractive index). The course also introduced students to spectroscopic ellipsometry, an optical technique used for process control in advanced manufacturing (especially for semiconductors, thin films, and coatings). Students gained hands-on experience with modern equipment, were introduced to the original research literature, performed experiments, presented their results in class, and wrote a report formatted like an article in a research journal.

b) related ABET Outcomes: PHYS 489 is expected to address some or all of the following Program Outcomes: e) Problem Solving, f) Professional Responsibility, h) Societal Impact, i) Life-long Learning, and j) Contemporary Issues.

Brief List of Topics Covered:

Below is the list of topics covered over the course of the semester. The number of lectures for each group of topics is given in parentheses.

1. Syllabus, course overview, pretest (1)
2. Electromagnetic fields, Maxwell's equations, generalized plane waves, Jones vectors and Stokes parameters (3)
3. Electrostatics and magnetostatics, dielectrics and paramagnets, Lorentz and Drude model, general oscillator models for optical dispersion (Sellmeyer, Cauchy) (3)
4. Optical properties of metals, restrahlen band, Lyddane-Sachs-Teller relation, Berreman effect, plasma oscillations, infrared response of insulators (2)
5. Optical response function, analytical properties of epsilon, Kramers-Kronig transform, Lowndes and Gervais models (2)
6. Einstein coefficients, population inversion and lasers, Fermi's Golden Rule, selection rules (2)
7. Metals, insulators, and semiconductors; free electrons, direct and indirect transitions (2)
8. Electrons and holes in GaAs, band structure of Si and Ge (2)
9. Interband transitions and dielectric function of semiconductors, variation of the dielectric function due to temperature, strain, and doping (2)
10. Excitons, luminescence, electroluminescence (4)
11. Epitaxial growth techniques of thin films, quantum structures, confinement (2)
12. Presentations from students about their experiments (2)
13. Experiments (equivalent to five class periods)

Prepared by Stefan Zollner, Spring 2018.

Course Number and Name: Physics 493, Experimental Nuclear Physics

Credits and Contact Hours: 3 credits (two 150-minute lab sessions each week).

Instructor's or Course Coordinator's Name: Vassili Papavassiliou

Textbook: none required

a) other supplemental materials: Experiment Write-Up and Supplementary Materials are provided on class webpage.

Specific Course Information:

a) catalog description: Advanced laboratory in experimental nuclear and particle physics methodology.

b) prerequisites or co-requisites: a C- or better in PHYS 315 and PHYS 315L *(pre-req.)*

c) This course is a possible technical elective for majors in Physics and Engineering Physics with any of the concentrations. In general, it is cross-listed with PHYS 593, a more advanced course taken by physics graduate students. This course meets the advanced laboratory requirement for all degree options.

Specific Goals of the Course:

a) specific outcomes of instruction: Students perform a series of advanced experiments in nuclear and particle physics and apply techniques of measurement, interpretation, and presentation of experimental data.

b) related ABET Outcomes: This course teaches students to:

(b) Design and conduct experiments, as well as analyze and interpret data

(d) Function on multidisciplinary teams

(g) Communicate effectively

(k) Use techniques, skills and modern tools necessary for physics research

Brief List of Topics Covered:

1. Below is the list of lab sessions offered to students over the course of the semester.
2. Introductory remarks (1)
3. Lectures on probability, statistics, error propagation (2)
4. Practical exercise on statistics with radiation counters (2)
5. Radiation safety training (1)
6. Muon decay and lifetime measurement (6)
7. Gamma-gamma correlations with ^{22}Na and ^{60}Co (6)
8. Compton scattering with ^{137}Cs (5)
9. Alpha spectroscopy with Si surface barrier detector and ^{241}Am (5)
10. Attend oral presentations by PHYS 593 graduate students (1)

Prepared by Vassili Papavassiliou, Fall 2017.

Course Number and Name: Physics 495, Mathematical Methods of Physics I

Credits and Contact Hours: 3 credits (three 50-minute classes each week); an additional 2 contact hours each week (during office hours)

Instructor or Course Coordinator Name: Michael Engelhardt

Textbook: The course does not follow a specific textbook; instead, comprehensive type-set notes are provided by the instructor. For reference, students are recommended to consult K. F. Riley, M. P. Hobson and S. J. Bence, *Mathematical Methods for Physics and Engineering,* Cambridge University Press, 3rd edition, 2006.

a) other supplemental materials: Comprehensive type-set notes distributed in hardcopy

Specific Course Information:

a) catalog description: Applications of mathematics to experimental and theoretical physics. Topics selected from: complex variables; special functions; numerical analysis; Fourier series and transforms, Laplace transforms.

b) prerequisites or co-requisites: PHYS 395, MATH 392 *(both pre-reqs.)*

c) This course is an elective for all majors in Physics and Engineering Physics

Specific Goals of the Course:

a) specific outcomes of instruction: Students should become proficient in these advanced mathematical techniques so that they will understand in detail the interplay between the mathematical tools and physics concepts. The advanced mathematics should become an aid to understanding, and not a barrier.

b) related ABET Outcomes: PHYS 495 addresses Program Outcome k) Technical Know-How: *an ability to use the techniques, skills, and modern engineering tools necessary for engineering physics practice.*

Brief List of Topics Covered:

1. Chapter 1: Review of vector analysis
2. Chapter 2: Fourier analysis
3. Chapter 3: Green's functions
4. Chapter 4: Spherical harmonics
5. Chapter 5: Calculus of residues
6. Chapter 6: Tensors
7. Chapter 7: Application: Electromagnetic fields induced by a moving point charge

Prepared by Michael Engelhardt, Fall 2017.

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Aerospace Engineering Courses

Engineering Physics Program
(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Aerospace Engineering Courses

Course Information	**AE 339 Aerodynamics I** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Fangjun Shu Office: JH224 Phone: 646-2118 email: shu@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	1:30—3:30pm TR or by appointment
CATALOG DESCRIPTION:	Fluid properties, conservation equations, incompressible 2-demensional flow; Bernoulli's equation; similarity parameters; subsonic aerodynamics: lift and drag, analysis and design of airfoils.
PREREQUISITES:	M E 234 or M E 237 and M E 228 or MATH 392
PRE/COREQUISITES	None
TEXT:	*Munson, B. R.,Okiishi, T. H., Huebsch, W.W. & Rothmayer A. P., Fundamentals of Fluid Mechanics, 7th ed., John Wiley, 2013.*
CLASS SCHEDULE:	Lecture: 10:20 a.m. - 11:35 a.m. - TTh - JH 109
GRADES:	Homework: 10% Exam 1&2: 60% (30% each) Final exam: 30%
COURSE OBJECTIVES:	Develop a basic proficiency in • Flow kinematic concepts—streamlines, vorticity and circulation (a,e). • Bernoulli's equation (a,e) • Potential flow theory (a,e) • Applications of mass, momentum and energy conservation laws to fluid mechanics problems (a,e). • Applications of dimensional analysis and dynamic similitude (b,e). • Use of aerodynamic lift and drag coefficients(c,e).
TOPICS COVERED:	• Fluid Statics • Flow Kinematics • Bernoulli's Equation • Review of Vector Calculus • Laplace's equation and potential flows • Control Volume analysis • Similitude, Dimensional Analysis and Modeling • Aerodynamic lift and drag coefficients • Brief introduction of boundary layer theory
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering b ability to design and conduct experiments, as well as to analyze and interpret data c ability to design a system, component or process to meet desired needs within realistic constraints

Course Information	**AE 339 Aerodynamics I** 3 credits Required Fall 2017
	e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC2 1 year math and basic science PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
POLICIES:	• HWs are due on the date specified. **No late HWs will be accepted.** • HW solutions will be posted on CANVAS. • Credit (either a make-up or an average score based on all your other exams) for any missed exam or homework will be given only if: o You inform me before the start of the exam or due time of homework AND o You produce a written signed document giving a valid excuse for your absence. **Otherwise, you will get a zero for the exam/HW missed.**
AUTHOR/DATE:	Fangjun Shu October 2017

Course Information	**AE 362 Orbital Mechanics** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. T. Alan Lovell Office: ABQ Phone: 505-507-3032 email:lovelta@nmsu.edu
ASSISTANTS:	Julia Hoogerhuies
OFFICE HOURS:	by email
CATALOG DESCRIPTION:	Dynamics of exoatmospheric flight of orbiting and non-orbiting bodies; 2-body orbital dynamics and Kepler's laws; orbits in 3 dimensions; orbit determination; orbit design and orbital maneuvers; lunar and interplanetary trajectories.
PREREQUISITES:	MATH 392, ME 237, and ME 261
TEXT:	*Orbital Mechanics for Engineering Students, 3rd ed. by H. D. Curtis (Butterworth-Heinemann, 2013)*
CLASS SCHEDULE:	Lecture: 8:30 a.m. - 9:20 a.m. - MWF – JH213
GRADES:	Grading: Grades will be based on performance on 6 homeworks and 2 exams.
COURSE OBJECTIVES:	• To learn and understand basic principles in orbital mechanics and apply these principles to relevant problems • To master the course content well enough to go on to graduate study or work in the aerospace industry
TOPICS COVERED:	• 2-body orbital dynamics including Kepler's laws and Kepler's equation • Orbits in 3 dimensions and orbital elements • Impulsive orbital maneuvers including Hohmann transfer • Lunar and interplanetary trajectories
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
POLICIES:	• Class materials (lecture slides/HW assignments/etc) will be posted to Canvas. • Homework will be assigned on a near-weekly basis. Generally homework will be due in class one week after it is assigned. Late homework will not

Course Information	**AE 362 Orbital Mechanics** 3 credits Required Fall 2017
	be accepted, and there are no make-up homework assignments. If you do not turn in a homework, then you get a zero for it. The lowest homework grade will be dropped. I will post homework solutions on Canvas after the due date. • There will be two exams during the semester, and one comprehensive final exam. Make-up exams with a valid excuse must be arranged one week before the scheduled exam date. If you can't take the exam for some emergency reason, you still need to notify me prior to the exam if at all possible. If you can't notify me prior to the exam (e.g. emergency hospitalization), notify me as soon as possible after the exam. • While "group" studying for exams is fine, HW assignments should be performed by each student independently. DO NOT seek help on HW problems from anyone except me or the TA. Failure to obey this policy will be considered CHEATING and will be met with appropriate action. • I will entertain any questions asked during class, but the best way to contact me outside of class is by email. This includes notifying me that you will miss class, general questions about the material, etc.
AUTHOR/DATE:	T. Alan Lovell November 6, 2017

Course Information	**AE 363 Aerospace Structures** 3 credits Required Spring 2018
INSTRUCTOR:	Dr. Young Lee Office: JH222 Phone: 646-7457 email: younglee@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	9:30 am - 10:30 am M-F, or by appointment by email
CATALOG DESCRIPTION:	Advanced concepts of stress and strain, introduction to the analysis of aero structures, complex bending and torsion, thin walled sections and shells, computational techniques.
PREREQUISITES:	CE 301
TEXT:	*No textbook will be required, but some useful references include:* • *Donaldson, B. K., Analysis of Aircraft Structures–An Introduction (Chapters 1-14), 2nd Ed., Cambridge Aerospace Series, 2008* • *J. Cutler, Understanding Aircraft Structures–See Canvas and also NMSU Electronic Book service (http://www.netlibrary.com/)*
CLASS SCHEDULE:	Lecture: 11:30 am - 12:20 pm - MWF - JH 210
GRADES:	Homework/ In-Class Excesice 10% Midterm Exam 1 30% Midterm Exam 2 30% Final exam 30%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • Formulate and solve some fundamental linearly-elastic problems; • Apply basic failure theory and perform thermal shock analysis for composite materials; • Perform simplified dynamic loading analysis on aerospace structures; • Calculate various area properties for nonhomogeneous cross-sections of a beam, and their principal values and directions; • Understand the formulations of stresses/strains/deflections in a beam under various loading and boundary conditions.
TOPICS COVERED:	• Fundamental theory of elasticity (stress-strain relations through linearly elastic material behavior, and structural deformation under compatibility conditions) • simplified failure analysis of composite materials • dynamic loading analysis (fatigue/impact design) • thermal shock analysis • stresses, strains and deflections in a beam with closed/open, homogeneous/nonhomogeneous cross-sections under various (longitudinal/transverse, bending, torsional, buckling) loading/boundary conditions

Course Information	**AE 363 Aerospace Structures** 3 credits Required Spring 2018
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
POLICIES:	• All the lectures will be made self-contained, being posted on Canvas after class. • There will be about 10 in-class exercises. No late submission will be allowed without a prior consent from instructor. The worst two will be dropped off in the final total score. • There will be about 10 homework sets, which will be collected before class starts on the due date. Any submission 10 minutes after class starts will be considered to be late, and will not be accepted without a prior consent from instructor. The worst two will be dropped in the final score. • All exams will be closed-book with a cheat sheet being provided. There will be no make-up exam at all, no matter what. The final letter grades may be on a curve.
AUTHOR/DATE:	Y. Lee January 2018

Course Information	**AE 364 Flight Dynamics and Controls** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Young Lee Office: JH222 Phone: 646-7457 email: younglee@nmsu.edu
ASSISTANTS:	N/A
OFFICE HOURS:	Open-door policy or by appointment
CATALOG DESCRIPTION:	Fundamentals of airplane flight dynamics, static trim, and stability; spacecraft and missile six degree of freedom dynamics; attitude control of spacecraft.
PREREQUISITES:	Math 392, ME 237, and ME 261
TEXT:	*No textbook* is required, but some references include: • Flight Stability and Automatic Control, 2nd ed., Robert C. Nelson, McGraw-Hill, 1998; • Bossert, D.E., Introduction to Aircraft Flight Mechanics : Performance, Static Stability, Dynamic Stability, Classical Feedback Control, and State-space Foundations, AIAA; • Anderson, Jr., J.D., Introduction to Flight, McGraw-Hill (any Edition); and • Kershner, W.K., The Student's Pilot's Flight Manual: From First Flight to Private Certificate (NMSU E-book)
CLASS SCHEDULE:	Lecture: 1:30 p.m. - 2:20 p.m. - MWF - JH 207
GRADES:	Homework 10% Midterm exam 50% Final exam 20% Class project 20%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • Understand static stability design for longitudinal/lateral/directional flights; • Use the 6-degree-of-freedom, rigid body equations of motion of an aircraft; • Evaluate longitudinal/lateral/directional dynamic stabilities of an airplane; and • Implement some control theories for autopilot design.
TOPICS COVERED:	• Static stability of longitudinal/directional/lateral motions and their control • 6-DOF aircraft equations of motion and stability derivatives • Longitudinal approximation: Phugoid/short-period modes • Lateral/directional approximation: Spiral/rolling/Dutch-roll modes • Fundamentals of automatic control theory: Laplace transform, block diagram, transfer function
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice

Course Information	**AE 364 Flight Dynamics and Controls** 3 credits Required Fall 2017
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
AUTHOR/DATE:	• Y. Lee August 2017

Course Information	**AE 419 Propulsion** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Ruey-Hung Chen Office: JH 104 Phone: 646-1945 email: chenrh@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	T & R 8:00 a.m.- 10:00 a.m.
CATALOG DESCRIPTION:	Propulsion systems, thermodynamic cycles, combustion, specific impulse; principles of gas turbines, jet engines, and rocket propulsion systems.
PREREQUISITES:	AE 439
TEXT:	*1.Mechanics and Thermodynamics of Propulsion, Hill & Peterson, Addison-Wesley, 1992*
CLASS SCHEDULE:	Lecture: T & R 10:20-11:35, Jett Hall 207
GRADES:	Quizzes 30% Midterm exam 30% Final exam 40%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • Identify & summarize major differences/rationales among different propulsion systems. • Apply principles of mass, momentum and energy to component sections of propulsion. • Evaluate the efficiency and thruster for major propulsion systems.
TOPICS COVERED:	• Introduction & Review of Fundamental Aero/Thermal Sciences and Thermo-chemistry • Performance of aircraft and air-breathing engines • Introduction to Rocket Engines and Electric Propulsion Engines
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
POLICIES:	➢ All exams and quizzes will be open-book & open-notes; no computer or smart phones are allowed during quizzes and exams

Course Information	AE 419 Propulsion 3 credits Required Fall 2017
	➢ Questions regarding grading and scores of each exam/quiz should be addressed to the instructor/TA within one week of the date when the exam/quiz is returned; no change or re-grading will be made afterwards. ➢ One midterm and one final: time, date, place, content and format are TBD. ➢ Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act Amendments Act (ADAAA) covers issues relating to disability and accommodations. If a student has questions or needs an accommodation in the classroom (all medical information is treated confidentially), contact: Trudy Luken, Director Student Accessibility Services (SAS) Corbett Center Student Union, Rm. 208 Phone: (575) 646-6840 E-mail: sas@nmsu.edu Website: http://sas.nmsu.edu/ ➢ NMSU policy prohibits discrimination on the basis of age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, retaliation, serious medical condition, sex, sexual orientation, spousal affiliation and protected veterans status. Furthermore, Title IX prohibits sex discrimination to include sexual misconduct: sexual violence (sexual assault, rape), sexual harassment and retaliation. For more information on discrimination issues, Title IX, Campus SaVE Act, NMSU Policy Chapter 3.25, NMSU's complaint process, or to file a complaint contact: Lauri Millot, Director and Title IX Coordinator Agustin Diaz, Associate Director, Title IX Deputy Coordinator Office of Institutional Equity (OIE) O'Loughlin House, 1130 University Avenue Phone: (575) 646-3635 E-mail: equity@nmsu.edu Website: http://eeo.nmsu.edu/
AUTHOR/DATE:	R. Chen October 2017

Course Information	**AE 424 Aerospace Systems Engineering** 3 credits Required Spring 2018
INSTRUCTOR:	Dr. Terry Armstrong Office: JH136 Phone: 646 - 4947email: oma@nmsu.edu
ASSISTANTS:	N/A
OFFICE HOURS:	Daily after 3pm or by appointment
CATALOG DESCRIPTION:	Basic principles of top down systems engineering and current practice; preliminary and detailed design of aircraft and space vehicles, including requirement, subsystem interaction, and integration, tradeoffs, constraints and non-technical aspects.
PREREQUISITES:	AE 362
TEXT:	The following materials and references will be used: • Lecture presentations and notes • NASA Systems Engineering Materials: http://spacese.spacegrant.org/ • *INCOSE Systems Engineering, Wiley, 4th ed or later*
CLASS SCHEDULE:	Lecture: 10:20 a.m. - 11:35 a.m. - TR - JH 213
GRADES:	Exam 1 30% Exam 2 30% Group Report 10% Group Presentation 10% Exercises/HW 20%
COURSE OBJECTIVES:	• to Introduce the fundamentals of systems engineering theory and practice • to establish the knowledge and comprehension of the value and purpose of systems engineering principles and process • to establish a working knowledge of the methods and tools systems engineers use • to understand the roles of systems engineers and develop the ability contributing to the development of complex aerospace systems
TOPICS COVERED:	• Concepts and theory of systems science and engineering • Requirements development • System design fundamentals and process • Design analysis and optimization • System evaluation, verification and validation • Systems engineering management • Engineering ethics
RELATIONSHIP TO PROGRAM OUTCOMES:	c ability to design a system, component or process to meet desired needs within realistic constraints d ability to function on multidisciplinary teams g ability to communicate effectively

Course Information	**AE 424 Aerospace Systems Engineering** 3 credits Required Spring 2018
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized AE3 design competence
POLICIES:	• Since class discussion is a very important method of learning for this course, class participation will be one of the determining factors for grading. • A quiz may be given in each class. A missing quiz cannot be made up later unless the absence was notified to the instructor in advance. • Homework assignments submitted passed the dues dates will receive no credits unless permitted by the instructor.
AUTHOR/DATE:	T.Armstrong January 2018

Course Information	**AE 428 Aerospace Capstone Design** 3 credits Required FA 2017
INSTRUCTOR:	Dr. Young H. Park Office: JH 11 Phone: 646-3092 email: ypark@nmsu.edu
ASSISTANTS:	Edward Rojas
OFFICE HOURS:	8:00 a.m.- 9:00 p.m. MTWRF or by appointment
CATALOG DESCRIPTION:	Team Project-analysis, design, hands-on build test, evaluate.
PREREQUISITES:	AE 424
TEXT:	*NA*
CLASS SCHEDULE:	Lecture: 3:30 p.m. - 6:20 p.m. - M – EC2 103 3:30 p.m. - 6:20 p.m. - W – EC2 103
GRADES:	Class Participation: 20% Individual & team performance: 30% Group Deliverable: 50%
COURSE OBJECTIVES:	• Have experience functioning as mechanical engineer within an engineering design and development group. (d) • Complete a real-life design task – transform a client's needs into a tangible, tractable project definition, and see the project through to completion. (c) • Understand and use a formal engineering design method, with emphasis on building concurrent engineering procedures into the basic design method. (c) • Become proficient in collaboratively preparing and reviewing formal technical design package related to an engineering design including final design binder and report (g)
TOPICS COVERED:	• Participation in a project team • Use of technical tools from past engineering courses • Strengthening of teaming skills • Learning how to apply engineering fundamentals to the design
RELATIONSHIP TO PROGRAM EDUCATIONAL OBJECTIVES:	B ability to formulate, analyze, and creatively participate in the solution of multidisciplinary problems through use of modern engineering C ability to communicate clearly and effectively with fellow engineers, employers and general public D skills needed to fulfill professional duties and responsibilities in teamwork, collegiality, ethics, technical leadership, etc.
RELATIONSHIP TO PROGRAM OUTCOMES:	c ability to design a system, component or process to meet desired needs within realistic constraints d ability to function on multidisciplinary teams g ability to communicate effectively
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC1 major design experience PC3 1 1/2 years engineering topics (engineering science and design)

Course Information	**AE 428 Aerospace Capstone Design** 3 credits Required FA 2017
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE3 design competence
POLICIES:	• None
AUTHOR/DATE:	Y. Park August 2017

Course Information	***AE 439 Aerodynamics II*** *3 credits* *Required* *Spring 2018*
INSTRUCTOR:	Dr. Fangjun Shu Office: JH104B Phone: 646-3503 email: shu@nmsu.edu
ASSISTANTS:	Jorge Ahumada
OFFICE HOURS:	1:00 p.m.- 3:00 p.m. TR or by appointment
CATALOG DESCRIPTION:	Principles of compressible flow, momentum and energy conservation; thermal properties of fluid; supersonic flow and shock waves; basics of supersonic aerodynamics.
PREREQUISITES:	AE 339, ME 240
TEXT:	*Fundamentals of Aerodynamics, 5th ed., John D. Anderson, Jr.*
CLASS SCHEDULE:	Lecture: 10:30 a.m. - 12:20 a.m. - MWF - JH 213
GRADES:	Homework 10% 2 midterm exams (30% ea.) 60% Final exam 30%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • Apply mass, momentum and energy conservation laws to aerodynamics problems. • Develop concepts of compressible flow, shock and expansion waves. • Solve isentropic, Fanno-line and Rayleigh-line flows in nozzle and gas pipeline design. • Calculate the lift, drag and moment characteristics of thin airfoils and finite wings under both subsonic and supersonic flow regimes.
TOPICS COVERED:	• Review of fluid mechanics for application to aerodynamics. • Conservation laws – mass, momentum and energy. • Inviscid, compressible flow is developed and applied to normal and oblique shocks, and expansion waves. • Compressible flow theory is applied to nozzles, diffusers, and wind tunnels. • Internal compressible flows – Fanno- and Rayleigh- line flows • Inviscid, incompressible flow with application of potential and stream functions. • Incompressible flow over airfoils. Concepts of center-of pressure and aerodynamic center are developed. • Induced drag and Prandtl's lifting-line are developed along with solution methods for finite wings. • Subsonic and supersonic compressible flow is applied to airfoils using linear theory.

Course Information	***AE 439 Aerodynamics II*** *3 credits* *Required* *Spring 2018*
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas
POLICIES:	• HWs are due on the date specified. **No late HWs will be accepted.** • HW solutions will be posted on CANVAS. • Credit (either a make-up or an average score based on all your other exams) for any missed exam or homework will be given only if: o You inform me before the start of the exam or due time of homework AND o You produce a written signed document giving a valid excuse for your absence. **Otherwise, you will get a zero for the exam/HW missed.**
AUTHOR/DATE:	F. Shu January 2018

Course Information	**AE 447 Aerofluids Laboratory** 3 credits Required Fall 2017
INSTRUCTOR:	Fangjun Shu Office: JH224 Phone: 646-2118 email: shu@nmsu.edu
ASSISTANTS:	Jorge Arturo Ahumada Lazo jahumada@nmsu.edu
OFFICE HOURS:	1:00 p.m.- 3:00 p.m. T TH or by appointment
CATALOG DESCRIPTION:	Use of subsonic wind tunnels and other flow to study basic flow phenomena and methods of fluid measurement and visualization.
PREREQUISITES:	ME 345 and AE 339
PRE/COREQUISITES	AE 439
TEXT:	None, the following are reference texts • *"Theory and Design for Mechanical Measurements" by R.S Figliola and D.E. Beasley, John Wiley and sons, 1991. This is the book used in ME 345.* • *"Experimental Methods for Engineers" by J.P. Holman, 7th Ed. McGraw-Hill* • *"Particle Image Velocimetry" by M. Raffel, C. Willert, S. Wereley and J. Kompenhans, 2nd Ed. Springer.* • *"Instrumentation, Measurements and Experiments in Fluids" by E. Rathakrishnan, CRC Press*, 2007
CLASS SCHEDULE:	Lecture: 8:30 a.m. - 9:20 a.m. - MW - JH 215 Lab: T: 2:35PM - 5:25PM; W: 12:30PM - 3:20PM; TH: 2:35PM - 5:25PM.
GRADES:	Class Participation 20% Six Laboratory Reports 60% Quizzes 20%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • Initiate the design of an experiment by using dimensional analysis and modeling (a, b, e). • Familiar with data acquisition, processing and visualization (b). • Aware of principles of flow measurement technologies (b). • Write technical reports about aerodynamic experiments and make oral presentations (g).
TOPICS COVERED:	• Dimension analysis and flow similarity • Flow Visualization • Data acquisition and uncertainty analysis • Velocity measurements (Hot wire, LDA and PIV) • Pressure and temperature measurements • Other measurement technology

Course Information	**AE 447 Aerofluids Laboratory** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering b ability to design and conduct experiments, as well as to analyze and interpret data e ability to identify, formulate, and solve engineering problems g ability to communicate effectively
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	AE1 knowledge covering aeronautical or astronautical engineering areas AE2 knowledge of some topics from area not emphasized
POLICIES:	• Students must attend classes and labs. • Lab reports will be due one week after the completion of the Lab. Late reports will only be accepted upon instructor's agreement. • Quizzes and exam are open book, quizzes may not be announced.
AUTHOR/DATE:	Fangjun Shu October 2017

Engineering Physics Program
(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Chemical Engineering Courses

CHME 101. Introduction to Chemical Engineering Calculations

Course number and name: CHME 101. Introduction to Chemical Engineering Calculations

Credits and contact hours: 2 credit hours = 30 contact hours per semester

Instructor's or course coordinator's name: David A. Rockstraw

Text book, title, author, and year

- Elementary Principles of Chemical Processes, 4th Edition by Richard M. Felder, Ronald W. Rousseau, Lisa G. Bullard; Wiley, July 2015, ©2016
- MATLAB Numerical Methods with Chemical Engineering Applications, by: Kamal I. M. Al-Malah, Ph.D.; McGraw-Hill Education, 2014 (free online in the eLibrary at AICHE.org for AICHE members).

a. other *supplemental materials*: hand-outs

Specific course information

a. ***catalog description:*** Introduction to the discipline of chemical engineering, including: an overview of the curriculum; career opportunities; units and conversions; process variables; basic data treatments; and computing techniques including computer programming and use of spreadsheets.

b. prerequisites: none co-requisites: MATH 190

c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will: • understand the diverse career opportunities available to one holding a BSCHE from NMSU; • be aware of the flow of content and prerequisite requirements across the BSCHE; • be capable of rapidly performing conversion of chemical engineering units both by hand and using computer software, specifically including (1) converting between mixture mass and mole fractions, and (2) explaining the difference and converting between absolute and relative pressure and temperature scales; • applying the concept of significant figures; • be able to perform a regression of data to a mathematical model; • numerically solve systems of linear algebraic equations by multiple methods; • be capable of validating calculated results; • be functional in the graphic user interface of Matlab, Mathcad, and Excel; • be capable of generating two-dimensional plots of data and functions in Matlab, Mathcad, and Excel; • implement logical IF statements writing Matlab code and using builtin functions of an Excel spreadsheet; • implement flow-of-control operations in Matlab, correctly applying WHILE and FOR statements; and • implement input/output data treatments in Matlab.

b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. Career opportunities in Chemical Engineering
2. Units and conversions
3. process variables
4. data regression
5. numerical calculations

CHME 102. Material Balances

Course number and name: CHME 102. Material Balances

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: Martha Mitchell

Text book, title, author, and year

- Elementary Principles of Chemical Processes, 4th edition, 2016. Felder, Rousseau and Bullard. Wiley and Sons. Loose-leaf (binder-ready) ISBN: 978-1-118-43122-1 E-text: ISBN: 978-1-119-19023-3
- Essential PTC MathCAD Prime 3.0 1st edition, 2013, Maxfield, Brent, Elsevier. ISBN: 978-0-12410410-5
  a. other *supplemental materials* none

Specific course information

a. ***catalog description:*** Chemical Engineering basic problem-solving skills; unit conversions; elementary stoichiometry; material balances; sources of data.
b. prerequisites: MATH 190G, CHME 101 co-requisites: CHEM 111/115
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to: • Describe careers that some chemical engineers pursue, and to describe to a high school student what a chemical engineer does; • Use modern engineering tools (MathCAD®, and Excel) to solve basic engineering and math problems that are part of material balance calculations (plotting, use of arrays and matrices, simple programming operations, formulas); • Generate two-dimensional plots, perform linear regression and solve systems of linear algebraic equations; • Correctly implement engineering calculations: unit conversions; units of mass and weight, significant figures; • Understand the importance of validating results; • Convert between mass and mole fractions in a mixture; • Explain the difference and convert between absolute and relative pressure and temperature scales; • Draw and label a correct diagram (flowchart) given a problem statement; • Choose a basis of calculation; • Correctly perform a degree of freedom analysis; • Analyze and solve elementary material balances on single and multi-unit process, for both nonreactive and reactive processes; • Solve material balance calculations with: recycle, purge, fractional conversion of the limiting reactant, percentage excess of a reactant, yield and selectivity, dry-basis composition, theoretical air and percent excess air; • Use equations of state for single-phase property calculations; • Use "standard" volumes for gases; • Calculate vapor pressures; • Use Raoult's and Henry's law; • Sketch a phase diagram; and • Calculate bubble points and dew points for ideal solutions.
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. Ch.1 - What Some Chemical Engineers Do for A Living
2. Ch. 2 - Introduction to Engineering Calculations

3. Ch. 3 - Excel basics: cells, arrays, plotting, using a spreadsheet • MathCAD® basics: unit conversions, plotting, problem solving • MATLAB® basics: problem solving, arrays, matrices • Process and process variables
4. Ch. 4 Fundamentals of Material Balances
5. Ch. 5 Single-Phase Systems
6. Ch. 6 Multiphase Systems

CHME 201. Energy Balances

Course number and name: CHME 201. Energy Balances & Basic Thermodynamics

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: Umakanta Jena

Text book, title, author, and year

- Elementary Principles of Chemical Processes, 4th edition, 2016. Felder, Rousseau and Bullard. Wiley and Sons. Loose-leaf (binder-ready) ISBN: 978-1-118-43122-1 E-text: ISBN: 978-1-11919023-3

a. other *supplemental materials*: none

Specific course information

a. ***catalog description:*** Chemical Engineering energy balances; combined energy and material balances including those with chemical reaction, purge and recycle; thermochemistry; application to unit operations; introduction to the first law of thermodynamics and its applications.

b. prerequisites: CHME 102, CHEM 115 or CHEM 111G, and MATH 192G co-requisites: none

c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to…

- Determine individual learning style and describe how learners of that style can help themselves , • Use modern engineering tools (example, Excel) to solve material and energy balance problems, • Understand how professional and ethical responsibility corresponds to the NMSU Student Code of Conduct; • Correctly implement unit conversions (outcome (a) an ability to apply knowledge of mathematics, science, and engineering), • Analyze and solve elementary material balances on single and multi-unit process, for both nonreactive and reactive processes, • Apply the first law of thermodynamics to batch and flow processes, • Locate thermophysical property data in the literature and estimate properties when data are not available, • Conduct combined material and energy balances around continuous multi-unit processes with and without chemical reaction, • Perform process calculations using psychrometric charts, enthalpy concentration diagrams and steam tables, • Derive and solve differential equations for transient heat and material balances on dynamic systems. • Determine individual learning style and describe how learners of that style can help themselves, • Use modern engineering tools (example, Excel) to solve material and energy balance problems, • Understand how professional and ethical responsibility corresponds to the NMSU Student Code of Conduct; • Correctly implement unit conversions, • Analyze and solve elementary material balances on single and multi-unit process, for both nonreactive and reactive processes, • Apply the first law of thermodynamics to batch and flow processes, • Locate thermophysical property data in the literature and estimate properties when data are not available; • Conduct combined material and energy balances around continuous multi-unit processes with and without chemical reaction, • Perform process calculations using psychrometric charts, enthalpy concentration diagrams and steam tables, • Derive and solve differential equations for transient heat and material balances on dynamic systems.

b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

7. **Brief list of topics to be covered**

1. Introduction to engineering calculations
2. Process variables
3. Material balances
4. Excel basics: cells, arrays, plotting, using a spreadsheet
5. Energy and energy balances
6. Material and energy balances on nonreactive processes
7. Material and energy balances on reactive processes
8. Transient balances

CHME 303. Chemical Engineering Thermodynamics

Course number and name: CHME 303. Chemical Engineering Thermodynamics

Credits and contact hours: 4 credit hours = 60 contact hours per semester

Instructor's or course coordinator's name: Hongmei Luo

Text book, title, author, and year

- Fundamentals of Chemical Engineering Thermodynamics, Dahm, K.D. & Visco, D.P., 1st edition, Cengage Learning, 2015, ISBN 1-111-58070-7.
- Sandler, Stanley I., Chemical, Biochemical, and Engineering Thermodynamics, 4th edition, John Wiley and Sons, 1999, ISBN# 0-471-66174-0.

a. other *supplemental materials*: none

Specific course information

a. ***catalog description:*** Applications of the First Law and Second Law to chemical process systems, especially phase and chemical equilibria and the behavior of real fluids. Development of fundamental thermodynamic property relations and complete energy and entropy balances. Modeling of physical properties for use in energy and entropy balances, heat and mass transfer, separations, reactor design, and process control.
b. prerequisites: CHME 201, MATH 291; co-requisites: MATH 392
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. student goals: • Enhance students' ability to perform material and energy balances. • Develop students' understanding of energy transformation limitations. • Enable students to better use, predict, and produce thermodynamic data. • Enable students to characterize and predict phase behavior. • Develop students' quantitative understanding of chemical reaction equilibrium. • Enhance students' ability to identify, formulate and solve engineering problems. • Develop students' design skills for engineering unit operations using thermodynamic principles, and including consideration of safety and environmental concerns. • Develop student's skills in the use of modern engineering tools. • Provide an opportunity for students to work effectively as a member of team.
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. Use an engineering problem-solving strategy
2. Define system boundaries.
3. Calculate the heat energy requirement for a chemical or physical process.
4. Solve problems using an appropriate energy balance.
5. Calculate the work requirement for a chemical or physical process. • Solve problems using the appropriate entropy balance.
6. Formulate and use ordinary and partial differential equations to solve thermodynamics problems.
7. Determine equilibrium conditions for chemical species transfer between phases.

8. Estimate property values for a chemical species at a given state.
9. Communicate thermodynamic concepts in the context of phase change and energy conversion processes, such as refrigeration, engines, and electricity production.
10. Use departure functions to solve the First and the Second Law problems for non-ideal systems

CHME 305. Transport Operations I: Fluid Flow

Course number and name: CHME 305. Transport Operations I: Fluid Flow

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: Reza Foudazi

Text book, title, author, and year

- Fluid Mechanics Fundamentals and Applications, 4th Edition Authors: by Yunus A. Cengel, John M. Cimbala Publisher: McGraw-Hill, 2018

a. other *supplemental materials* none

Specific course information

a. ***catalog description:*** Theory of momentum transport. Unified treatment via equations of change. Shell balance solution to 1-D problems in viscous flow. Analysis of chemical engineering unit operations involving fluid flow. General design and operation of fluid flow equipment and piping networks.
b. prerequisites: CHME 201, MATH 291 co-requisites: MATH 392
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to : • solve applied math problems involving linear ordinary differential equations with boundary conditions; • solve partial differential equations that can be analytically solved with boundary condition; • identify how coordinate systems are used with ODEs and PDEs; • simplify second order PDEs with assumptions; • identify when an analytical solution to a PDE is possible and when numerical methods are required; • identify the properties of fluids; • calculate problems that involve pressure measurements; • solve fluid statics problems using the basic equation of fluid statics; • apply principles of fluid kinematics to differentiation among vector fields; • describe physical phenomena of fluid flow; • define and explain viscosity, density, and specific gravity; • calculate surface forces on static fluids; • differentiate between Newtonian and Non-Newtonian fluids; • identify laminar flow and turbulent flow; • calculate the Reynold's number and it in fluid flow problems; • apply the Bernoulli equation to sets of fluid problems; • solve energy balances in the context of fluids and fluid motion; • distinguish between approximations of and appropriate models for Bernoulli's Equation (i.e friction losses, pumps, compressors, turbines, surface forces, gas-liquid flow, non-Newtonian fluids, and the Moody diagram); • apply momentum balances using the governing equations of momentum to solve one dimensional velocity profile problems of external or internal viscous fluid flow; • interpret the different approximations of the momentum balance; • classify differential vs. integral forms of momentum analysis; • calculate problems using the Navier Stoke's Equations.identify different turbo- and fluidmachinery; • explain why computational fluid dynamics is important; • solve problems using external flow with applications: boundary layers, lift, drag; and • calculate problems with dimensional analysis methods.
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. viscosity and fluid definitions
2. fluid statics
3. Bernoulli equation
4. fluid kinematics
5. velocity fields
6. Reynolds Transport Theorem
7. finite control volume analysis
8. differential analysis of fluid flow
9. dimensional analysis
10. viscous flow in pipes
11. flow over immersed bodies
12. turbomachinery

CHME 306. Transport Operations II: Heat and Mass Transfer

Course number and name: CHME 306. Transport Operations II: Heat and Mass Transfer

Credits and contact hours: 4 credit hours = 60 contact hours per semester

Instructor's or course coordinator's name: Catherine Brewer

Text book, title, author, and year

- Fundamentals of Heat and Mass Transfer, 7/E by Bergman, Lavine, Incropera, and Dewitt. ISBN 9780470501979; Wiley (2011)

a. other *supplemental materials* none

Specific course information

a. ***catalog description:*** Theory of heat and mass transport. Unified treatment via equations of change. Analogies between heat and mass transfer. Shell balance solution to 1-D problems in heat and mass transfer. Analysis of chemical engineering unit operations involving heat transfer. Design principles for mass transfer equipment. 4 credits. Restricted to majors.
b. prerequisites: CHME 305 and MATH 392 co-requisites: CHME 392
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will: Adopt a systematic problem solving approach, consistently and effectively. • Diagram heat flows for conductive, convective, and radiative processes. • Find and use material property values. • Convert and use appropriate units of energy, power, flux, etc. • Write conservation equations for planar, cylindrical and spherical systems. • Apply assumptions such as steady state, number of dimensions, order of magnitude, and/or constant properties to simplify conservation equations. • Solve the energy conservation equation for the temperature distribution using appropriate boundary and/or initial conditions. • Calculate heat fluxes into and out of a control volume. • Draw resistance circuits and calculate the overall heat transfer coefficient, U, for compound systems. • Calculate the temperature distribution, heat flux, efficiency, and effectiveness of extended surfaces such as fins. • Use lumped capacitance and exact solution models to solve transient heat transfer problems. • Calculate transport dimensionless numbers and explain what they represent. • Use fluid velocity profiles to calculate boundary layer shapes and thicknesses. • Calculate convection heat transfer coefficient, h, for external and internal flows using formulas and graphs of experimental results. • Explain the causes and relative magnitudes of free convection. • Calculate free convection coefficients using equations and experimental results. • Label key regimes and heat transfer features of boiling and condensation curves. • Compare and contrast parallel, cross, and countercurrent flow in heat exchangers. • Determine the needed surface areas and/or fluid flow rates for heat exchangers given unit operation or process energy needs. • Calculate and explain heat exchanger efficiency. • Predict likelihood and account for consequences of fouling. • Define radiation terminology such as blackbody, grey surface, emissivity, etc. • Relate surface temperature to radiation wavelength and energy. • Calculate the view factor between two surfaces and use it to calculate heat transfer. • Write and solve the mass and molar forms of the 1-D mass conservation equations. • Calculate absolute and relative species velocities and fluxes. • Use heat transfer relationships and analogous equations to solve diffusion and advection mass transfer problems. • Predict which kind(s) of heat transfer will be relevant for a given situation. • Describe implications of problem solutions and perform additional "what if" calculations to understand patterns in the "bigger picture".

b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. modes of heat transfer
2. steady state, 1-D conduction
3. 2-D conduction
4. transient conduction
5. extended surfaces
6. boundary layers
7. forced convection
8. natural convection
9. convection with phase change
10. heat exchangers
11. radiation science
12. radiation exchange
13. 1-D mass diffusion
14. mass fractions and concentrations

CHME 307. Transport Operations III: Staged Operations

Course number and name: CHME 307. Transport Operations III: Staged Operations

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: Thomas Manz

Text book, title, author, and year

- Wankat, Phillip C., Separation Process Engineering (Includes Mass Transfer Analysis), 4th edition, Prentice Hall, 2012, ISBN# 0-13-344365-5.

a. other *supplemental materials* none

Specific course information

a. ***catalog description:*** Theory of mass transport. Mass transfer coefficients. Analysis of chemical engineering unit operations involving mass transfer and separations. Equilibrium stage concept. General design and operation of mass-transfer equipment and separation sequences.
b. prerequisites: CHME 302, CHME 306 co-requisites: none
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will: • Determine which kind of separation (e.g., distillation, adsorption, membrane, etc.) is best suited to separate a particular mixture • Design various kinds of separation units to achieve a target flow rate and purity • Evaluate the cost effectiveness and energy requirements of a separation • Perform McCabe-Theile analysis • Include efficiencies and mass transfer effects in the design of separation units
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. Single equilibrium stages and flash drum calculations
2. Continuous and batch distillation columns
3. Packed and staged distillation columns
4. McCabe-Thiele analysis
5. Absorption and stripping
6. Extractive separation
7. Membrane processes
8. Adsorption processes

CHME 352L. Simulation of Unit Operations

Course number and name: CHME 352L. Simulation of Unit Operations

Credits and contact hours: 1 credit hours = 15 contact hours per semester

Instructor's or course coordinator's name: John W. Schutte (under direction of David A. Rockstraw)

Text book, title, author, and year

- Aspen Plus® Chemical Engineering Applications by Kamal I.M. Al-Malah, 2017.

a. other *supplemental materials* This course will use content from the texts required of the pre- and co-requisite courses, as well as texts from numerous foundation courses of the curriculum.

Specific course information

a. ***catalog description:*** Definition, specification, and convergence of basic unit operations in a process simulator. Course will cover pipe networks, pressure changers, heat exchangers, distillation columns, and chemical reactors.
b. prerequisites: none co-requisites: CHME 307, CHME 441
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to: • specify and converge unit operations in Aspen Plus®; • perform a physical property analysis; • apply non-rigorous balance units, and know how and when to do so; • specify and converge pressure changer unit operations; • specify and converge pipes and pipe networks (mechanical energy balance); • specify and converge heat exchangers; • specify and converge reactors and understand when to use stoichiometric vs. kinetic models; • specify and converge flash drums and decanters; and • understand the basics of performing distillation column analysis.
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. convergence
2. Physical property analysis
3. Non-rigorous balance units
4. Pressure changers
5. Pipes and pipe networks (mechanical energy balance)
6. Heat exchangers
7. Reactors and kinetic models
8. Flash drums and decanters
9. Basics of distillation column analysis

CHME 361. Engineering Materials

Course number and name: CHME 361. Engineering Material

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: Paul K. Andersen

Text book, title, author, and year

- Michael F. Ashby and David R. H. Jones (2012), Engineering Materials 1: An Introduction to Properties, Applications, and Design, Fourth Edition. (Oxford: Elsevier.)

a. other *supplemental materials* P. K. Andersen (2017) Study Guide for Engineering Materials 1. (Available on the course Canvas site)

Specific course information

a. ***catalog description:*** Bonding and crystal structure of simple materials. Electrical and mechanical properties of materials. Phase diagrams and heat treatment. Corrosion and environmental effects. Application of concepts to metal alloys, ceramics, polymers, and composites. Selection of materials for engineering design.
b. prerequisites: CHEM 111G or CHEM 114 or CHEM 115; MATH 190G co-requisites: none
c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to: • Explain the relationships between composition, bonding, structure, and properties. • Explain the effects of supply and demand on materials prices. • Compute stress and strain and identify important mechanical properties. • Explain the effects of defects on material properties. • Explain the common modes of materials failure. • Predict rates of materials failures. • Select materials to avoid failure. • Explain the origins of electrical and magnetic properties. • Discuss contemporary issues in materials science and engineering.
b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. Materials and Properties
2. Price and Availability
3. Bonding and Structure
4. Stress and Strain
5. Yielding and Ductility
6. Fracture and Toughness
7. Fatigue
8. Creep Deformation and Fracture
9. Oxidation and Corrosion
10. Friction and Wear
11. Electric and Magnetic Properties

CHME 441.Chemical Kinetics and Reactor Engineering

Course number and name: CHME 441. Chemical Kinetics and Reactor Engineering

Credits and contact hours: 3 credit hours = 45 contact hours per semester

Instructor's or course coordinator's name: David A. Rockstraw

Text book, title, author, and year

- Elements of Chemical Reaction Engineering, 5/E by H. Scott Fogler ISBN-13: 978-0133887518 ISBN-10: 0133887510; Prentice Hall (2016)

Specific course information

a. ***catalog description:*** Analysis and interpretation of kinetic data and catalytic phenomena. Applied reaction kinetics; ideal reactor modeling; non-ideal flow models. Mass transfer accompanied by chemical reaction. Application of basic engineering principles to design, operation, and analysis of industrial reactors.

b. prerequisites: CHEM 313, CHME 302 and CHME 306 co-requisites: CHME 307

c. this is a required course for Engineering Physics majors with the Chemical Concentration

Specific goals for the course

a. The student will be able to: define the rate of chemical reaction, conversion, and space time; • write mole balances in terms of conversion for a batch reactor, CSTR, PFR, and PBR; • determine reactor sizes (volume, catalyst weight) for reactors either alone or in series once given the molar flow rate of A and the rate of reaction, – rA, as a function of conversion, X; • write the relationship between the relative rates of reaction; • write a rate law and define reaction order and activation energy; • define the Arrhenius Equation and describe how rate of reaction varies with temperature; • describe homogeneous, heterogeneous, elementary, nonelementary and reversible reactions; • express species concentration as a function of conversion for liquid and gas phase reactions; • express the volumetric flow rate for a gas phase reaction as a function of conversion; • express the rate of reaction as a function of conversion for any given rate law; • account for effect of pressure drop on conversion in packed bed reactors; • size batch reactors, semibatch reactors, CSTRs, PFRs, PBRs, membrane reactors, and microreactors for isothermal operation given the rate law and feed conditions; • determine the reaction order and specific reaction rate from experimental data; • describe how the methods of half lives, and of initial rate, are used to analyze rate data; • choose the appropriate reactor and reaction system that would maximize the selectivity of the desired product given the rate laws for all the reactions occurring in the system; • size reactors to maximize selectivity and to determine the species concentrations in a batch reactor, a semibatch reactor, a CSTR, a PFR, and a PBR, in systems with multiple reactions; • discuss pseudo-steady-state-hypothesis and how it is used; • explain what an enzyme is and how it acts as a catalyst; • describe Michaelis-Menten enzyme kinetics and rate law with its temperature dependence; • discuss how to distinguish the different types of enzyme inhibition; • discuss the stages of cell growth and the rate laws used to describe growth; • write material balances on cells, substrates, and products in bioreactors to size chemostats and plot concentration-time trajectories in batch reactors; • define a catalyst, a catalytic mechanism and a rate limit step; • describe the steps in a catalytic mechanism and how one goes about deriving a rate law and a mechanism and rate limiting step consistent with the experimental data; • size isothermal reactors for reactions with Langmuir-Hinshelwood kinetics; • discuss the different types of catalyst deactivation and the reactor types and describe schemes that can help offset the deactivation; • describe the steps in Chemical Vapor Deposition(CVD); • size adiabatic CSTRs, PFRs, and PBRs; • use reactor staging to obtain high conversions for highly exothermic reversible reactions; • size nonadiabatic CSTRs, PFRs, and PBRs; • carry out an analysis to determine the Multiple Steady States (MSS) in a CSTR along with the ignition and extinction temperatures; • analyze multiple reactions carried out in CSTRs, PFRs, and PBRs which are not operated isothermally in order to determine the concentrations and temperature as a function of position (PFR/PBR) and operating variables; • analyze batch reactors and semibatch not operated isothermally; • analyze perturbations in temperature and presence for CSTRs being operated at steady state and describe under what conditions the reactors can be unsafe (safety); • analyze multiple reactions in batch and semibatch reactors not operated isothermally; • define a residence time distribution (RTD) [E(t), F(t)] and the mean residence time; • determine E(t) form tracer data; • write the RTD functions (E(t), F(t), I(t)) for ideal CSTRs, PFRs, and laminar flow reactors; • describe the tanks-in-series and dispersion one parameter models; • describe how to obtain the mean residence time and variance to calculate the number of tanksin-series and the Peclet number; • calculate Peclet numbers and dispersion coefficients using correlations and RTD data; and • calculate conversion for a first order reaction in a tubular reactor with dispersion.

b. The Program Outcomes addressed by this course can be found in Table 3.1.c in Criterion 3 of this Self-Study Report.

Brief list of topics to be covered

1. mole balances
2. conversion
3. reactor sizing
4. rate laws
5. reacting system stoichiometry
6. isothermal reactor design
7. collection and analysis of rate data
8. systems involving multiple reactions
9. non-ideal reaction mechanisms
10. bioreactions and bioreactors
11. steady-state nonisothermal reactor design
12. unsteady state nonisothermal reactor design
13. catalysis and catalytic reactors
14. distributions of residence times for chemical reactors
15. models for nonideal reactors

Engineering Physics Program
(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Electrical Engineering Courses

Equivalent Electrical Engineering Courses between New and Old Curricula

New Curriculum (2016+ Catalog) ***Course and Title***	*Old Curriculum (Prior to 2016 Catalog)* ***Course and Title***
E E 100 Introduction to Electrical & Computer Engin.	E E 162 Digital Circuit Design
E E 112 Embedded Systems	E E 161 Computer Aided Prob. Solving
E E 200 Linear Algebra, Probability, Statistics Apps	E E 210 Engineering Analysis I
E E 212 Intro to Computer Archit. & Organization	E E 363 Computer Systems Architecture I
E E 230 AC Circuit Analysis & Intro to Power Sys.	E E 280 DC & AC Circuits E E 391 Intro to Electric Power Engineering
E E 240 Multivariate and Vector Calculus Apps	E E 310 Engineering Analysis II
E E 300 Cornerstone Design	E E 418 Capstone Design I
E E 317 Semiconductor Devices and Electronics	E E 380 Electronics I
E E 320 Signals & Systems I	E E 312 Signals & Systems I
E E 325 Signals & Systems II	E E 314 Signals & Systems II
E E 340 Fields and Waves	E E 351 App. Electromagnetics
E E 402 Capstone Design	E E 419 Capstone Design II

EE 100 - Introduction to Electrical and Computer Engineering

Course Number and Name: EE 100 Introduction to Electrical and Computer Eng.
Credits: 4 credits
Instructor: Paul M. Furth
Text Book, Title, Author and Year: *Principles of Electric Circuits – Conventional Current, 9th Ed.,* Thomas L. Floyd (2010) and *Digital Fundamentals*, 11th Ed., Thomas L. Floyd (2015).
Other Supplemental Materials: None
Catalog Description: Introduction to analog (DC) circuits and digital logic, including electric component descriptions and equations, Ohm's law, Kirchhoff's voltage and current laws, ideal op-amp circuits, Boolean algebra, design of combinational and sequential logic circuits and VHDL.
Prerequisites: None, **and Corequisites:** MATH 190G
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Introduce students to the field of electrical and computer engineering through applying skills in basic circuits and digital logic.
Course Outcomes: At the end of EE 100, students will:

a. Analyze and design DC circuits, including ideal op-amps, using concepts of voltage, current, power, Kirchoff's laws, and network theorems.
b. Analyze and design combinatorial and sequential logic circuits and state machines and implement designs in VHDL
c. Design simple systems involving dc circuits, op-amps and FPGA for a specified function or purpose.
d. Work and learn effectively in teams.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 100 Course Outcome
Ability to apply mathematics, science and engineering principles.	**a, b**
Ability to design a system, component, or process to meet desired needs.	**c**
Ability to function on multidisciplinary teams.	**d**

Topics list

a. Quantities and Units
b. Voltage, Current, Resistance and Ohm's Law
c. Energy and Power
d. Series Circuits, Parallel Circuits, and Series/Parallel Circuits
e. Thevenin's Theorem
f. Node-Voltage Method

g. Ideal Op-amps
h. Number Systems, Operations and Codes
i. Logic Gates, VHDL
j. Boolean Algebra, DeMorgan's Theorem, and Logic Simplification
k. Function of Combinational Logics, e.g., adders, decoders, multiplexors
l. Latches, Flip-flops and Registers
m. Finite-State Machines and Counters
n. Laboratory topics include: (1) the operation of laboratory instruments, including, the digital multi-meter, function generator, and oscilloscope, (2) proto-typing and testing circuits on breadboards, (3) using other circuit elements, including LEDs and sensors, (4) IC opamp circuits, (5) FPGA programming using VHDL, (7) FPGA interfacing to peripheral devices, including switches, 7-segment displays, and sensors through GPIO.

EE 112 - Embedded Systems

Course Number and Name: EE 112 Embedded Systems
Credits: 4 credits
Instructor: Paul M. Furth
Text Book, Title, Author and Year: *Problem Solving and Program Design in C, 7th Ed.*, Jeri R. Hanly and Elliot B. Koffman (2012).
Other Supplemental Materials: None
Catalog Description: Introduction to programming through microcontroller-based projects. Extensive practice in writing computer programs to solve engineering problems with microcontrollers, sensors, and other peripheral devices.
Prerequisites: EE 100, **and Corequisites:** MATH 190G
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Introduce students to computer programming on a micro-controller that interfaces with sensors, and other peripheral devices.
Course Outcomes: At the end of EE 100, students will:

a. Analyze a problem statement, design an algorithm to solve the problem, and implement the algorithm with a computer program.
b. Use basic components of a computer program including control statements, data structures, functions, and loops
c. Program a microcontroller to access and control a variety of sensing and other peripheral devices
d. Work and learn effectively in teams.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 112 Course Outcome
Ability to apply mathematics, science and engineering principles.	**b**
Ability to design a system, component, or process to meet desired needs.	**c**
Ability to function on multidisciplinary teams.	**d**
Ability to identify, formulate and solve engineering problems.	**a**

Topics list

a. Introduction to the Computer and Software Development Method
b. C Language Elements
c. Variables, Assignments, Inputting and Outputting Data
d. Arithmetic Expressions and Math Library Functions
e. Functions with Input Arguments

f. Conditions, If and Compound If Statements
g. Switch Statement
h. While Loops, For Loops, Do-While Loops
i. Conditional Loops, Counting Loops, Loop Design
j. Nested Loops
k. Pointers and Functions with Output Arguments
l. Declaring and Referencing Array Elements
m. Functions with Array Input or Output Arguments
n. Searching and Sorting Arrays
o. Parallel Arrays and Array Processing
p. Introduction to Strings
q. Arduino and Atmel Microcontroller Organization
r. Laboratory topics include: (1) Arduino programming environment, (2) interfacing with potentiometer, speaker, LEDs, temperature sensor, light sensor, pushbutton switches, and rotary encoder, (3) ADC sampling rate, (4) hardware interrupts, and (5) a student-selected hardware/software project.

EE 200 - Linear Algebra and Probability

Course Number and Name: EE200 Linear Algebra and Probability
Credits: 4 credits
Instructor: Charles Creusere
Text Book, Title, Author and Year: E. Kreyszig, *Linear Alg & Probability NM State*, John Wiley & Sons, Inc., 2012, ISBN: 9781119240945. This custom text contains Chapters 7, 8, 20, 24, 25, and Appendix 2 from E. Kreyzig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, Inc., 2011, ISBN: 9780470458365.
Other Supplemental Materials: Matlab; Chapter 10, Goodman & Yates
Catalog Description: The theory of linear algebra (vectors and matrices) and probability (random variables and random processes) with application to electrical engineering. Computer programming to solve problems in linear algebra and probability.
Prerequisites: Math 192 and EE112. **Corequisites:** none.
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Provide students with basic math background in probability theory and linear algebra and to demonstate the utility of such mathematical concepts in solving engineering problems. Students learn and apply Matlab to solve problems and master concepts.
Course Outcomes: At the end of EE 200, student will:

a. Perform vector and matrix operations, including matrix inversion, eigen analysis, finding basis and dimension of vector spaces and rank of a matrix, and solving a set of linear equations.
b. Calculate probabilities using probability mass, density, and cumulative distribution functions for single and multiple, discrete and continuous random variables, and relate them to electrical engineering applications.
c. Perform simple parameter estimation, such as finding sample mean and variance, and relate to confidence intervals.
d. Describe random processes in the context of signal processing and communications systems problems.
e. Use MATLAB to solve problems involving linear algebra and probability, including designing and performing simple numerical experiments.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 200 Course Outcome
Ability to apply mathematics, science and engineering principles.	**a, b**
Ability to design and conduct experiments, analyze and interpret data.	**C**
Ability to identify, formulate and solve engineering problems.	**d**

Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**e**

Topics list

a. Experiments, Outcomes, and Events
b. Probability
c. Random Variables--Distributions
d. Mean, Variance, Moments
e. Important Distributions: Normal, etc.
f. Multivariate Distributions
g. Random Processes
h. Statistics: Sample Mean/Variance, Confidence Intervals
i. Matrix/Vector Equations
j. Systems of Linear Equations: Gauss Elimination
k. Matrix Ranks and Vector Spaces
l. Determinants
m. Matrix Inverses: Gauss-Jordan Elimination
n. Eigenvalue Problems

EE 212 - Computer Organization and Design

Course Number and Name: EE212 Computer Organization and Design
Credits: 4 credits (3+3P)
Instructor: Abdel-Hameed Badawy
Text Book, Title, Author and Year: *Computer Organization and Design: The Hardware/Software Interface*, 5th edition, MIPS edition, David A. Patterson and John L. Hennessy (2014)
Other Supplemental Materials: Quartus II – FPGA programming software
Catalog Description: Concepts of modern computer architecture. Processor micro-architectures, hardwired vs. micro-programmed control, pipelining and pipeline hazards, memory hierarchies, bus-based system architecture, memory mapping, hardware-software interface, and operating system concepts. Comparison of architectures to illustrate concepts of computer organization; relationships between architectural and software features.
Prerequisites and Co-requisites: CS 273 (Machine Programming and Organization) or EE 260 (Embedded Systems) or EE 100 (Circuits and Digital Design) and EE 112 (Embedded Systems Programming)
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Provide students with an overview of the various aspects of computer system organization and CPU architecture.
Course Outcomes: At the end of EE 212, student will:

a. Understand the micro components of a computer system, including memory, cache, registers, ALU's, pipelines, instruction decoding.
b. Understand the operation of a processor, including the fetch/execute cycle, memory access, virtual memory, addressing modes, data types, and instruction sets.
c. Understand the relationship between hardware and software.
d. Understand their professional and ethical responsibilities with respect to computer architectural design decisions.
e. Understand the potential global, economic, environmental, and societal impact of their engineering decisions.
f. Demonstrate an awareness of current topics in computer architecture

Mapping to Departmental Student Outcomes

ECE Outcome	EE 212 Course Outcome
Understanding of professional and ethical responsibility.	**e**
The broad education necessary to understand the impact of engineering solutions in a global and societal context.	**f**
Knowledge of contemporary issues.	**g**

Topics list

a. Hardware architecture
b. Data types
c. Assembly programming
d. Pipelining
e. Cache
f. Virtual memory
g. Multi-processing
h. Cache coherence & Consistency models
i. Hardware security

EE 230 - AC Circuits and Introduction to Power

Course Number and Name: EE230 AC Circuits and Introduction to Power
Credits: 4 credits
Instructor: Sang-Yeon Cho
Text Book, Title, Author and Year: *Electric Circuits*, 10th Ed., James Nilsson and Susan Riedel, Pearson, 2015
Other Supplemental Materials: Lab kits
Catalog Description: Electric component descriptions and equations; complete solutions of RLC circuits; steady-state analysis of AC circuits; introduction to power systems in the steady-state.
Prerequisites: EE 100, PHYS 215G and MATH 192G. **Corequisites:** none.
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: EE230 provides students with an understanding of the basic methods that are used for the time and frequency domain analysis of AC electric circuits and power systems.
Course Outcomes: Students completing the course with a grade of C or better will be able:

a. To develop competency in the application, analysis and design of RL, RC, and RLC circuits (sinusoidal steady state), Phasor analysis, power concepts in ac circuits; and have initial exposure to frequency response concepts.
b. To develop competency in the basic structure, analysis methods, and properties of balance, three-phase ac power systems.
c. To apply the basic tools and circuit elements used in electrical engineering, the proper and responsible use of oscilloscopes, digital multi-meters, power supplies, function generators, and other electronic testing equipment.
d. To use circuit/problem solving software such as MultiSim, MathCAD, and/or Matlab.
e. To offer the student an opportunity to display his/her competency in both course work, laboratory procedures and problem-solving skills by doing in-lab demonstrations and presentations.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 230 Course Outcome
Ability to apply mathematics, science and engineering principles.	**a**
Ability to design and conduct experiments, analyze and interpret data.	**c**
Ability to identify, formulate and solve engineering problems.	**b**
Ability to communicate effectively.	**e**
Ability to use the techniques, skills and	**d**

modern engineering tools necessary for engineering practice.	

Topics list

a. Review - Kirchoff's Laws, Node-Voltage Method, Mesh-Current Method, Source Transformation, Thevenin and Norton Equivalents
b. Inductance, Capacitance, Mutual Inductance
c. Natural and Step Responses of First-order RL and RC Circuits
d. Natural and Step Responses of RLC circuits
e. Sinusoidal Steady-State Analysis
f. Circuit Elements in the Frequency Domain, and Phasor diagrams
g. Instantaneous Power, Complex Power, Power Calculations, Maximum Power Transfer
h. Balanced Three-Phase Circuits

EE 300 - Cornerstone Design

Course Number and Name: EE 300 Cornerstone Design
Credits: 2 credits
Instructor: Paul M. Furth
Text Book, Title, Author and Year: None
Other Supplemental Materials: None
Catalog Description: Application and realization of engineering principles to a guided team-based design project. Formulation and implementation of test procedures, evaluation of alternate solutions and oral and written communication of the design and test results.
Prerequisites: EE 212 and EE 230, **and Corequisites:** None.
Core, Specialization, Elective: ECE Core
Course Goal: Introduce students to the design process by applying basic knowledge of electrical and computer engineering to a in a team-based project.
Course Outcomes: At the end of EE 300, students will:

a. Formulate and implement test procedures for validation of requirements.
b. Evaluate alternative design solutions.
c. Document test procedures and design solutions.
d. Implement design to include a printed-circuit board, electronics and coding.
e. Communicate the design and validation both orally and in writing to a wide range of target audiences.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 300 Course Outcome
Ability to design and conduct experiments, analyze and interpret data.	**a**
Ability to design a system, component, or process to meet desired needs.	**b**
Ability to communicate effectively.	**c, e**
Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**d**

Topics list

a. Project Scheduling
b. Design Requirements
c. Testing and Test Procedures
d. Electronic Measurements
e. Lab Notebooks
f. Design Process
g. Component Datasheets
h. Design Evaluation

i. Visio, PowerPoint
j. Word, LaTeX
k. Printed Circuit Board Layout
l. Bill of Materials
m. Soldering, Proto-typing

EE 320 - Signals and Systems I

Course Number and Name: EE 320 Signals and Systems I
Credits: 3 credits
Instructor: Steven Sandoval
Text Book, Title, Author and Year: *Signals and Systems, 2nd Edition* by Alan V. Oppenheim and Alan S. Willsky (ISBN-13: 978-0138147570)
Other Supplemental Materials: MATLAB software
Catalog Description: Continuous and discrete time signals and systems. Linear, time-invariant systems. Fourier series, continuous and discrete time Fourier transforms. Time and frequency characterization of signals and systems.
Prerequisites EE 200 and EE 230. **Corequisites:** MATH 392.
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Provide students with an introduction to the fundamentals of signal analysis and system analysis.
Course Outcomes: At the end of EE 320, student will:

a. Understand different types of signals (continuous-time, discrete-time, periodic, etc.) and how these signals are represented mathematically and in a computer.
b. Understand systems representations (e.g., impulse responses), implementations (e.g., convolution and difference/differential equations), and properties (e.g., linearity).
c. Gain insight into transform-domain analysis for signals and systems.
d. Develop the ability to apply transform domain and LTI analysis to simple applications in signal processing, communications, and controls using MATLAB.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 320 Course Outcome
Ability to apply mathematics, science and engineering principles.	**a, d**
Ability to design a system, component, or process to meet desired needs.	**b, c**

Topics list

a. Continuous-time (CT) Signals and Discrete-time (DT) Signals
b. Signal Transformations and Signal Properties
c. Complex Exponential Signals, Harmonically-Related Complex Exponentials,
d. DT Unit Impulse and Unit Step, CT Impulse and Unit Step
e. CT and DT Systems, Basic System Properties
f. Linear, Time-Invariant (LTI) Systems Theory, DT Convolution
g. CT Sifting property, CT Convolution Properties of the Convolution Operator, Properties of LTI Systems
h. Causal LTI Systems Described by Differential and Difference Equations, Linear Constant-Coefficient Differential Equations

i. Linear Constant-Coefficient Difference Equations, Block Diagram Representations
j. Response of CT LTI Systems to Complex Exponentials, Response of DT LTI Systems to Complex Exponentials
k. CT Fourier Series, Fourier Series , Discrete-Time Fourier Series, CT Fourier Transform, Discrete-Time Fourier Transform (DTFT)
l. Magnitude-Phase Representation of the Fourier Transform, Magnitude-Phase Representation of the Frequency Response of LTI Systems
m. Linear and Non-Linear Phase, Group Delay, Log-Magnitude and Bode plots
n. First-Order CT Systems, Asymptotic Approximations to the Bode Plot, Second-Order CT Systems, Bode Plots for Rational Frequency Responses
o. Time-Domain Properties of Ideal Frequency-Selective Filters, Time-Domain Properties of Non-Ideal Frequency-Selective Filters

EE 340 - Fields and Waves

Course Number and Name: EE340 Fields and Waves
Credits: 4 credits
Instructor: Kwong T. Ng
Text Book, Title, Author and Year: *Fundamentals of Applied Electromagnetics, 6th edition,* Fawwaz T. Ulaby, Eric Michielssen, and Umberto Ravaioli (2010)
Other Supplemental Materials: ANSYS Designer, ANSYS HFSS, and MATLAB software
Catalog Description: Static electromagnetic field. Maxwell's equation and time-varying electromagnetic fields. Generalized plane wave propagation, reflection, transmission, superposition and polarization. Transmission line theory. Extensions to optical wave propagation. Applications including Time Domain Reflectometry (TDR) and fiber optic transmission. Laboratory experience with RF/microwave test equipment and optical apparatus. Restricted to Majors: Electrical Engineering.
Prerequisites and Corequisites: C- or better in EE 240
Core, Specialization, Elective: *Course is required for Engineering Physics students with the Electrical Concentration*
Course Goal: Provide students with a study of electromagnetic fields and their applications.
Course Outcomes: At the end of EE 340, student will:

a. Demonstrate an understanding of the fundamental principles, theories, and equations (such as Maxwell's) governing transmission lines, static and time-varying fields, propagation, reflection and transmission of plane waves, and waveguides.
b. Analyze and solve electromagnetic-related problems by applying fundamental principles, theories, and equations (such as Maxwell's equations and transmission line properties).
c. Demonstrate effective teamwork.
d. Demonstrate the use of RF/microwave test equipment and software to perform high frequency circuit measurements.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 340 Course Outcome
Ability to apply mathematics, science and engineering principles.	**a, b**
Ability to design and conduct experiments, analyze and interpret data.	**d**
Ability to function on multidisciplinary teams.	**c, d**
Ability to identify, formulate and solve engineering problems.	**a, b**

Topics list

a. Transmission Line and Distributed Circuit Theory, Transmission Line Circuit Design
b. Review of Electrostatics and Magnetostatics
c. Time-Varying Fields and Maxwell's Equations, Boundary Conditions
d. Plane Wave Propagation and Applications
e. Plane Wave Reflection and Transmission, and Applications
f. Analysis and Design of Waveguide Systems

EE 380 - Electronics I

Course Number and Name: EE380 Electronics I
Credits: 4 credits
Instructor: Jaime Ramirez-Angulo
Text Book, Title, Author and Year: *Microlectronic Circuits, 7th Edition*, Oxford University Press, Sedra and Smith (2017)
Other Supplemental Materials: Demo version of circuit simulation software TOPSPICE available at http://www.penzar.com/demopage.htm. EE380 component kit (available from instructor, cost: approximately $32/lab pair
Catalog Description:. Electronics I, Credits 4, Analysis and design of single time constant networks, op-amps applications, diode circuits, linear power supplies and single transistor MOS and BJT amplifiers. Introduction to solid-state devices and digital circuits
Prerequisites: C or better in EE162, EE280 and CHEM 111G. **Corequisites:** none
Core, Specialization, Elective: ECE Core
Course Goal: Provide students with proficiency analysis and design of diode circuits op-amp circuits and single stage amplifiers with MOS and BJT transistors.
Course Outcomes: At the end of EE 380, student will:

a. Apply knowledge from science, math and engineering to electronic circuit design.
b. Become proficient with lab equipment required to test electronic circuits.
c. Become proficient with software to capture and simulate electronic circuits
d. Understand the professional and ethical responsibilities related to electronic circuit design.
e. Understand how to characterize experimentally electronic circuits.
f. Become proficient with utilization of software for the design of PCBs
g. Maintain a knowledge of contemporary professional, societal and global issues as they relate to electronic circuits and VLSI systems.
h. Write lab reports

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 380 Course Outcome
Ability to apply mathematics, science and engineering principles.	A
Ability to design a system, component, or process to meet desired needs.	A
Ability to communicate effectively.	H
Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	B,C,E.F

Topics list

a. Amplifier models: voltage, current, transconductance and transresistance. Analysis and design of single stage and multistage amplifiers. Frequency response of amplifiers
b. Single time constant networks: Transfer functions of first order low pass and high pass networks
c. Physical operation of PN junction.
d. Analysis of ideal op-amp circuits: Inverting, noninverting and differential configuration with resistive and frequency dependent elements
e. Non ideal op-amp characteristics: Finite DC gain, Finite bandwidth and gain-bandwidth product. DC offset, slew rate, Input bias currents. Frequency response of nonideal op-amp amplifiers.
f. Terminal characteristics of Ideal diodes. Analysis of circuits with ideal diodes. Terminal characteristics of nonideal diodes. Analysis of circuits with nonideal diodes. Analysis and design of diode circuits: rectifiers, power supplies, regulators, limiters, peak detectors, voltage doublers. Other diode types: photodiodes, LEDs.
g. Physical operation and terminal characteristics of MOS transistors. Biasing and small-signal models of MOS transistors. Small signal analysis of MOS single stage amplifiers: Common source, common drain and common gate amplifiers
h. Physical operation and terminal characteristics of Bipolar Junction Transistors (BJTs). Biasing and small-signal models of BJT circuits. Small signal analysis of BJT single stage amplifiers: Common emitter, common collector and common base amplifiers

EE 402 - Capstone Design
Course Number and Name: EE 402 Capstone Design
Credits: 3 credits
Coordinator: Satish J. Ranade
Text Book, Title, Author and Year: None
Other Supplemental Materials: None
Catalog Description: Application and realization of engineering principles to a significant team-based design project with significant student managment and autonomy. Determination of performance requirements, including safety, economics, ethics and manufacturability; extensive communication of design choices and test results to broad audiences; and interfacing of design with other hardware and software.
Prerequisites: EE 300, EE 317, EE 325, and EE 340
Core, Specialization, Elective: ECE Required
Course Goal: In EE 402 students demonstrate the ability to design a system with significant hardware and software components for a specific purpose.
Course Outcomes: In EE 402 students will:

a. Determine detailed performance requirements at the system and subsystem levels based on problem statement and/or customer objectives.
b. Incorporate appropriate safety, economic, ethical, and manufacturability constraints in requirements.
c. Formulate, implement, and document detailed test procedures for validation of requirements.
d. Develop methodology to justify choice of best design(s) in light of alternative design solutions.
e. Analyze project risk, provide a work breakdown structure, team management plan, and budget to ensure successful implementation of solution.
f. Implement the design, interfacing it with other hardware and software entities.
g. Validate the design implementation.
h. Communicate the design and validation both orally and in writing to a wide range of target audiences.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 402 Course Outcome
Ability to design and conduct experiments, analyze and interpret data.	**c, g**
Ability to design a system, component, or process to meet desired needs.	**a, d**
Ability to function on multidisciplinary teams.	**e**
Understanding of professional and ethical responsibility.	**b**
Ability to communicate effectively.	**h**

Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**f**

Topics list

a. Team, individual, and peer reporting
b. Communicating with the customer to develop design requirements
c. Requirements testing, feasibility, and measurability
d. Safety class and ethics of designs
e. How to develop and track budget information
f. How to assess and communicate risk
g. Project scheduling and management
h. Communication to broad audiences
i. Documentation of design and testing (written and oral)
j. Intellectual property

EE 418 - Capstone I

Course Number and Name: EE 418 Capstone I
Credits: 3 credits
Coordinator: Satish J. Ranade
Text Book, Title, Author and Year: None
Other Supplemental Materials: None
Catalog Description: Application of engineering principles to a significant design project. Includes teamwork, written and oral communications, and realistic technical, economic, and public safety requirements.
Prerequisites: Complete all ECE Core classes with C- or better
Core, Specialization, Elective: *Engineering Physics Students with the Electrical Concentration can take this course to fulfill their capstone design requirement.*
Course Goal: In the EE418/419 sequence students demonstrate the ability to design a system with significant hardware and software components for a specific purpose.
Course Outcomes: In EE418 students will:

a. Convert a problem statement or customer objective into appropriate system requirements and propose solutions at a block-diagram level
b. Develop detailed subsystem requirements, alternate designs and methodology to identify best design(s)
c. Analyze project risk and provide a WBS, management plan(appropriate delegation and integration of individual team member tasks), and budget to ensure successful implementation of solution in EE 419
d. Complete design with demonstration of critical subsystem prototypes(s)
e. Be able to consider business, ethical and societal aspects of design work and communicate the progress of the design.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 460 Course Outcome
Ability to design and conduct experiments, analyze and interpret data.	**b, d**
Ability to design a system, component, or process to meet desired needs.	**b**
Ability to function on multidisciplinary teams.	**a, b, c**
Ability to identify, formulate and solve engineering problems.	**a**
Understanding of professional and ethical responsibility.	**d**
Ability to communicate effectively.	**d**
The broad education necessary to understand the impact of engineering solutions in a global and societal context.	**d**
Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**c**

Topics list

a. NMSU Employee Safety Class
b. Ethics
c. Intellectual property
d. Group status Report and attendance log (Bi-Weekly)
e. Individual Status Report and Peer Review (Bi-weekly)
f. Elevator Speech, Youtube video, Safety Quiz
g. System Concept Review and report
h. Preliminary Design Review and report
i. Critical Design Review, to include prototype demonstration, and draft final report

EE 419- Capstone II

Course Number and Name: EE 419 Capstone II

Credits: 3 credits
Coordinator: Satish J. Ranade
Text Book, Title, Author and Year: None
Other Supplemental Materials: None
Catalog Description: Realization of design project from E E 418 within time and budget constraints.
Prerequisites: Complete all ECE Core classes with C- or better
Core, Specialization, Elective: *Engineering Physics Students with the Electrical Concentration can take this course to fulfill their capstone design requirement.*
Course Goal: In the EE418/419 sequence students demonstrate the ability to design a system with significant hardware and software components for a specific purpose.
Course Outcomes: In EE418 students will:

a. Implement, test and iterate design developed in EE418 to validate established requirements and constraints.
b. Implement and test interfaces to user and hardware and software entities if required
c. Document the design, implementation, test and usage; communicate both orally and in writing.
d. Appropriately delegate and integrate individual team member tasks.

Mapping to Departmental Student Outcomes:

ECE Outcome	EE 460 Course Outcome
Ability to design and conduct experiments, analyze and interpret data.	**a, b**
Ability to design a system, component, or process to meet desired needs.	**a, b**
Ability to function on multidisciplinary teams.	**d**
Ability to identify, formulate and solve engineering problems.	**a**
Ability to communicate effectively.	**c**
Knowledge of contemporary issues.	
Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.	**a-d**

Topics list

a. Finalize system design and implementation schedule
b. Define test plan

c. Implement design
d. Perform and document subsystem/system tests
e. Document design via an overall report, reference manual, user manual and interface document
f. Communicate design and project progress through written reports and presentations

Engineering Physics Program
(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Mechanical Engineering Courses

Course Information	**ME159 Graphical Communication and Design** 2 credits Required Fall 2017
INSTRUCTOR:	Mostafa Hassanalian Office: JH007 Phone: 449-0850 email: mhalian@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	M,TR,F 3:00-4:00pm or by appointment
CATALOG DESCRIPTION:	Sketching and orthographic projection. Covers detail and assembly working drawings, dimensioning, tolerance specification, and design projects.
PRE/COREQUISITES:	Math190
TEXT:	*NX 11 for Designers, Sham Tickoo, CADCIM Technologies, 2017.* *This is a Canvas course – Go to https://my.nmsu.edu>LaunchPad>Canvas or use https://nmsu.instructure.com/login directly in the web browser.*
CLASS SCHEDULE:	Lecture: 1:10 p.m. - 2:10 p.m. - T - EC2 103 Section M02 & M04 Lab: 2:10 p.m. - 5:00 p.m. - T - EC1 210A &210B Lecture: 1:30 p.m. - 2:20 p.m. - W - EC2 103 Section M01 & M03 Lab: 2:30 p.m. - 5:20 p.m. - W - EC1 210A &210B Lab Hours Outside of Class for Doing Homework: 8:00 a.m. – 5:00 p.m. - Jett Hall 004 Open for 24 Hours – Hernandez Hall Computer Lab
GRADES:	Quizzes ~10% Labs/Homework ~50% Project ~20% Final Exam ~20% (possible +10% with Extra Credit))
COURSE OBJECTIVES:	• The student will become familiar with 3-D, featured based, parametric solids modeling as a design tool in mechanical engineering. (ME4) • The student will become familiar with the practices and procedures used to produce and read engineering working drawings (c). • The student will become familiar with computers from an historical, software, and hardware perspective as they are used in mechanical engineering (k). • The student will become familiar with the general principles of computer aided design and drafting (CADD), and be reasonably proficient in the use of one modern CADD software package – Unigraphics NX from Siemens Corporation. (k)
TOPICS COVERED:	<u>Using Unigraphics NX</u> • Feature-based solids modeling – creation of basic and intermediate features • NX as a design tool - building design intent into models • Assembly modeling

Course Information	**ME159 Graphical Communication and Design** 2 credits Required Fall 2017
	• Crea ting engineering drawings of parts and assemblies Practices and Procedures Used to Produce Engineering Drawings • Creating 2D orthographic drawings of 3D objects – standard views, required views, placement, etc. • Required drawing dimensions – identify features, decide how many dimensions, etc. • Good dimensioning practices – where paced in drawing? How should they look? • Reading engineering drawings – using 2D orthographic views and dimensions to infer 3D shape
RELATIONSHIP TO PROGRAM OUTCOMES:	c ability to design a system, component or process to meet desired needs within realistic constraints k ability to use the techniques, skills and modern tools necessary for engineering practice
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABETSPECIFIC CRITERIA:	ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• Homework is due at the ***beginning*** of the next class lecture. No assignments or homework will be accepted after that time. • Students cannot miss ***more than three lectures***. • Students who fail in the final exam with a grade less than ***25%*** will ***automatically fail the course***.. • Paper for printing up to 200 sheets during the semester will be supplied free of charge. Printing beyond that amount will be charged at the rate of 5¢/page (see administrative assistant in EC). • **ALL** absences must be "excused"; otherwise a **0** will be recorded for that Lecture/Lab Assignment. Communicate with the instructor as soon as you know that you will miss the class. Because of limited space/machines, any make-up work must be coordinated with the instructor. • Plagiarism is using another person's work without acknowledgment, making it appear to be one's own. Intentional and unintentional instances of plagiarism are considered instances of academic misconduct and are subject to disciplinary action such as failure on the assignment, failure of the course or dismissal from the university.
AUTHOR/DATE:	Mostafa Hassanalian October 2017

Course Information	**ME 236 Engineering Mechanics I** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Borys Drach Office: JH234 Phone: 646-8041 email: borys@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	MW 2:30 – 3:30pm, Jett Hall 234 or by appointment (via e-mail)
CATALOG DESCRIPTION:	Force systems, resultants, equilibrium, distributed forces, area moments, friction, and kinematics of particles.
PREREQUISITES:	Math 192G
PRE/COREQUISITES:	PHYS 215G
TEXT:	Russell C. Hibbeler "Engineering Mechanics: Statics", 14th edition, Pearson, ISBN-10: 0133918920, ISBN-13: 978-0133918922 + "MasteringEngineering" access
CLASS SCHEDULE:	MWF 11:30am – 12:20pm, Jett Hall 210
GRADES:	In-class assignments 5% Homework 10% Midterm exam 1 25% Midterm exam 2 25% Final exam 35%
COURSE OBJECTIVES:	<u>After completing this course, a student should have:</u> • understanding of Static Particle and Body Equilibrium • understanding of Equivalent Force Systems • understanding of Simple Truss and Frame Structural Analyses • understanding of Dry Friction and proficiency in Dry Friction analysis • understanding of Center of Gravity and Geometric Centroid • understanding of Area and Mass Moments of Inertia • understanding of Kinematics of Particles • proficiency in developing Mathematical Models (a) • ability to use knowledge acquired in the course to formulate, solve and interpret solutions of engineering problems(e)
TOPICS COVERED:	• Vector Algebra • Particle Equilibrium • Equivalent Force Systems • Rigid Body Equilibrium • Structural Analysis of Trusses, Frames and Machines • Friction • Center of Gravity and Centroid • Area and Mass Moments of Inertia • Kinematics of Particles

Course Information	**ME 236 Engineering Mechanics I** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations
POLICIES:	• Students are expected to attend all lectures. Attendance will be tracked via in-class assignments. Attendance will be taken into account during final grading. • Use of electronic devices in the course is not permitted. • Homework will be assigned, submitted and graded via the online system "MasteringEngineering" (online access is required) • Discussion of the homework solution is not permitted. You must work alone. • No credit will be given for late homework. • Dates and format of the exams will be discussed in class. Exams cannot be retaken. All make-up arrangements must be discussed with the instructor before the date of the exam. Make-up exams will only be allowed in extraordinary cases • **Zero tolerance policy**. A student suspected of cheating will receive zero for the assignment and the incident will be reported to the College administration, see below. • **College policy**. The College of Engineering has a "2 strikes and you're out" policy for academic misconduct. This means that a student will be suspended after found guilty of two academic misconduct cases. Suspension means out for one year. A strike can count from academic misconduct occurring in any college. Academic Misconduct Policy: http://studenthandbook.nmsu.edu/student-code-of-conduct/academic-misconduct/ Plagiarism is using another person's work without acknowledgment, making it appear to be one's own. Intentional and unintentional instances of plagiarism are considered instances of academic misconduct and are subject to disciplinary action such as failure on the assignment, failure of the course or dismissal from the university. For source and more information visit http://lib.nmsu.edu/plagiarism/
AUTHOR/DATE:	Borys Drach October 2017

Course Information	**ME 237 Engineering Mechanics II** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. V. Choo Office: JH130 Phone: 646-2225 email: vchoo@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	Email or by appointment
CATALOG DESCRIPTION:	Kinetics of particles, kinematics and kinetics rigid bodies, systems of particles, energy and momentum principles, and kinetics of rigid bodies in three dimensions.
PREREQUISITES:	ME 236 or CE 233
PRE/COREQUISITES :	Math 291
TEXT:	*Engineering Mechanics: Dynamics, 14th Ed., Russell C. Hibbeler, Pearson Education, ISBN-10: 0133915387, ISBN-13: 9780133915389..*
CLASS SCHEDULE:	Lecture: 12:30 P.M. - 1:20 P.M. - MWF - JH 210 M01
GRADES:	Homework: 10% Formative Test 1 and Test 2: 10% each Summative Test1: 35% Summative Test2: 35%
COURSE OBJECTIVES:	After completing this course, a student should be able to: • develop Mathematical Models (FBD's) • analyze the Kinematic and Kinetic Problems of Particles • apply the Energy and Momentum Principles to Particles in Motion • analyze the Kinematic and Kinetic Problems of Rigid Bodies in Planar Motion • apply the Energy and Momentum Principles for Planar Motion of Rigid Bodies • analyze the Kinematic and Kinetic Problems of Rigid Bodies in Three Dimensional Motion • use the knowledge acquired in this course to formulate, solve and interpret solutions of engineering problems.(e)
TOPICS COVERED:	• Vector Algebra and Static Equilibrium • Kinematics and Kinetics, Energy and Momentum principles for: Particles in Motion Rigid Bodies in Planar Motion Rigid Bodies in Three Dimensional Motion • Moments and Products of Inertia • Relative Motion and Moving Reference Frame

Course Information	**ME 237 Engineering Mechanics II** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations
POLICIES:	• Homework assignments must include (1) problem description, (2) mathematical model(s), (3) formulation of solution, (4) presentation of mathematical procedures used and (5) results. • Late homework assignments will not be accepted. • Collaboration in the form of discussion of formulation of solutions or results is encouraged; however, each individual must work independently to create the required solutions to homework assignments.
AUTHOR/DATE:	V. Choo August 2017

Course Information	**ME 240 Thermodynamics** 3 credits Required Fall 2017
INSTRUCTOR:	Krishna Kota Office: JH 128 Phone: 646-5720 Email: kkota@nmsu.edu
ASSISTANTS:	Lazar Cvijovic
OFFICE HOURS:	2:30 to 4:00 p.m. TR or by appointment
CATALOG DESCRIPTION:	First and second laws of thermodynamics, irreversibility and availability, applications to pure substances and ideal gases.
PREREQUISITES:	Phys 215G
TEXT:	*Çengel, Y. A. and Boles, M. A., Thermodynamics: An Engineering Approach, 8th ed., the McGraw-Hill Companies, Inc., New York, © 2015,* ISBN-13: 978-007-3398174 This is a Canvas course – http://learn.nmsu.edu
CLASS SCHEDULE:	Lecture: 11:45 a.m. - 1:00 p.m. - TR – JH 207
GRADES:	Homework 15%, Quizzes 25% Midterm exam 25%, Final Exam 35%
COURSE OBJECTIVES:	• The student will be able to determine properties of real substances, such as steam and refrigerant 134-a, and ideal gases from either tabular data or equations of state. (e) • The student will be able to analyze processes involving ideal gases and real substances as working fluids in both closed systems and open systems (systems and control volumes) to determine process diagrams, apply the first law of thermodynamics to perform energy balances, and determine heat and work transfers. (e) • The student will be able to analyze closed and open systems through the application of the second law. (e) • The student will be able to analyze the Rankine cycle.(e)
TOPICS COVERED:	• Basic Thermodynamic concepts • Introduction to energy and the First Law • Properties of pure substances • First Law for closed systems • First Law for open systems • The Second Law • Entropy and First and Second Law applications • Introduction to power cycles • Reviews and Exams

Course Information	**ME 240 Thermodynamics** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• Homework: 5-8 homeworks will be assigned in this course and selected problems from each of them will be graded. Please submit the solutions to homework problems before the end of class on the prescribed due date. Late homeworks will not be accepted. • Quizzes and Exams: Text book, class notes or any other material is not allowed during exams and quizzes. Usage of any kind of electronic device (including smart phones) is not permitted. All electronic devices must be muted and stored in your backpacks, which must be kept in front of the class room at least five minutes before an exam. Sharing of calculators is not allowed. Please bring your own calculator. Discussions of any kind are not allowed. You can only speak with the instructor or the TA. Violation of any of the above discussed exam policies will be considered as cheating for which a zero will be awarded on that exam. • Additional Exam and Classroom Policies & Recommendations: Pen vs. pencil policy · Exam proctoring policy · Restroom usage policy • Please try to attend all the classes. • Please try to be in the class room on time. If you arrive late, please quietly occupy a seat without disturbing the lecture or other students. • Please check CANVAS frequently for announcements and updates. • It is strongly recommended to refrain from using smart phones in the classroom.
AUTHOR/DATE:	K. Kota August 2017

Course Information	**ME 261 Mechanical Engineering Problem Solving** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Gabe Garcia Office: JH104 Phone: 646-3503 email: gabegarc@nmsu.edu
ASSISTANTS:	TBA
OFFICE HOURS:	9:30 a.m.- 12:00 p.m. TR 3:00 p.m.-5:00 p.m. T or by appointment
CATALOG DESCRIPTION:	Introduction to programming syntax, logic, and structure. Numerical techniques for root finding, solution of linear and nonlinear systems of equations, integration, differentiation, and solution of ordinary differential equations will be covered. Multi function computer algorithms will be developed to solve engineering problems.
PREREQUISITES:	Math 192
TEXT:	*NONE*
CLASS SCHEDULE:	Lecture: MW 08:30 a.m. - 09:20 a.m. EC 110 Sections M1A, M1B Lab: M 2:30 p.m. - 5:20 p.m. JH 245 Section M1A Lab: R 5:35 p.m. - 8:25 p.m. JH 245 Section M1B
GRADES:	Homework: 2.5% Lab Work: 2.5% Exam1: 15% Exam2: 30% Exam3: 25% Exam4: 25%
COURSE OBJECTIVES:	• Students will learn a variety of numerical methods that are useful in both basic and advanced engineering calculations. (a) • Students will learn how to formulate algorithms and write programs to solve engineering problems. (e) • Students will develop an appreciation for the hazards and limitations of numerical solutions, including accuracy, stability, and computer limitations of memory and speed. (k)
TOPICS COVERED:	• MATLAB Program Environment • MATLAB Functions • Roots of Equations • Linear systems of equations • Non Linear systems of equations • Interpolation and Curve fitting • Numerical differentiation and integration • Solution of Ordinary differential equations

Course Information	**ME 261 Mechanical Engineering Problem Solving** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations ME3 familiarity with statistics and linear algebra
ASSIGNMENT POLICIES:	• All computer programs must be written in MATLAB as instructed and well commented. • All Homework and Labs must be submitted through CANVAS by the assignment due date and time. Note that CANVAS will not allow you to upload after the due date and time so make sure you give yourself enough time to get your assignments uploaded. • Late assignments will be assigned a zero grade. Collaboration in the form of discussion of formulation of solutions or results is encouraged; however, each individual must work independently to create the solution and computer programs.
Student Accessibility Services:	Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) covers issues relating to disability and accommodations. If a student has questions or needs an accommodation in the classroom (all medical information is treated confidentially), contact: Trudy Luken Student Accessibility Services (SAS) - Corbett Center, Rm. 244 Phone: 646.6840 E-mail: sas@nmsu.edu • Website: www.nmsu.edu/~ssd/
Institutional Equity:	NMSU policy prohibits discrimination on the basis of age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, retaliation, serious medical condition, sex, sexual orientation, spousal affiliation and protected veterans status. Furthermore, Title IX prohibits sex discrimination to include sexual misconduct, sexual violence, sexual harassment and retaliation.
POLICIES:	Plagiarism is using another person's work without acknowledgment, making it appear to be one's own. Intentional and unintentional instances of plagiarism are considered instances of academic misconduct and are subject to disciplinary action such as failure on the assignment, failure of the course or dismissal from the university. The NMSU Library has more information and help on how to avoid plagiarism at http://lib.nmsu.edu/plagiarism/
AUTHOR/DATE:	G. Garcia August 2017

Course Information	**ME 326 Mechanical Design** 3 credits Required Spring 2018
INSTRUCTOR:	Ali Seyedkavoosi Office: JH115 Phone: 646-6533 email: akavoosi@nmsu.edu
ASSISTANTS:	Norberto Di Stefano
OFFICE HOURS:	2:30 p.m.- 3:30 p.m. TR or by appointment
CATALOG DESCRIPTION:	Design methodology and practice for mechanical engineers.
PREREQUISITES:	ME 237 and CE 301
TEXT:	*Fundamentals of Machine Component Design, 7th Ed., Juvinal and Marshek, Wiley, 2006*
CLASS SCHEDULE:	Lecture: 11:30 a.m. - 12:20 p.m. - MW - JH 213 Lab: 12:30 p.m. - 1:20 p.m. - MWF - JH 213
GRADES:	Homework and Attendance: 10% In-Class Assignments and Quizzes: 10% Midterm exam: 20% Project: 20% Final Exam: 40%
COURSE OBJECTIVES:	• Conduct experiments and analyze data (b) • Major design experience (c) • Team working (d) • Professional and ethical responsibilities (f) • Knowledge of contemporary issues (j)
TOPICS COVERED:	• Loads Analysis • Design Methods • Deflection Analysis • Case studies • Professional practice • Safety
RELATIONSHIP TO PROGRAM OUTCOMES:	c ability to design a system, component or process to meet desired needs within realistic constraints d ability to function on multidisciplinary teams f understanding of professional and ethical responsibility j knowledge of contemporary issues
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations

Course Information	**ME 326 Mechanical Design** 3 credits Required Spring 2018
	ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• Students are expected to attend all lectures. Attendance will be tracked via in-class assignments. Note that attendance will be considered during final grading. • Students are expected to come in on time. If a lecture is already in progress, a student shall enter quietly and take the nearest seat without distracting others. • -%20 for submitting late homework to 2 hours and no credit will be given for submitting after 2 hours late homework. • Exams cannot be retaken. • All make-up arrangements must be discussed with the instructor before the date of the exam. Make-up exams will only be allowed in extraordinary cases. • Grades will be normalized. Then, A 100-90; B 89-80; C 79-70, D 69-60, etc.
AUTHOR/DATE:	Ali Seyedkavoosi 01/17/2018

Course Information	**ME 338 Fluid Mechanics** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. C. Hocut Office: JH 228 Phone: 646-6034 email: chocut@nmsu.edu
ASSISTANTS:	Edgar Gonzalez
OFFICE HOURS:	3:30 p.m.- 5:30 p.m. T, TH or by appointment
CATALOG DESCRIPTION:	Properties of fluids. Fluid statics and fluid dynamics. Applications of the conservation equations continuity, energy, and momentum to fluid systems.
PREREQUISITES:	M E 234 or M E 237 and M E 228 or MATH 392
PRE/COREQUISITES :	None
TEXT:	*Fundamentals of Fluid Dynamics, J. Wiley, B.R. Munson, D.F. Young and T.H. Okiishi, and W.W. Huebsch, 7th edition, 2012*
CLASS SCHEDULE:	Lecture: 8:30 a.m. - 9:20 p.m. – MWF - GT 336
GRADES:	Homework: 10% Two exams: 60% Final: 30%
COURSE OBJECTIVES:	Develop a basic proficiency in: • Ability to analyze hydrostatic loading problems (a,e). • Applications of mass, momentum and energy conservation laws to fluid mechanics problems (a,e). • Applications of dimensional analysis and dynamic similitude (b,e). • Development of understanding of empirical formulations for internal and external flows (c,e).
TOPICS COVERED:	• Fluid Statics • Bernoulli's Equation & Fluid Dynamics • Integral Approach and Control Volumes • Dimensional Analysis • Internal Flow – Pipe Flows
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering b ability to design and conduct experiments, as well as to analyze and interpret data c ability to design a system, component or process to meet desired needs within realistic constraints e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC2 1 year math and basic science PC3 1 1/2 years engineering topics (engineering science and design)

Course Information	**ME 338 Fluid Mechanics** 3 credits Required Fall 2017
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• Final grades will be determined using the following grading scale: A=>85, B=75-84, C=65-74, D=50-65, F=<50. Graded material will include homework, two exams and a comprehensive final.
AUTHOR/DATE:	C. Hocut November 2017

Course Information	**ME 341 Heat Transfer** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Krishna Kota Office: JH 128 Phone: 646-5720 E-mail: kkota@nmsu.edu
ASSISTANTS:	Lazar Cvijovic
OFFICE HOURS:	2:30 p.m.- 4:00 p.m. TR or by appointment
CATALOG DESCRIPTION:	Fundamentals of conduction, convection, and radiation. Design of heat transfer systems.
PREREQUISITES:	ME 240, ME 328
TEXT:	*Fundamentals of Heat and Mass Transfer, 7th Edition by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Wiley, ISBN-13: 978-0470501979; ISBN-10: 0470501979*
CLASS SCHEDULE:	Lecture: 1:30 p.m. - 2:20 p.m. - MWF - JH 213
GRADES:	Homework 15% Quizzes 25% Midterm Exam 25% Final Exam 35%
COURSE OBJECTIVES:	• At the end of this course, it is anticipated that the students would have gained -A thorough understanding of the three modes of heat transfer (conduction, convection, and radiation) -Basic knowledge required to apply heat transfer principles to practical and contemporary engineering problems (primarily in thermal management and energy and power generation systems) -The skills necessary to be successful in their professional duties in employment or further educational pursuits and be able to clearly communicate, formulate, analyze and creatively deduce solutions to technical problems in the area of heat transfer.
TOPICS COVERED:	Thermal Resistance Analysis, Steady-State Conduction, Transient Conduction, Internal Convection, External Convection, Free Convection, Heat Exchangers, Radiation Properties and Processes, Radiation Exchange Between Surfaces, Applications and Design
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering e ability to identify, formulate, and solve engineering problems
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)

Course Information	**ME 341 Heat Transfer** 3 credits Required Fall 2017
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME2 ability to apply advanced mathematics, multivariate calculus, and differential equations ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• <u>Homework</u>: 5-8 homeworks will be assigned in this course and selected problems from each of them will be graded. Please submit the solutions to homework problems before the end of class on the prescribed due date. Late homeworks will not be accepted. • <u>Quizzes and Exams</u>: Text book, class notes or any other material is not allowed during exams and quizzes. Usage of any kind of electronic device (including smart phones) is not permitted. All electronic devices must be muted and stored in your backpacks, which must be kept in front of the class room at least five minutes before an exam. Sharing of calculators is not allowed. Please bring your own calculator. Discussions of any kind are not allowed. You can only speak with the instructor or the TA. There will be no make-up exams or make-up quizzes. If you know beforehand that you will miss an exam or quiz, please contact me to discuss options at least two days before the scheduled exam/quiz date. Any kind of discussion concerning a make-up exam/quiz will not be entertained after the actual exam/quiz date. Quiz dates will be announced ahead; there will be no surprise quizzes. The final exam date/time (Monday, December 04, 01:00 PM – 03:00 PM) is decided by the university and it will not be changed. Rescheduling of exams can be done only with the permission of the Department Head and if there is a valid reason (legal, medical etc.). Please write your name legibly on your question papers, equation sheets and all your answer sheets during exams/quizzes and on your homeworks. Otherwise, they will not be graded. Violation of any of the above discussed exam policies will be considered as cheating for which a zero will be awarded on that exam. • <u>Additional Exam and Classroom Policies & Recommendations</u>: Pen vs. pencil policy · Exam proctoring policy · Restroom usage policy Please try to attend all the classes. .
AUTHOR/DATE:	K. Kota August 2017

Course Information	**ME 345 Experimental Methods I** 3 credits Required Fall 2017
INSTRUCTOR:	Dr. Vincent Choo Office: JH130 Phone: 646-2225 email: vchoo@nmsu.edu
ASSISTANTS:	Ryan Gabaldon, Joshua Budish
OFFICE HOURS:	via email or by appointment
CATALOG DESCRIPTION:	Emphasis on experimental techniques, basic instrumentation, data acquisition and analysis, and written presentation of results. Includes experiments in dynamics and deformable body mechanics.
PREREQUISITES:	Math 392, ME 237, and ME 240
PRE/COREQUISITES :	CE 301
TEXT:	*Lecture Notes*
CLASS SCHEDULE:	Lecture: 9:30 A.M. - 10:20 A.M. - MW – TB 104 Lab: See Course Schedule - JH 233
GRADES:	Summative Tests (2@35% ea.) 70% Homework/Class Quizzes/Formative Tests: 5% Lab Quizzes: 10% Lab Reports: 10% Oral Presentation: 5%
COURSE OBJECTIVES:	On the completion of this course, students will be able to: • design and conduct experiments using basic instrumentation (b, k) • carryout experimental data acquisition (k) • conduct statistical experimental data analysis and interpret data (b) • effectively communicate orally and in written format (g) • work on a team (g) • write technical reports (g)
TOPICS COVERED:	• LabView programming for experimental data acquisition • Statistical analysis of experimental data • Uncertainty analysis • Design, fabrication and calibration of force transducers • Vibration • Wheatstone bridge • Normal strain measurement • Shear strain measurement • Normal Strain correction • Shear Strain correction • Ultrasonic NDE of isotropic and homogeneous materials

Course Information	**ME 345 Experimental Methods I** 3 credits Required Fall 2017
RELATIONSHIP TO PROGRAM OUTCOMES:	b ability to design and conduct experiments, as well as to analyze and interpret data g ability to communicate effectively k ability to use the techniques, skills and modern tools necessary for engineering practice
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME3 familiarity with statistics and linear algebra
POLICIES:	• Attend all lectures and laboratory classes. No late homework assignments will be accepted.
AUTHOR/DATE:	V. Choo August 2017

Course Information	**ME 425 Design of Machine Elements** 3 credits Required Spring 2018
INSTRUCTOR:	Ahmed Kanaan Office: JH115 Phone: email: alhrdop@nmsu.edu
ASSISTANTS:	NA
OFFICE HOURS:	1:15 p.m.- 2:15 p.m. Tu&Th or by appointment
CATALOG DESCRIPTION:	Design of machine elements through the application of mechanics. Fatigue and theories of failure. Design projects assigned.
PREREQUISITES:	ME 326
TEXT:	*Fundamentals of Machine Component Design, 4th Ed., R.C. Juvinall and K.M. Marshek, Wiley, 2009*
CLASS SCHEDULE:	Lecture: 11:45 a.m. - 1:00 p.m. - TR - JH 205
GRADES:	Homework: 30% Quizzes: 20% Project: 25% Final Exam: 25%
COURSE OBJECTIVES:	• Perform load analyses on machine element parts and assemblies. • Perform stress and strain analyses on machine elements and determine element deflections. • Utilize standard failure theories and fatigue analysis to develop safety factors and reliability for machine elements. • Select materials for machine elements and machine element assemblies. • Design machine elements and machine element assemblies. • Work effectively as part of a design team.
TOPICS COVERED:	• Load analysis, especially free body diagrams • Materials • Stress, including Mohr's Circle • Deflections • Failure theories and fatigue analysis • Bearings, gears, and shafts • Project
RELATIONSHIP TO PROGRAM OUTCOMES:	a ability to apply knowledge of mathematics, science, and engineering c ability to design a system, component or process to meet desired needs within realistic constraints e ability to identify, formulate, and solve engineering problems k ability to use the techniques, skills and modern tools necessary for engineering practice

Course Information	**ME 425 Design of Machine Elements** 3 credits Required Spring 2018
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• All homework is due the period following its assignment. • Homework must be submitted on time unless prior arrangements have been made with the instructor.
AUTHOR/DATE:	Name Ahmed Kanaan Date5/4/18

Course Information	**ME 426/427 Design Project Laboratory I & II** 6 credits Required FA 2017
INSTRUCTOR:	Dr. Young H. Park Office: JH 111 Phone: 646-3092 email: ypark@nmsu.edu
ASSISTANTS:	Edward Rojas
OFFICE HOURS:	8:00 a.m.- 9:00 a.m. MTWRF or by appointment
CATALOG DESCRIPTION:	Students address a design problem in which innovation and attention to detail are emphasized. Solution of the problem entails applications of mechanics and/or the thermal sciences. --- ME 426 Continuation of M E 426 --- ME 427
PREREQUISITES:	ME 326 and (ME 338 or AE 339) --- ME 426 ME 426 --- ME 427
PRE/COREQUISITES :	ME 425 and ME 341 --- ME 426
TEXT:	*None*
CLASS SCHEDULE:	Lecture: 3:30 p.m. - 6:20 p.m. - M – EC2 103 3:30 p.m. - 6:20 p.m. - W – EC2 103
GRADES:	Class Participation: 20% Individual & team performance: 30% Group Deliverable: 50%
COURSE OBJECTIVES:	• Have experience functioning as mechanical engineer within an engineering design and development group. (d) • Complete a real-life design task – transform a client's needs into a tangible, tractable project definition, and see the project through to completion. (c) • Understand and use a formal engineering design method, with emphasis on building concurrent engineering procedures into the basic design method. (c) • Become proficient in collaboratively preparing and reviewing formal technical design package related to an engineering design including final design binder and report (g) • Become proficient in written communication and be able to write an effective report (WQI)
TOPICS COVERED:	• Participation in a project team • Use of technical tools from past engineering courses • Strengthening of teaming skills • Learning how to apply engineering fundamentals to the design
RELATIONSHIP TO PROGRAM	B ability to formulate, analyze, and creatively participate in the solution of multidisciplinary problems through use of modern engineering

Course Information	**ME 426/427 Design Project Laboratory I & II** 6 credits Required FA 2017
EDUCATIONAL OBJECTIVES:	C ability to communicate clearly and effectively with fellow engineers, employers and general public D skills needed to fulfill professional duties and responsibilities in teamwork, collegiality, ethics, technical leadership, etc.
RELATIONSHIP TO PROGRAM OUTCOMES:	c ability to design a system, component or process to meet desired needs within realistic constraints d ability to function on multidisciplinary teams g ability to communicate effectively
CONTRIBUTION TO PROFESSIONAL COMPONENT:	PC1 major design experience PC3 1 1/2 years engineering topics (engineering science and design)
RELATIONSHIP TO ABET SPECIFIC CRITERIA:	ME4 ability to work professionally in both thermal and mechanical systems areas
POLICIES:	• None
AUTHOR/DATE:	Y. Park August 2017

Engineering Physics Program

(Bachelor of Science in Engineering Physics)

at

New Mexico State University

Syllabi of Other Required Courses (English, Communications, Mathematics, Chemistry, General Engineering, Civil Engineering)

(in alphabetical order of course acronym)

CE 301. Mechanics of Materials (3)

1. Course number and name: CHEM 111G. General Chemistry I

2. Credits and contact hours: 3 credit hours (class meets 150 minutes per week for lecture)

3. Instructor's or course coordinator's name: Craig Newtson

4. Text book, title, author, and year

"Mechanics of Materials" R.C. Hibbeler, 10th Edition, 2016

a. ***other supplemental materials:*** none

5. Specific course information

a. catalog description: Stress, strain, and elasticity of materials.

b. prerequisites: C E 233 – Mechanics – Statics or M E 236 – Engineering Mechanics I (prerequisite)

c. required, elective, or selected elective: This course is required for Engineering Physics majors with the Aerospace and Mechanical Concentrations.

6. Specific goals for the course

a. At the end of the course the student will be able to: (1) Calculate deformations, stresses, and strains of various types of members under loading; (2) Calculate principal stresses and strains; (3) Perform two-dimensional stress and strain transformation; (4) Analyze statically indeterminate structures using the method of consistent deformations; (5) Construct shear and moment diagrams for beam type structures; (6) Calculate beam deflections and rotations using various methods.

b. *This course provides measures for Student Outcomes (a), (c) and (e)*

7. Brief list of topics to be covered

- Stress; Strain; Stress-Strain Relationships
- Normal Stress; Shear Stress; Bearing Stress
- Factor of Safety and Simple Design
- Stresses on Oblique Planes
- Hooke's Law
- Axial Deformation
- Statically Indeterminate Problems
- Torsion of Circular Shafts; Power
- Bending
- Composite Materials
- Eccentric Loads
- Beam Shear and Moment Equations; Shear and Moment Diagrams; Beam Design
- Shear Stress; Shear Flow
- Mohr's Circle
- Combined Loads
- Pressure Vessels
- Beam Deflections
- Indeterminate Beam Analysis
- Columns

CHEM 111G. General Chemistry I (4)

1. Course number and name: CHEM 111G. General Chemistry I

2. Credits and contact hours: 4 credit hours (3 credit hours for lecture, 1 credit hour for lab)

3. Instructor's or course coordinator's name: Antonio Lara

4. Text book, title, author, and year

- Chemistry—an Atom-Focused Approach, by Gilbert, Kirss, and Foster

a. other supplemental materials: Lab Manuals

5. Specific course information

a. catalog description: Descriptive and theoretical chemistry

b. prerequisites: C- or better in MATH 120G

c. required, elective, or selected elective: This course is required for Engineering Physics majors with the Aerospace, Electrical and Mechanical Concentrations.

6. Specific goals for the course

a. The student will: • demonstrate knowledge of basic chemical principles, including the following areas: structure of the atoms and nature of electrons, periodicity of atomic properties, ionic vs. covalent bonds and the compounds containing them, molecular structure, geometry, properties, stoichiometry, reaction energetics, solutions, types of reactions; • see applicability of chemistry to common occurrences in daily life; • analyze a problem and determine the appropriate mathematical manipulation to solve it; • blend macroscopic phenomena with microscopic understanding; • experience scientific inquiry through chemistry; • construct hypotheses and design the verification in their laboratory experiments; and • hone scientific communication skills with lab reports that reflect their quantitative analyses.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- A molecular view
- Chemical Bonding
- Bonding Theories
- Intermolecular Forces
- Stoichiometry
- Aqueous Solutions

CHEM 115G. Principles of Chemistry I (4)

1. Course number and name: CHEM 115G. Principles of Chemistry I

2. Credits and contact hours: 4 credit hours (3 credit hours for lecture, 1 credit hour for lab)

3. Instructor's or course coordinator's name: Feifei Li

4. Text book, title, author, and year

- Chemistry: The Central Science, 13/E by Brown, Nelson & Kemp

a. ***other supplemental materials:*** none

5. Specific course information

a. catalog description: Detailed introduction to analytical, inorganic and physical aspects of chemistry; both descriptive and theoretical explanations. Structured for chemistry and biochemistry majors but appropriate for other physical and life science students.

b. prerequisites: Eligible to take MATH 190G and ACT composite score of ^{3}22; co-requisites: none

c. required, elective, or selected elective: This course is required for Engineering Physics majors with the Chemical Concentration.

6. Specific goals for the course

a. The student will: • understand relationship that exists between physical and chemical properties in matter; • develop skills to solve chemical problems in qualitative and quantitative manners; • be provided a molecular world view, an outlook unique to chemistry and essential to an educated person; and • be prepared for subsequent high level chemistry courses.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Matter and Measurement
- Moles
- Atomic Weights & the Periodic Table
- Compounds • Chemical Reactions
- Calculations based on a balanced chemical equation
- Limiting Reactants • Oxidation-reduction
- Electrolyte
- Acids and Bases
- Precipitation
- Calculation of molarity
- Basic thermochemistry
- Enthalpy of reaction and Hess's law
- Calorimetry; Enthalpy of formation
- Atomic orbitals
- Electron Configuration
- Bohr Model
- Periodic Trends
- Metals and non Metals
- Basic concepts of Chemical bonding
- Drawing Lewis structures
- Extend Octet. Bond Enthalpy
- Polarity
- Valence Bond Theory
- MO Theory

CHEM 116G. Principles of Chemistry II (4)

1. Course number and name: CHEM 116G. Principles of Chemistry II

2. Credits and contact hours: 4 credit hours (3 credit hours for lecture, 1 credit hour for lab)

3. Instructor's or course coordinator's name: William Quintana

4. Text book, title, author, and year

- CHEMISTRY: The Central Science, 13th Edition, by Brown, Lemay, Bursten, Murphy and Woodward, Pearson/Prentice Hall
- Laboratory Experiments for CHEMISTRY: The Central Science, by Nelson and Kemp,

a. ***other supplemental materials:*** none

5. Specific course information

a. ***catalog description:*** Recommended for chemistry majors and other qualified students.

b. ***prerequisites:*** CHEM 115; co-requisites: none

c. ***required, elective, or selected elective:*** This course is required for Engineering Physics majors with the Chemical Concentration.

6. Specific goals for the course

a. The student will: • understand basic chemical principles in important aspects of chemistry, such as matter, atoms, molecules and ions, stoichiometry, thermochemistry, chemical equilibrium (gas phase, acid–base, solubility), intermolecular forces, and electrochemistry; • understand the qualitative and quantitative aspects important to chemistry. • establish a firm foundation in chemical concepts that will be explored further in higher-level courses that are part of an undergraduate education; and • develop a molecular view of chemistry, unique to this particular branch of science

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Molecular Geometry and Bonding Theories
- Gases
- Liquids and Intermolecular Forces.
- Properties of Solutions
- Chemical Kinetics
- Chemical Equilibrium
- Acid – Base Equilibria
- Aqueous Equilibria
- Chemical Thermodynamics
- Electrochemistry
- Nuclear Chemistry

CHEM 313. Organic Chemistry (3)

1. Course number and name: CHEM 313. Organic Chemistry I

2. Credits and contact hours: 3 credit hours = 45 contact hours per semester

3. Instructor's or course coordinator's name: James Herndon

4. Text book, title, author, and year

- Organic Chemistry, 8th ed., by Carey and Giuliano (ISBN #978-0-07-340261-1)

a. other supplemental materials: none

5. Specific course information

a. catalog description: Nomenclature, uses, basic reactions, and preparation methods of the most important classes of aliphatic and aromatic compounds.

b. prerequisites: CHEM 112G or 116; co-requisites: none

c. required, elective, or selected elective: This course is required for Engineering Physics majors with the Chemical Concentration.

6. Specific goals for the course

a. The student will acquire a fundamental understanding of the reactivity and physical properties of organic molecules after completing CHEM 313/314. A graduate of this course should be capable of looking at a chemical structure and be able to predict reactivity, acid-base behavior, stability, solubility, possible precursor compounds, and spectral properties from the molecular structure alone.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Structure and Properties
- Alkanes and Cycloalkanes
- Cis-trans stereoisomers
- Chirality
- Alcohols and Alkyl Halides
- Nucleophilic Substitution
- Alkenes – Elimination reactions
- Alkynes
- Free Radicals
- Conjugation in Alkadiene & Allylic systems
- Arenes and Aromaticity

COMM 265G. Oral Communications Elective (3)

1. Course number and name: Communication 265G: Principles of Human Communication

2. Credits and contact hours: 3 credit hours = 45 contact hours per semester

3. Instructor's or course coordinator's name: Team Taught by Greg Armfield and Danielle Halliwell

4. Text book, title, author, and year

- Armfield. G. G. & Morgan, E.L. (Eds.). (2016). Human Communication in Action. (6th Ed.) Dubuque, IA: Kendall/Hunt. ISBN: 978-1-4652-9729-7.

a. ***other supplemental materials:*** none

5. Specific course information

a. catalog description: COMM 265G is an introduction to the study of human communication. You will learn how communication functions in a variety of situations and settings. COMM 265G combines both the theory and practice of communication. This means we will study many of the communicative actions that you already do, while understanding the communication truths (habits, patterns) that you can reform and improve the way you interact with others. The topics we will cover are public speaking, nonverbal communication, interpersonal communication, intercultural communication, organizational communication, communication and technology, small group communication, and leadership and communication.

b. prerequisites: none; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. COMM 265G is a general education course and complies with the general education philosophy and objectives of New Mexico State University and with the State Common Core Competencies. Thus, upon completion of the course, each student should be able to do the following: • Develop strategies for reducing communication anxiety and for building confidence while communicating with others. • Express a primary purpose in a compelling statement and order supporting points logically and convincingly. • Analyze and evaluate oral and written communication in terms of situation, audience, purpose, and culturally diverse points of view. • Use effective rhetorical strategies to persuade, inform, and entertain. • Integrate research correctly and ethically from credible sources to support the primary purpose of communication. • Engage in reasoned civic discourse while recognizing the distinctions among opinions, facts, and inferences.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

• An Introduction and Principles
• Apprehension, Speech Making
• Public Speaking
• Organization, Outlining, Audience Analysis, and Supporting Material

• Informative Speeches
• Interpersonal Communication
• IPC and Relationships
• Conflict
• Relationships and Conflict
• Introduction to Culture Communication: Narratives and Rituals
• Cultural Adaptation
• Organizational Comm. •
Impromptu Speech
• Persuasive Speech
• Credibility
• Emotion
• Persuasion
• Nonverbal
• Leadership
• Comm. Technology
• Common Myths

ENGL 111G. Rhetoric and Composition (4)

1. Course number and name: ENGL 111G. Rhetoric and Composition

2. Credits and contact hours: 4 credit hours = 60 contact hours per semester

3. Instructor's or course coordinator's name: various instructors from the Department of English

4. Text book, title, author, and year

- Habits of the Creative Mind, Paideia 16, and Readings for Writers come as a bundled set. • Graff, Gerald and Cathy Birkenstein, They Say, I Say: The Moves That Matter in Academic Writing, 3rd ed, WWW Norton, 2014.
- Miller, Richard E. and Ann Jurecic, Habits of the Creative Mind, Bedford/St. Martin's, 2016. • Al-Khateeb, Mais T., Felicita Arzu Carmichael, Kefaya Diab, Dylan Retzinger, Kellie Sharp-Hoskins, and Kelly A. Whitney, Paideia 16: Research, Writing, and Argument in English 111 at New Mexico State University. Hayden-McNeil, 2016.
- New Mexico State University, Readings for Writers, Bedford/St. Martin's, 2015.

a. other supplemental materials Jump drive or other electronic storage device for backing up and storing assignments.

5. Specific course information

a. catalog description: Skills and methods used in writing university-level essays.

b. prerequisites ACT standard score in English of 16 or higher or a Compass score 76 or higher; for those scoring 13-15 in English on the ACT or 35-75 on the Compass, successful completion of a developmental writing course; for those scoring 12 or below on the ACT standard score in English or 34 or below on the Compass, successful completion of two developmental writing courses. co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The student will: • Practice writing processes, from invention, drafting, and revising to editing and polishing. • Read actively and think critically. • Use writing to persuade, inform, and engage an audience. • Explore new methods of academic inquiry, rhetorical analysis, and documentation. • Develop academic research abilities. • Analyze and evaluate oral and written communication in terms of situation, audience, purpose, aesthetics, and adverse points of view. • Express a primary purpose in a compelling statement and order supporting points logically and convincingly. • Use effective rhetorical strategies to persuade, inform, and engage. • Employ writing and/or speaking processes such as planning, collaborating, organizing, composing, revising, and editing to create presentations using correct diction, syntax, grammar, mechanics. • Integrate research correctly and ethically from credible sources to support the primary purpose of communication. • Engage in reasoned civic discourse while recognizing the distinctions among opinions, facts, and inferences.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- UNIT 1 – Inquiry into self and your linguistic experiences o Language and literacy – relationship to home and language o Looking back on your linguistic identities o How do linguistic and cultural experiences affect your ideas about what it means to write in college?
- UNIT 2 – Inquiry into mindful critical reading o What does it mean to read mindfully and critically? o Grappling with difficult and critical texts when you write o Embedding other authors' words and ideas within your texts
- UNIT 3 – Inquiry into community research o What is research? o Exploring primary sources and local resources o Researching an issue in your hometown, on campus, or in another close community o Working with the NMSU library's Research Diaries o Citing and acknowledging outside texts
- UNIT 4 – Inquiry into broader conversations: public, political, and social concerns o What is research (again, we ask)? o Finding a topic of inquiry: What is your relationship as a researcher to the subject? o Exploring secondary sources in print and digital spaces o Inquiring and interpreting o Writing it up and reaching a conclusion o Creating a bibliography
- UNIT 5 – Reflection on inquiry: writing in college and beyond

ENGL 218G. Technical and Scientific Communication (3)

1. Course number and name: ENGL 218G. Technical and Scientific Communication

2. Credits and contact hours: 3 credit hours = 45 contact hours per semester

3. Instructor's or course coordinator's name: various instructors from the Department of English

4. Text book, title, author, and year

- Johnson-Sheehan, Richard. (2011). Technical Communication Strategies for Today. New York: Longman.
- Howard, Rebecca Moore. (2014). Writing Matters. (Special ed.). Boston: McGraw Hill.

a. other supplemental materials none

5. Specific course information

a. catalog description: Effective writing for courses and careers in sciences, engineering, and agriculture. Strategies for understanding and presenting technical information for various purposes to various audiences.

b. prerequisites: ENGL 111G or SPCD 111G or ENGL 111M; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The student will… • Describe the difference between technical communication and other forms of writing • Identify and describe documents used in technical communication, including memos, letters, emails, reports, proposals, and instruction manuals • Demonstrate the ability to analyze a rhetorical situation and develop appropriate documents in response • Identify and analyze target audiences • Understand and use basic principles of document design • Demonstrate familiarity with the computer-assisted writing process • Demonstrate the ability to manage information effectively and use it appropriately • Correctly use technical and scientific documentation styles • Present information in a coherent, logical manner, both in spoken and written form Course goals: • To understand the genre and manipulate the structure of selected technical documents; • To convey clearly, cogently and correctly through written media, the technical aspects of a practice to non-specialist audience; • To recognize and use the rhetorical and stylistic elements necessary for the successful practice of scientific and technical communication; • To work collaboratively and individually to research, to analyze, and to write about, public debates regarding the conduct of science and technology; • To appreciate your obligations as prospective practitioners in your chosen field to laypersons affected by your work.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

Through reading and writing, and online discussions/workshop exercises, the student will become familiar with effective writing for courses and careers in the sciences, engineering, and agriculture and develop strategies for understanding and presenting technical information for various purposes to various audiences.

ENGR 100. Introduction to Engineering (3)

1. Course number and name: ENGR 100. Introduction to Engineering

2. Credits and contact hours: 3 credit hours (2+3P) = 75 contact hours per semester

3. Instructor's or course coordinator's name: John Tapia

4. Text book, title, author, and year

- Engineering Fundamentals: An Introduction to Engineering, 5th ed., S. Moaveni, Cengage (2016).

a. other supplemental materials - none

5. Specific course information

a. catalog description: An introduction to the various engineering disciplines, the engineering approach to problem solving, and the design process. Projects emphasize the importance of teamwork, written & oral communication skills, as well as ethical responsibilities.

b. prerequisites: Placement in MATH 121 or better; co-requisites: ENGL 111

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The student will… • have a social and professional network of peers; • have a solid curriculum plan for each semester including summers; • have a desire to pursue extra-curricular activities related to engineering; • engage in critical thinking and the design process while learning important team building skills and ethical approaches to problem solving; • gain appreciation for, and skills for effective communication, teamwork, and ethics; • become familiarized with the engineering profession; • gain a knowledge of and skills in Microsoft Excel; • gain a knowledge of and skills in MATLAB; • use other tools such as drawing software, mathematics, economics, etc.; and • gain knowledge of dimensions, length, time, mass, force, temperature, electric current, energy and power, and related parameters in engineering.

b. ENGR 100 addresses Student Outcomes (a), (d), (e), (f), (g), (h), (i), (j), and (k).

7. Brief list of topics to be covered

- see 6. Goals above

MATH 191G. Calculus and Analytic Geometry I (4)

1. Course number and name: MATH 191G. Calculus and Analytic Geometry I

2. Credits and contact hours: 4 credit hours = 60 contact hours per semester

3. Instructor's or course coordinator's name: Mary Ballyk

4. Text book, title, author, and year

- Calculus, Early Transcendentals, Third Edition by Jon Rogawski and Colin Adams. Publisher: W. H. Freeman; 3 edition (January 15, 2015)

a. ***other supplemental materials*** none

5. Specific course information

a. catalog description: Limits and continuity, theory and computation of derivatives, applications of derivatives, extreme values, critical points, derivative tests, L'Hopital's Rule.

b. prerequisites: MATH 190 with C- or better; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The goals are to present the concepts of calculus, to stress techniques, applications, and problem solving, and to emphasize numerical aspects such as approximations and order of magnitude. Overall, the goals are to illustrate the power of calculus as a tool for modeling situations arising in physics, science, engineering and other fields

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Rates of change • tangent lines
- limits
- Limit laws
- Continuity
- methods to evaluate limits
- Trig limits
- limits at infinity
- Intermediate Value Theorem
- Definition of the derivative
- derivatives as functions
- product and quotient rules
- Rates of change, higher derivatives
- The chain rule
- implicit differentiation
- derivatives of exponential and log
- functions, related rates
- L'Hopital's rule
- Linear approximations
- extreme values.
- The mean value theorem
- shapes of graphs
- Graph sketching
- Max/min problems

MATH 192G. Calculus II (4)

1. Course number and name: MATH 192G. Calculus II

2. Credits and contact hours: 4 credit hours = 60 contact hours per semester

3. Instructor's or course coordinator's name: Amal Mostafa

4. Text book, title, author, and year

- Calculus, Early Transcendentals, Third Edition by Jon Rogawski and Colin Adams. Publisher: W. H. Freeman; 3 edition (January 15, 2015)

a. ***other supplemental materials*** none

5. Specific course information

a. catalog description: Riemann sums, the definite integral, antiderivatives, fundamental theorems, techniques of integration, applications of integrals, improper integrals, Taylor polynomials, sequences and series, power series and Taylor series.

b. prerequisites: C or better in MATH 191; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.6.

Specific goals for the course

a. The goals are to present the concepts of calculus, to stress techniques, applications, and problem solving. Overall, the goals are to illustrate the power of calculus as a tool for modeling situations arising in physics, science, engineering and other fields.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Definite and indefinite integrals
- Fundamental theorem of calculus
- Total & net change, substitution, transcendental functions
- Applications of integrals
- Volumes, volumes of revolution, shells
- Work and energy
- integration by parts
- trigonometric integrals
- trigonometric substitutions
- Improper integrals
- numerical integration
- Taylor polynomials
- Sequences
- infinite series
- Convergence tests
- power series
- Taylor series

MATH 291. Calculus and Analytic Geometry III (3)

1. Course number and name: MATH 291. Calculus and Analytic Geometry III

2. Credits and contact hours: 3 credit hours = 45 contact hours per semester

3. Instructor's or course coordinator's name: Chris Stuart

4. Text book, title, author, and year

- Calculus, Early Transcendentals, Third Edition by Jon Rogawski and Colin Adams. Publisher: W. H. Freeman; 3 edition (January 15, 2015)

a. ***other supplemental materials*** none

5. Specific course information

a. catalog description: Vector algebra, directional derivatives, approximation, max-min problems, multiple integrals, applications, cylindrical and spherical coordinates, change of variables.

b. prerequisites: C or better in MATH 192G; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The goals are to present the concepts of calculus, to stress techniques, applications, and problem solving, and to emphasize numerical aspects such as approximations and order of magnitude. Overall, the goals are to illustrate the power of calculus as a tool for modeling situations arising in physics, science, engineering and other fields.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- Vectors in the Plane
- Vectors in Three Dimensions
- Dot Product and the Angle Between Two Vectors
- The Cross Product
- Planes in Three-Space
- A Survey of Quadric Surfaces
- Cylindrical and Spherical Coordinates
- Vector-Valued Functions
- Calculus of Vector-Valued Functions
- Arc Length and Curvature
- Motion in Three-Space
- Planetary Motion According to Kepler and Newton
- Functions of Two or More Variables
- Limits and Continuity in Several Variables
- Partial Derivatives
- Differentiability and Tangent Planes
- The Gradient and Directional Derivatives
- The Chain Rule
- Optimization in Several Variables
- Integration in Two Variables
- Double Integrals over More General Regions
- Triple Integrals
- Integration in Polar, Cylindrical, and Spherical Coordinates
- Applications of Multiple Integral

MATH 392. Differential Equations (3)

1. Course number and name: MATH 392. Differential Equations

2. Credits and contact hours: 3 credit hours = 45 contact hours per semester

3. Instructor's or course coordinator's name: Dante DeBlassie

4. Text book, title, author, and year

- Differential Equations (Classic Version), Second Edition by J. Polking, A. Boggess and D. Arnold, Pearson, 2018. ISBN 9780134689586.

a. other supplemental materials: none

5. Specific course information

a. catalog description: Introduction to differential equations and dynamical systems with emphasis on modeling and applications. Basic analytic, qualitative and numerical methods. Equilibria and bifurcations. Linear systems with matrix methods, real and complex solutions.

b. prerequisites: C− or better in MATH 192G or B or better in MATH 236; co-requisites: none

c. required, elective, or selected elective: This course is required for all Engineering Physics majors.

6. Specific goals for the course

a. The student will be capable of applying the mathematical concepts described.

b. *This course does not provide a measure for Student Outcomes (a)-(k)*

7. Brief list of topics to be covered

- First-order differential equations, modeling and applications
- Second-order differential equations
- The Laplace Transform
- Numerical Methods
- Matrix Algebra
- Linear Systems with constant coefficients
- Nonlinear Systems
- Series solutions
- Fourier Series
- Partial Differential Equations