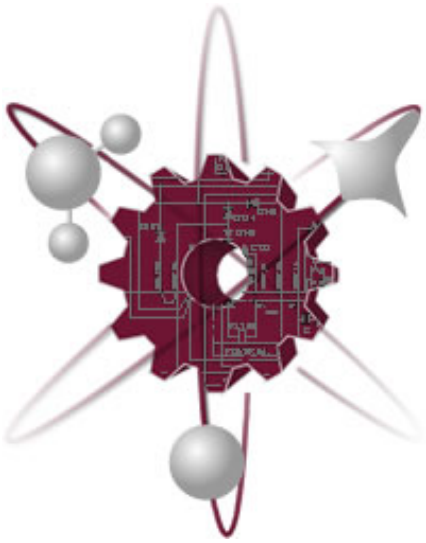
Appendix A: Syllabi

Engineering Physics

Bachelor of Science in Engineering Physics

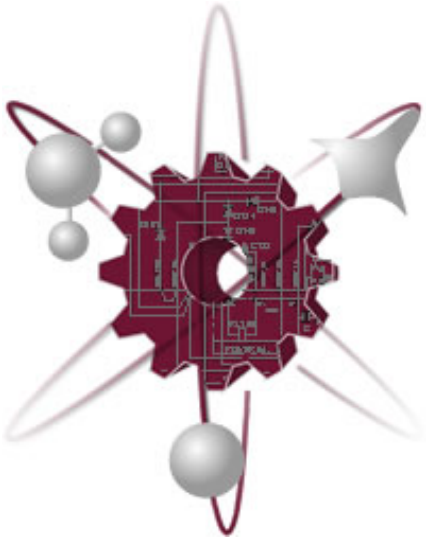


Self-Study Report

New Mexico State University

Other Courses

(Civil Engineering, Chemistry, Mathematics)



1. CE 301 Mechanics of Materials

2. Credits & Contact Hours: 3 credit hours, 9:30 – 10:20 am M/W/F

3. Instructor's name: Brad D. Weldon

4. Textbook

Mechanics of Materials, 3rd Edition, Roy R. Craig, Jr., 2011.

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5. Course Information

a. Course Description: Mechanics of Materials. Basic concepts of solid mechanics and how they apply to engineering design and analysis and provide understanding of the behavior of various types of engineering materials under different types of loadings.

b. Prerequisites: CE 233

c. Designation: Required for Undergraduate Civil Engineering Program

6. Course Goals

a. Outcomes of instruction:

At the end of the course the student will be able to:

Calculate deformations, stresses, and strains of various types of members under loading

Calculate principal stresses and strains

Perform two-dimensional stress and strain transformation

Analyze statically indeterminate structures using the method of consistent deformations

Construct shear and moment diagrams for beam type structures

Calculate beam deflections and rotations using various methods

b. Student Outcomes:

Criterion 3 Outcomes:

- apply knowledge of mathematics, science, and engineering in solving structural engineering problems [a]
- design components in structural engineering systems to meet desired needs [c]

- apply critical thinking skills to identify, formulate, and solve structural engineering problems common in civil engineering [e]

7. Topics 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

Prepared by: Brad D. Weldon Date: 08/15/2011

Course and Course Number: Chemistry 111G – General Chemistry I; 4 credits (3+3P)

Course Instructors: William Quintana, Antonio Lara

Catalog Description: Descriptive and theoretical chemistry

Prerequisite: (1) Grade of C or better in MATH 120 or a MPE Score adequate to enroll in a mathematics course beyond MATH 120, and (2) one of the following: B or better in second semester high school chemistry course, or grade of at least C in CHEM 100, or an enhanced ACT score of at least 22.

Required Texts:

- *Principles of Chemistry, a Molecular Approach*, by Nivaldo J. Tro; Publisher: Pearson 2010.
- *CHEM 111-112 lab textbook*, 5th edition, published by Cengage Learning
- *Laboratory Notebook* (Hayden), McNeil Pub

Objectives: At the end of this course, it is expected that the student will be able to:

1. Demonstrate knowledge of basic chemical principles, including the following areas: structure of the atom and nature of electrons, nuclear chemistry, periodicity of atomic properties, ionic vs. covalent bonds and the compounds containing them, molecular structure, geometry, stoichiometry, solutions, types of reactions.
2. See the applicability of chemistry to common occurrences in daily life.
3. Analyze a problem and determine the appropriate mathematical manipulation required to solve it.
4. Tie together macroscopic phenomena with microscopic understanding.

Lab Sections: Lab is a co-requisite for all students except those repeating the course.

Means of assessment:

Half exam (6.8%), three hour exams and final exam (13.3% each): 60%; Attendance: 5%;; Quizzes, assignments, participation: 15%; Lab experiments: 20%

Content:

The course will cover the material of the first half of the textbook. Labs are as follows:

Experiment 1: Sig. Figs and Density
Experiment 2: Laboratory Techniques
Experiment 9: Light Emission: Characterization of Ions by Flame Tests
Experiment 3: The Periodic Table
Experiment.15: Physical Changes
Experiment.17: Qualitative Analysis of Cations
Experiment.14: Solid Substances: Classification Using Physical Properties
Experiment.8: Shapes of Molecules
Experiment.12: Energy Changes & Chemical Reactions
Experiment.7: Solubility Rules
Experiment.16: Chemical Changes
Experiment.6: Hardware Models: Stoichiometry, Limiting Reactant and Yield

Course and Course Number: Chemistry 112G – General Chemistry II; 4 credits (3+3P)

Course Instructor: Deanna (Dede) Dunlay

Catalog Description: Descriptive and theoretical chemistry

Prerequisite: grade D or better in CHEM 111G and be approved to take MATH 121 or 152

Required Texts:

- *Principles of Chemistry, a Molecular Approach*, by Nivaldo J. Tro; Publisher: Pearson 2010.
- *CHEM 111-112 lab textbook*, 6th edition, published by Cengage Learning
- *Laboratory Notebook* (Hayden), McNeil Pub

Objectives:

The Higher Education Department has identified several common core competencies which the student will achieve through this sequence of science courses (CHEM 111 and 112). The student will:

- describe the process of scientific inquiry
- solve problems scientifically
- communicate scientific information
- apply quantitative analysis to scientific problems
- apply scientific thinking to real world problems

In CHEM 112G, these objectives will be realized by stressing the applications of chemistry to the real world in the areas of solutions, thermodynamics, chemical equilibrium (including acids/bases and solubility) and electrochemistry. This will be achieved through traditional assessments such as homework, quizzes and exams, but will also include opportunities of verbal expression of ideas through written laboratory assignments. macroscopic phenomena with microscopic understanding.

Lab Sections: Lab is a co-requisite for <u>all</u> students except those repeating the course.

Means of assessment:

Half exam (6.8%), three hour exams and final exam (13.3% each): 60%; Attendance: 5%;; Quizzes, assignments, participation: 15%; Lab experiments: 20%

Content:

The course will cover the material of the 2nd portion of the textbook. Labs are as follows:
Experiment 5: Prepartion of Alum
Experiment 4: Conseration of Mass and Percentage Yield
Experiment 18: Volumetric Analysis: Perecentage of Acetic Acid in Vinegar
Experiment 23: Determination of Molar Mass of an Unknown Solute
Experiment 20: Intro to Equilibrium
Experiments 21&22: Spectrochemical Analysis and Equilibrium Constant Determination
Experiment 19: Meaning of pH in a solution
Experiment 24: Buffer Solutions: Preparation and Properties
Experiment 25: Determination of Solubility Product Constant
ELEC 1001R: Redox Chemistry: Activity of Metal <u>or</u> ANAL 1001R: Redox Titration of Iron

Course and Course Number: Chemistry 115 – Principle of Chemistry I; 4 credits (3+3P)

Course Instructors: William Quintana

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

Prerequisite: MATH 190 or above, B or better in 2nd semester high-school chemistry and an ACT composite score of 22 or higher

Required Texts:

- *CHEMISTRY: The Central* Science, 12th Edition, by Brown, Lemay, Bursten, Murphy and Woodward, Pearson/Prentice Hall.
- *Laboratory Experiments for CHEMISTRY: The Central Science*, by Nelson and Kemp, Pearson/Prentice Hall.

Objectives: CHEM 115 is taught with the following objectives in mind:

1. Present basic chemical principles in important aspects of chemistry, such as matter, atoms, molecules and ions, stoichiometry (calculations and chemical formulas, aqueous reactions and solutions), thermochemistry, electronic structure of atoms, periodicity, chemical bonding and molecular geometry and gas behavior. These topics should prepare you for CHEM 116.
2. Understand the qualitative and quantitative aspects important to chemistry.
3. Help you establish a firm foundation in chemical concepts that will be explored further in higher-level courses that are part of your undergraduate education.
4. Provide a molecular view of chemistry, unique to this particular branch of science.

Lab Sections: Lab is a co-requisite for all students except those repeating the course.

Means of assessment:

Three exams (15% each): 45%; Cllickers and Attendance: 10%; Quizzes: 10%; Lab experiments: 20%, Final Exam: 15%.

Content:

The course will cover the material of the first half of the textbook. Labs are as follows:
Experiment 1: Basic Laboratory Techniques
Experiment 2: Identification of Substances by Physical Porpeties
Experiment 3: Separation of the Component of a Mixture
Experiment 4: Chemical Reactiuons
Experiment.5: Chemical Formulas
Experiment.6: Chemical Reactions of Copper and Percent Yield
Experiment.7: Chemicals in Everyday Life: What are they and how we know?
Experiment.9: Gravimetric Determination of Phosphorus in Plant Food
Experiment.10: Paper Chromatography: Separtions of Cations and Dyes
Experiment.8: Gravimetric Analysis of a Chloride Salt
Experiment.12: Atomic Spectra and Atomic Structure
Experiment.11: Molecular Geometries of Covalent Molecules
Experiment.14: Determination of R, the gas-law constant

Course and Course Number: Chemistry 116 – Principle of Chemistry II; 4 credits (3+3P)

Course Instructors: Deanna (Dede) Dunlavy

Catalog Description: Recommended for chemistry majors and other qualified students.

Prerequisite: C or better in CHEM 115

Required Texts:

- *CHEMISTRY: The Central* Science, 12th Edition, by Brown, Lemay, Bursten, Murphy and Woodward, Pearson/Prentice Hall.
- *Laboratory Experiments for CHEMISTRY: The Central Science*, by Nelson and Kemp, Pearson/Prentice Hall.

Objectives:

The Higher Education Department has identified several common core competencies which the student will achieve through this sequence of science courses (CHEM 115 and 116). The student will:

- describe the process of scientific inquiry
- solve problems scientifically
- communicate scientific information
- apply quantitative analysis to scientific problems
- apply scientific thinking to real world problems

In CHEM 116, these objectives will be realized by stressing the applications of chemistry to the real world in the areas of states of matter from a theoretical basis, solutions, kinetics, thermodynamics, chemical equilibrium (including acids/bases and solubility) and electrochemistry. This will be achieved through traditional assessments such as homework, quizzes and exams, but will also include opportunities of verbal expression of ideas through written laboratory assignments.

Lab Sections: Lab is a co-requisite for all students except those repeating the course.

Means of assessment:

Three exams (15% each): 45%; Attendance: 5%; Quizzes, assignments, participation: 15%; Lab experiments: 20%, Final Exam: 15%.

Content:

The course will cover the material of the second half of the textbook.
The actual schedule of labs is announced during the semester.

Course and Course Number: Chemistry 313 – Organic Chemistry I; 3 credits

Course Instructors: James Herndon

Catalog Description: Nomenclature, uses, basic reactions, and preparation methods of the most important classes of aliphatic and aromatic compounds.

Prerequisite: C or better in CHEM 112G or CHEM 116

Required Texts:
"The Virtual Textbook of Organic Chemistry" which is free at:
http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm.

The normally used textbook is: *Organic Chemistry*, 7th Edition by John McMurry

Objectives and Content:
What will be covered? This class is the first half of a two-semester course in Organic Chemistry; the prerequisite is a course in General Chemistry. The most important General Chemistry concepts are: structure and bonding, electronegativity, and thermodynamics. Organic Chemistry is a qualitative course, not a quantitative course and requires virtually no math; the necessary math skills were taught in the fourth grade of elementary school. The first few weeks of the class are a review of some of the most relevant concepts from General Chemistry. The next few chapters on stereochemistry offer discussions of phenomena unique to trigonal and tetrahedral geometries, and this is the part of the course where the use of models is most applicable. This is followed by a discussion of chemical reactivity, which offers a detailed look at the physical chemistry concepts required to understand organic chemistry concepts. The remaining sections are studies of reactions or organic compounds classified according to functional group; the majority of the second half of the course (CHEM 314) is a continuation of these studies.
Who benefits from a course in organic chemistry? Nearly everyone. Knowledge of organic chemistry offers one a unique perspective on the world and in many ways organic chemistry is consumer awareness as well as a science course. You will find yourself reading food and cosmetic labels. When you see a news report about a new miracle drug, you will be anxious to know its chemical structure. You will also have a greater understanding of current political issues; many bad legislative/legal decisions could easily been avoided if everyone had passed a course in organic chemistry.
Why is organic chemistry a difficult course? There is no universal answer to this question, and some actually find it to be quite easy. Organic chemistry requires a variety of skills, including memorization, extrapolation, working puzzles, and serious thinking. The best way to learn is through doing problems and doing them from scratch. One of the major mistakes students make is to look at the answer to a problem first, and then see how the book got the answer. When you do this the problem seems a lot easier than it really is, and also keep in mind that I have never asked anyone to do this on an exam!

Means of assessment:
Five tests: (100 points each): Homwork (100 points), Final Exam (200 points)

Course and Course Number: Chemistry 313 – Organic Chemistry I; 3 credits

Course Instructors: James Herndon

Catalog Description: Nomenclature, uses, basic reactions, and preparation methods of the most important classes of aliphatic and aromatic compounds.

Prerequisite: C or better in CHEM 112G or CHEM 116

Required Texts:
"The Virtual Textbook of Organic Chemistry" which is free at:
http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm.

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Means of assessment:
Five tests (100 points each): 500 points; Homworks, On-line Quizzes: 100 points; Comprehensive Final Exam: 200 points

Course and Course Number: Chemistry 314 – Organic Chemistry II; 3 credits

Course Instructors: James Herndon

Catalog Description: Nomenclature, uses, basic reactions, and preparation methods of the most important classes of aliphatic and aromatic compounds.

Prerequisite: C or better in CHEM 313

Required Texts:
"The Virtual Textbook of Organic Chemistry" which is free at:
http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm.

The normally used textbook is: *Organic Chemistry*, 7th Edition by John McMurry

Objectives and Content:
What will be covered? This class is the second half of a two-semester course in Organic Chemistry. The most important General Chemistry concepts are: structure and bonding, electronegativity, and thermodynamics. Organic Chemistry is a qualitative course, not a quantitative course and requires virtually no math; the necessary math skills were taught in the fourth grade of elementary school. The first few weeks of the class are a review of some of the most relevant concepts from General Chemistry. The next few chapters on stereochemistry offer discussions of phenomena unique to trigonal and tetrahedral geometries, and this is the part of the course where the use of models is most applicable. This is followed by a discussion of chemical reactivity, which offers a detailed look at the physical chemistry concepts required to understand organic chemistry concepts. The remaining sections are studies of reactions or organic compounds classified according to functional group; the majority of the second half of the course (CHEM 314) is a continuation f these studies.

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Means of assessment:
Five tests (100 points each): 500 points; Homworks, On-line Quizzes: 100 points; Comprehensive Final Exam: 200 points

Mathematics 191 - Calculus and Analytic Geometry I; 3 credits

Catalog Description: Algebraic, logarithmic, exponential and trigonometric functions, theory and computation of derivatives, approximation, graphing and modeling. May include an introduction to integration.

Prerequisite: Grade of C or better in Math 190.

Text: *Single Variable Calculus (Early Transcendentals)*, Jon Rogawski, Freeman.

Objectives: The goals are to present the concepts of calculus, stressing techniques, applications, and problem solving, and emphasizing 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. In fulfillment of these goals, this and later courses will stress topics such as polynomial approximation, setting up integrals, differential equations, as well as the use of appropriate technology.

Lab Sections: The fourth hour will be staffed by graduate assistants, and will be run as a problem-solving session, focusing on the common on-line homework problems. This will provide somewhat uniform preparation for the common exams. More individual section work (e.g. projects, other homework) will be done in the hours the instructor teaches. This will help to ensure that GAs running multiple sections are not overburdened.

Other means of assessment: Instructors are encouraged to use reading quizzes, short quizzes based on homework, and other means of assessing student work, especially early in the semester. This helps instructors to learn students' names quickly, to provide regular feedback, and to generate classroom discussion.

Projects: NMSU's Department of Mathematical Sciences has a strong tradition in discovery based learning, especially in calculus courses, including producing one of the MAA's all-time bestseller's "Student Research Projects in Calculus." Instructors are encouraged to give a few to several short projects during the semester. The department has resources for these projects (see the bookcase on the south wall of the reading room) and instructors are encouraged to work with coordinators in developing new or modifying existing projects. Care should be taken so that projects do not run up against exams.

Content:
Trigonometric, exponential, and logarithmic functions (excluding hyperbolic functions)
Rates of change, secant and tangent lines; limits. Review of linear functions
Limit laws, continuity, methods for evaluating limits
Squeeze Theorem; Intermediate Value Theorem
Derivatives; differentiation rules
Rates of change; higher derivatives; derivatives of trigonometric functions
The Chain Rule; implicit differentiation

Revised by Daniel Ramras, December 2009

Mathematics 192 - Calculus and Analytic Geometry II; 3 credits

Catalog Description: Riemann sums, the definite integral, anti-derivatives, fundamental theorems, use of integral tables, numerical integration, modeling, improper integrals, series, Taylor polynomials.

Prerequisite: Grade of C or better in Math 191.

Text: *Single Variable Calculus (Early Transcendentals)*, Jon Rogawski, Freeman.

Objectives: The goals are to present the concepts of calculus, stressing techniques, applications, and problem solving, and emphasizing 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. In fulfillment of these goals, this and later courses will stress topics such as polynomial approximation, setting up integrals, as well as the use of appropriate technology.
Midterm and Final Exams: This course is required to have a uniform common final exam.

Lab Sections: The fourth hour will be staffed by graduate assistants, and will be run as a problem-solving session, focusing on the common on-line homework problems. More individual section work (e.g. projects, other homework) will be done in the hours the instructor

Other means of assessment: Instructors are encouraged to use reading quizzes, short quizzes based on homework, and other means of assessing student work, especially early in the semester. This helps instructors to learn students' names quickly, to provide regular feedback, and to generate classroom discussion.

Projects: NMSU's Department of Mathematical Sciences has a strong tradition in discovery based learning, especially in calculus courses, including producing one of the MAA's all-time bestseller's "Student Research Projects in Calculus." Instructors are encouraged to give a few to several short projects during the semester.

Contents:
Approximating and Computing Area, The Definite Integral
Antiderivatives, The Fundamental Theorem of Calculus
Net or Total change, Substitution
Exponential Growth and Decay, Area Between Two Curves, Density and Average Value
Volume, Volumes of Revolution, Shells (optional)
Work and Energy, Numerical Integration, Integration by Parts
Integration by Parts, Trigonometric Integrals, Trigonometric Substitution
Trigonometric Substitution, Improper Integrals
Arc Length or Fluid Pressure and Force or Center of Mass, Taylor Polynomials
Taylor Polynomials, Sequences
Infinite Series, Convergence Tests, Power Series

Revised by Debra Zarett, May 2010

Mathematics 291 - Calculus and Analytic Geometry III; 3 credits

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

Prerequisite: Grade C or better in Math 192.

Text: *Calculus: Early Transcendentals*, by Jon Rogawski, W. H. Freeman and Company, New York.

Objectives: To introduce basic concepts and tools of Analytic Geometry and Multivariable Calculus with strong emphasis on conceptual understanding and applications.

Contents:
The course covers Chapters 12 through 15 of the text. It starts with vectors and analytic geometry in space, then moves to calculus of vector functions, which is presented as a natural extension of one-variable calculus.

The core parts of the course are devoted to techniques and applications of partial derivatives and multiple integrals with special attention paid to their geometric and physical meaning and significance.

An optional topic is an introduction to vector calculus, mainly to vector fields and line integrals. Its main goal is to prepare grounds for higher level courses on Differential Equations and Vector Calculus and to help students to feel more at ease in Engineering and Physics courses that use these notions quite early.

Vectors in the plane and in three dimensions. The dot product.
Cross product. Planes in three-space.
A survey of quadratic surfaces. Cylindrical and spherical coordinates.
Calculus of vector-valued functions.
Applications: arc length, speed, curvature, motion in three-space
Functions of several variables.
Limits and continuity *(very briefly)*, Partial derivatives.
Differentiability, linear approximation, tangent planes, and the gradient and directional derivatives.
The Chain rule, optimization in several variables.
Integration in several variables.
Double integrals over more general regions.
Triple integrals
Integration in polar, cylindrical, and spherical coordinates
Change of variables
Vector fields and line integrals

Revised 2/10 by Tiziana Giorgi and Debra Zarret

Mathematics 392 - Ordinary Differential Equations; 3 credits

Catalog Description: An introduction to differential equations in the context of dynamical systems. Modeling, separation of variables, qualitative and numerical methods, equilibria and bifurcations, linear systems, driven oscillations, real and complex solutions. Additions topics optional.

Prerequisite: Grade of C or better in Math 192.

Text: *Differential Equations, Third Edition*, Blanchard, Devaney and Hall. Brooks-Cole, 2006.

Objectives: To introduce basic concepts, theory, methods and applications of ordinary differential equations with emphasis on modeling and dynamics.

Content: The main part of the course is Chapters 1-4 from the text. All sections should be covered with the exceptions of 2.5, 3.8 and 4.5. The dependence of asymptotic behavior of solutions on parameters should be stressed as should bifurcations of equilibria. These aspects can be illustrated graphically using the applets on the DETools CD included with the text. Numerical methods should be also included. The systems approach to higher order equations and eigenvalue methods for solving linear systems should be emphasized. This material will take at least 3/4 of a semester to cover adequately; additional material can be taken from the remaining chapters or other sources depending on the interests of the class and/or the instructor.
The above description has been formulated in consultation with the College of Engineering, the Department of Physics and other client departments. Certain analytical methods have been de-emphasized or eliminated, while dynamics, models, numerical/graphical methods and systems of equations form the core of the course.

Internet Resources: The authors of the text maintain an Internet site as part of the Boston University Ordinary Differential Equations Project. Much useful information is available at http://math.bu.edu/odes. The computers in SH 118 run DETools, Maple and Matlab. Two graphical tools, PPLANE and DFIELD are freely downloadable. They offer numerical and graphical methods that are substantially more flexible and powerful than the DETools.

Contents:
Models of growth and decay, Comparison of analytic, numerical and graphical methods, basic idea of existence/uniqueness, equilibria and bifurcations, linear equations
First order systems, second order equations, oscillations, Euler's method, special analytic techniques, qualitative analysis
Linear systems, superposition, real and complex eigenvalues, behavior along eigenvectors, repeated eigenvalues, zero eigenvalues, trace-determinant plane. Linearization of non-linear systems
Second order linear equations. Forced oscillations and resonance, periodically forced harmonic oscillator, amplitude and phase of asymptotic solutions

Revised by David Pengelley; edited and posted by Liz Eres August 17, 2009.