Appendix I
Section B. Course Syllabi

Department of Physics ABET Course Syllabi were formatted to conform to the Engineering Physics ABET Program Outcomes.

The Electrical Engineering ABET Course Syllabi were formatted to conform to the EE ABET Program Outcomes.

The Mechanical Engineering ABET Course Syllabi were formatted to conform to the ME ABET Program Outcomes.

The Program Outcomes ***(a)*** thru ***(k)*** are the same for the EP, EE, and ME programs. However, the Educational Objectives for the three programs differ slightly.

Other Course Syllabi are not formatted to the ABET format as they do not measure any of the EP Program Outcomes

CHEM 111 General Chemistry I Spring 2006

GENERAL INFORMATION:
This course is the first of a two semester General Chemistry sequence. Completion of the two-course sequence fulfills the General Education requirement of the College of Arts and Sciences. Should you only take CHEM 111, your General Education requirement will not be met. Students desiring only one semester of chemistry for your General Education requirement should take CHEM 110.

One key factor in succeeding in this class is that you come in with sufficient algebra skills. If you have not been placed into MATH 185 or higher, you should postpone taking this class until your math skills are improved. Also, if you have never had a chemistry class, you should take CHEM 100 instead. CHEM 100 prepares you to take CHEM 111. If your major only requires you to take one semester of chemistry, make sure that you need CHEM 111 and not CHEM 110 which is designed to be a one semester experience. If you are uncertain if you have been properly placed in this class, please talk to your professor or advisor.

Lab is a co-requisite for all students. ***If you are repeating the course, please see the Syllabus Addendum for Course Repeaters for further instructions***.

This is the second semester that the chemistry department has implemented a new approach toward CHEM 111/112. In this new approach, CHEM 111 will stress conceptual aspects of chemistry and CHEM 112 will handle quantitative aspects. There will be a few mathematical treatments in CHEM 111, however, for which algebra is a necessity.

PREREQUISITES:
- A C or better in MATH 115 or placement in a higher level math class
- One of the following:
  - a B or better in a second semester high school chemistry course
  - a C or better in CHEM 100
  - enhanced ACT score of at least 22

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, periodicity of atomic properties, ionic vs covalent bonds and the compounds containing them, molecular structure and bonding, gas laws, types of solids, liquid properties, phase changes, reaction energetics and kinetics, extent of reaction, solutions, electrochemistry and redox reactions, acid/base 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.

INSTRUCTORS:

Section 1 - 8:55 – 10:10 TuTh **Dr. Deanna Dunlavy**
Office: CB 104B *Phone:* 646-4823 *E-mail:* ddunlavy@nmsu.edu
Office Hours: 10:30 – 11:30 MTuWThF and by appointment

Section 2 - 1:30 – 2:20 MWF **Dr. Jeremy Smith**
Office: CB 293 *Phone:* 646-3346 *E-mail:* jesmith@nmsu.edu
Office Hours: 2:30–3:20 MWF and by appointment

Section 3 - 9:30 – 10:20 MWF **Dr. Deanna Dunlavy**
Office: CB 104B *Phone:* 646-4823 *E-mail:* ddunlavy@nmsu.edu
Office Hours: 10:30 – 11:30 MTuWThF and by appointment

REQUIRED MATERIALS:

TEXTBOOK:

Chemistry, A Molecular Science, by Dennis Wertz, 2nd Custom Edition, Pearson Custom Publishing, New Jersey, 2006.

LAB MATERIALS:

- CHEM 111-112 lab textbook, published by Outernet Publishing Co.
- Laboratory Notebook (Hayden, McNeil Pub.)
- Goggles, as described below on the last page

CALCULATOR:

You will need a calculator with exponential notation, log and ln. Alpha-numeric calculators (ones that can store equations and text) are NOT permitted to be used on quizzes and exams.

CELL PHONES:

If you have a cell phone, do not bring it to class. Be courteous to your fellow students. If you must bring it, turn it off!! Cell phones are NOT permitted at any exam.

EXTRA HELP:

1. Both your lecture instructor and laboratory TA have posted office hours.
2. A list of tutors, who can be hired for hourly fee, is available in CB 100.
3. Supplemental Instruction Workshops, a one credit hour course, are available for enrollment. SI workshops are peer instructed and provide small group activities to help you master content and gain better study strategies. The workshop associated with CHEM 111 is listed as CHEM 101. There are four workshops being offered this
4. A web site created by Dr. Sergei Smirnov in this department includes many resources including practice problems for you to try, copies of old exams and quizzes, and links to many chemistry sites. To reach it go to www.chemistry.nmsu.edu/studntres/chem111. Be aware that the content covered in this semester will be ***significantly*** different in sequence than the old exams present on this site cover.

Math 191. Calculus I

Section 05 Spring 2006

Classes Meet: TuTh, 10:20-11:35 am, SH 114

Instructor: Dr. Susana Salamanca-Riba
260 Science Hall
646-2305
mailto:ssalaman@nmsu.edu

Web page: http://emmy.nmsu.edu/~ssalaman

Office Hours: Tue, Thu 2:30-3:30 in SH 260 and Wednesdays 2:30-3:30 in SH118

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 180 and 185.

Text: *Calculus: Concepts and Contexts, 3rd Edition*, James Stewart, Brooks/Cole.

Grading system:

Homework	10%
Reading/Homework Quizzes and Long Assignments	20%
Midterms (3 x 15)	45%
Final Exam	25%

The minimum standard for an S grade in the course will be a C average.

Exams dates: On 2/16, 3/16, 4/20, from 7:00 to 8:30 PM. Final Exam on 5/9, 1-3 PM

Goals and Expectations: *I am here to help you learn*. But it is also my duty to assess what you have learned. Modes of assessment include on-line homework, midterms, and reading/homework quizzes. In return for my guidance I expect, more importantly than anything else, consistent participation -- regular attendance and completion of assignments.

Assignments/Quizzes: On-line homework will be assigned weekly. For the most part it will be graded automatically. I will also assign reading for each class period. I will use regular *reading quizzes* to stimulate class discussion, or *homework quizzes* to gauge your understanding of assigned problems. I will also assign a few longer assignments to get a deeper understanding of some of the more important topics.
Assignments must be turned in before or at the start of the class when it is due. This is to discourage students to work on it during class time. During class, you need your full attention on

what is been currently covered. I urge you to attempt all the problems on the assignments on your own. You can talk to other people. But do that after you have attempted the problem yourself. The goal of the assignments is that you learn by doing them. They are for you to gain more proficiency in the subject. Since all problems from homework can appear in quizzes or exams, you should try to do them all.
Note: More than 70% of your grade will be based on work you do in exams or quizzes**. So, use the homework to learn how to do well in tests.** Use the immediate on-line homework feedback to help you. There is also strong correlation between success in exams and completing most homework assignments. So try to do as many as you can.
Late assignments/quizzes will not be accepted. The 3 lowest scores of the assignments will be dropped so that you don't have to worry about missing a couple of assignments. If you have a long illness or other special circumstances that will cause you to miss more assignments, please contact me as soon as possible.

Midterms and Final: There will be 3 uniform midterms from 7-8:30 pm on the Thursday evenings of 2/16, 3/16, and 4/20. The tests will have two parts. *Calculators will only be allowed on the second part*. You should factor this in when working homework problems: only use your calculator on problems for which its use is necessary. Conflicts for any of the exams should be reported to me at least two weeks prior to the test. Make-up exams will be given on the Friday afternoons of 2/17, 3/17 and 4/21 from 3:30-5 pm for those students having conflicts. Other make-ups will be given only in the case of a university sanctioned excuse and/or at my discretion. **If you miss a test, a medical certificate or university excuse is required for a makeup. Unless it is an unforeseen circumstance, I need the excuse two weeks before the date of the exam.**

Graphing calculator: One will be useful for many of the problems both on homework and on the exams.

On-line materials: Homework assignments for this course will be provided and solution submitted on line. You will need to register at http://www.ilrn.com/. The course code for this course is **E-298ZCHTEEE9S6**

Help!!! Here are some places to go for help:

1. My posted office hours
2. Help for on-line homework is available in both WH 27 and for calculus in WH 99. A schedule will be provided.
3. The Tools for Enriching Calculus CD-ROM has been included with the text
4. In addition to the *Interactive skill builder* that comes on the CD-ROM with the book, there is an *on-line learning center* associated with the textbook. The URL is http://www.ilrn.com/. Look under the *student resources* heading for the options available to you.

Math 192 Calculus and Analytic Geometry II

Section 04 Spring 2006

Classes Meet: TTh, 10:20-11:35 am, SH 110

Instructor: Dr. Joe Lakey
230 Science Hall (Office hours TBD)
646-2417
mailto:jlakey@nmsu.edu

Description: Riemann sums, the definite integral, antiderivatives, fundamental theorems, use of integral tables, numerical integration, modeling, improper integrals, differential equations, series, Taylor polynomials.

Prerequisite: Grade of C or better in Math 191 or equivalent

Text: *Calculus: Concepts and Contexts, 3rd Edition*, James Stewart, Brooks/Cole.

Grading system:

Homework	10%
Reading/Homework Quizzes and Miniprojects	20%
Midterms (3 x 15)	45%
Final Exam	25%

Goals and Expectations: *I am here to help you learn*. But it is also my duty to assess what you have learned. Modes of assessment include on-line homework, midterms, and reading/homework quizzes. I will try to evaluate your work in a manner consistent with what you feel are your personal strengths. In return for my guidance I expect, more importantly than anything else, consistent participation -- regular attendance and completion of assignments.

Daily feed: On-line homework will be assigned weekly. For the most part it will be graded automatically. I will also assign reading for each class period. I will use regular *reading quizzes* to stimulate class discussion, or *homework quizzes* to gauge your understanding of assigned problems. I will also assign a few mini projects to get a deeper understanding of some of the more important topics.

Midterms and Final: There will be 3 uniform midterms from 7-8:30 pm on the Thursday evenings of 2/16, 3/16, and 4/20. The tests will have two parts. *Calculators will only be allowed on the second part*. You should factor this in when working homework problems: only use your calculator on problems for which its use is necessary. Conflicts for any of the exams should be reported to me at least two weeks prior to the test. Make-up exams will be given on the Friday afternoons of 2/17, 3/17 and 4/21 from 3:30-5 pm for those students having conflicts. Other make-ups will be given only in the case of a university sanctioned excuse and/or at my discretion.

Graphing calculator: One will be useful for many of the problems both on homework and on the exams.

On-line materials: Homework assignments for this course will be provided and solution submitted on line. You will need to register at http://www.ilrn.com/. The course code for this course is E-5EGTDFVHDV9B3

Help!!! Here are some places to go for help:

1. My posted office hours
2. Help for on-line homework is available in both WH 27 and for calculus in WH 99. A schedule will be provided.
3. The Tools for Enriching Calculus CD-ROM has been included with the text
4. In addition to the *Interactive skill builder* that comes on the CD-ROM with the book, there is an *on-line learning center* associated with the textbook. The URL is http://www.ilrn.com/. Look under the *student resources* heading for the options available to you.

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 291 - Calculus and Analytic Geometry III

3 credits

Information For Instructors

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: *Multivariable Calculus: Concepts and Contexts,* by James Stewart, Brooks/Cole.

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

Content: The course covers Chapters 9 through 12 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.

It is strongly recommended that writing projects and group work make up part of the course.

Comments:

- It is up to the course coordinator and other instructors to decide on the number and timing of exams. Calculus instructors are welcome to give exams in the MLC testing center.
- Lagrange multipliers are not listed on this syllabus. This topic would make a very nice project.
- The use of calculators and computers is strongly recommended. Because of the limitations of graphing calculators in drawing 3-dimensional graphs, using Scientific Workplace and/or Maple is strongly encouraged.
- Engineering students other than electrical engineers do not take Math 391, but will see line and surface integrals in engineering and physics courses. Seeing line integrals in Math 291, even superficially, will benefit these students.

- If an instructor wishes to present surface area using parametric equations (in Section 12.6), then some of the material in Section 10.5 needs to beog covered.

The following is a sample syllabus for a 15-week semester.

Week	Sections	Topics
1	9.1, 9.2, 9.3	Vectors in 3-space. The dot-product.
2	9.4, 9.5	Cross product. Lines and planes in 3-space.
3	9.6, 9.7	Surfaces in space. Cylindrical and spherical coordinates.
4	10.1, 10.2	Calculus of vector-functions.
5	10.3, 10.4	Applications: arc length, curvature, normals.
	Project 1	*Components of the acceleration optional (or in a project)*
6	Project 1, 11.1	Functions of several variables.
7	11.2, 11.3	Limits and continuity *(very briefly),* Partial derivatives
8	11.4, 11.5	Tangent planes, approximations, and the chain rule.
9	11.6, 11.7	Directional derivatives, gradient, and extrema.
10	12.1, 12.2	Double and iterated integrals.
11	12.3, 12.4, 12.5	Double integrals for general regions and in polar coordinates. Applications.
12	12.5 (contd), 12.6	Applications. Surface area.
	Project 2	
13	Project 2, 12.7,	Triple integrals
	12.8	Integrals in cylindrical and spherical coordinates.
14	Catch up	*Vector fields and line integrals (13.1, 13.2, 13.3) optional.*
15	Review	

Revised 5/02 by Joe Lakey
Approved by the Undergraduate Curriculum Committee
Posted on 5/29/02 by Pat Morandi

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 391 - Vector Analysis

3 credits

Information For Instructors

Catalog Description: Calculus of vector-valued functions, Green's and Stoke's theorems, and applications.

Prerequisite: Grade of C or better in Math 291.

Text: *Introduction to Vector Analysis, 7th Ed.* Davis/Snider. W. C. Brown, Publishers, 1998.

Other resources: Here is a partial list of alternative texts and references:
Vector Calculus, , P.C. Matthews. Springer-Verlag, 1998.
Div, Grad, Curl and All That, H.M. Shey. W.W. Norton & Co., 1973.

Objectives: Though not stated in the catalog description, the core material should include vectors in calculus and analytic geometry, line and surface integrals, the gradient, divergence, curl and the Laplacian, and the theorems of Green, Gauss and Stokes. All of this material is in the text for Math 291 which can be used as an alternative resource, but the treatment here should be deeper -- emphasizing deep physical concepts like potential functions and conservation laws, without diving completely into the formalism of differential forms. The students' primary objective should be to understand basic concepts of vector calculus through its applications. Fluid flow and electromagnetism should be used to illustrate each theoretical point, and provide real-world problems. The student should be encouraged to develop geometric intuition while using algebra and calculus for computation. To pave the way for Stoke's theorem, the curl should be introduced as the limit of circulation per unit area (e.g. about an infinitesimal rectangle or circle). Divergence should be introduced as the limit of outflow per unit volume. Students may then discover their coordinate expressions through projects or exercises. The instructor will have to create these or rely on other sources; there are some examples in the project drawer in the math reading room.

Content: The course contains most of chapters 1 through 4: Vector Algebra; Vector Functions of a Single Variable; Scalar and Vector Fields; Line, Surface, and Volume Integrals. Sections 1.15, 2.5, 3.7, 3.9, 3.11, 4.5, 4.10, 5.6-5.8 are optional.

The following is a "minimal content" outline for a semester calendar using the text by Davis and Snider. Since this is a multiple section course and some students have to change sections, it is necessary that you stick to the schedule for the first two weeks.

Week	Sections		Week	Sections
1	1.1-1.5		10	4.1-4.4
2	1.6-1.10		11	4.6-4.7
3	1.11-1.14		12	4.8-4.9*
4	2.1-2.2		13 **	5.1-5.3
5	2.3-2.4 *		14	5.4-5.5
6	3.1-3.2			Final
7	3.3-3.4			
8*	3.5-3.6			
9	3.8-3.10			

* Mid-term week

** Student evaluations

Revised 4/05 by Mary Ballyk and Joe Lakey
Approved by the Undergraduate Curriculum Committee
Posted on 5/11/05 by Melinda Caskey

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 392 - Ordinary Differential Equations

3 credits

Information For Instructors

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, Second Edition,* Blanchard, Devaney and Hall. Brooks-Cole, 2002.

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 1.9, 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. A more detailed outline can be found below. When pacing the course, keep in mind that the material of Chapters 1 and 3 is more fundamental than that of Chapter 4.

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/, instructors are urged to investigate this site. The computers in SH 118 run 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.

Timetable: The following is a possible outline of sections that should be covered based on 14 weeks of class. You should factor in time for midterm exams and projects. It is natural to give midterm exams on Chapter 1 and on Chapters 2-3. Some material in Chapters 2 and 4 naturally lends itself to

computer aided projects.

Topics	Approximate Time	Reference
Models of growth and decay, Comparison of analytic, numerical and graphical methods, basic idea of existence/uniqueness, equilibria and bifurcations, linear equations.	4 weeks This chapter is long. It is important not to get bogged down.	Chapter 1 1.1 - 1.8
First order systems, second order equations, oscillations, Euler's method, special analytic techniques, qualitative analysis.	3 weeks	Chapter 2 2.1 - 2.4
Linear systems, superposition, real and complex eigenvalues, behavior along eigenvectors, repeated eigenvalues, zero eigenvalues, trace-determinant plane. Linearization of non-linear systems.	4 weeks	Chapter 3 3.1 - 3.5, 3.7 Chapter 5 5.1
Second order linear equations. Forced oscillations and resonance, periodically forced harmonic oscillator, amplitude and phase of asymptotic solutions.	3 weeks	Chapter 3 3.6 Chapter 4 4.1 - 4.4

Approved by the Undergraduate Curriculum Committee
Posted 5/11/05 by Melinda Caskey

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 471 - Complex Variables

3 credits

Information For Instructors

Catalog Description: A first course in complex function theory, with emphasis on applications..

Prerequisite: Math 391 or both Math 392 and Math 291.

Text: Churchill and Brown, *Complex Variables and Applications*, Sixth Ed.

Objectives: Complex functions lie at the core of physical and engineering mathematics, and their study builds bridges to and among subjects in higher mathematics such as topology and analysis. While the theory has become elegant and simple, it was developed historically as a toolkit for solving applied problems. The goal of this course is to develop skills in applying the theory to real-world problems. Topics particularly appropriate for applied projects or exercise sets include:
The geometry of complex arithmetic, complex powers, and conformal mappings, plane symmetries, and stereographic projection. The "rotating phasor" and oscillatory systems. Analyticity. the Cauchy integral formula and respresentations of functions; the relationship between the Cauchy-Riemann equations and Laplace's equation,. Applications to PDE's such as heat flow and wave propogation. The relationship bewteen Laurent series and Fourier series and transforms and Laplace transforms, the relationship between causality and analyticity, Applications of inversion through contour integrals.

Content: The course covers at least parts of the first ten chapters of Churchill and Brown's *Complex Variables and Applications*, with emphasis on those topics relevant to applications.

The following is a somewhat ambitious calendar of topics.

# Weeks	Text Reference	Topics
1.5	Ch. 1	Arithmetic and Geometry of complex numbers
1.5	Ch. 2	Differentiation
2	Ch. 3	Elementary functions
	Exam 1	Chs. 1-3
1.5	Ch. 4 (selected sections)	Integration
1.5	Ch. 5	Series

1	Ch. 6	Poles and residues
2	Ch. 7 (selected sections)	Applications of residues
	Exam 2	Chs. 4-7
1	Ch 8 (selected sections)	Basic mappings
1.5	Ch. 9 (selected sections)	Conformal mappings
1	Ch. 10 (selected sections)	Applications of conformal mappings
	Final Exam	

Comments: The material on residues often bogs the students down and can create a rush at the end for covering conformal mappings, which is one of the most important topics.

Revised 11/99 by Joe Lakey
Approved by the Undergraduate Curriculum Committee
Posted on 3/15/00 by Liz Eres

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 472 - Fourier Series and Boundary Value Problems

3 credits

Information For Instructors

Catalog Description: Fourier series and methods of solution of the boundary value problems of applied mathematics

Prerequisite: MATH 392.

Text: David L. Powers, *Boundary Value Problems*, Third Edition, Saunders College Publishing, 1987.

Objectives: The principal objective is to learn to solve partial differential equations involving initial and boundary conditions. The secondary objective is to tie the formal mathematics with physical intuition. These objectives can partly be accomplished by deriving mathematical models for a number of physical problems, and partly by interpreting the results of formal calculations in physical terms. Powers' book is useful in that there is an abundance of exercises providing variations on the main themes of modelling and computing series solutions developed in the text, thereby reinforcing both modelling and computational skills. Fourier series are best introduced as the expansions of initial or boundary conditions that arise in the separation of variables that reduce PDEs to ODEs. In this vein, convergence tests can be made more clear if presented in the context of solving specific problems. They can be reinforced even more by using short computer programs to compute and plot partial sums of series as a means of visualizing rates of convergence and their dependence on smoothness.

Content: It helps to start the course in Chapter 2, bringing in topics on Fourier series from Chapter 1 gradually as needed. It is recommended to cover most of the first five chapters, and some of Chapter 6. If numerical analysis is included it is suggested to provide at least pseudocode algorithms, which can be juxtaposed to Fourier based algorithms.

Comments: This course can have a diverse audience composed of undergraduate and graduate students from engineering, math and physics. Those students with a stronger math background can benefit from supplementary materials such as T.W. Korner's *Fourier Analysis* and accompanying *Exercises in Fourier Analysis* (Cambridge University Press). Churchill and Brown's *Boundary Value Problems* (McGraw-Hill) provides additional material at a more standard level.

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 473 - Calculus of Variations and Optimal Control

3 credits

Information For Instructors

Catalog Description: Euler's equations, conditions for extrema, direct methods, dynamic programming, and the Pontryagin maximal principle.

Prerequisite: Grade of C or better in either Math 392 or concent of the instructor.

Text: Enid R. Pinch, *Optimal control and calculus of variations*, paperbound edition, Oxford University Press, 1995.

This text was chosen for two main reasons. First, it is a compact presentation of basics of the subjects of its title, giving the reader access to basic techniques without getting bogged down in long proofs. (Proof of the Pontryagin maximum principle is postponed to the end of the book.) Second, the introductory sections develop the new material concretely as extensions of ideas found in the first three semesters of calculus and in a course on ordinary differential equations.

The text was supplemented by readings gathered from other sources on specialized topics and applications.

Description: As part of preparation for the course I rounded up copies of several recent books on optimal control and calculus of variations, including the second edition of a text used earlier, *Variational Calculus with Optimal Control: Optimization with elementary convexity*, by John L. Troutman (Springer, 1995), *Introduction to the Calculus of Variations and its applications* by F.Y.M. Wan (Chapman Hall, 1995), and the book I finally chose. The Troutman and Wan books were rather expensive, encyclopedic, and mathematically sophisticated. However, I used each of these books as a source for elementary mechanical and physical examples of principles of the calculus of variations in action.

Nearly every derivation or development in the Pinch book starts by writing down the Taylor expansion of a function of several variables. It starts with a review of optimization of functions of one variable, continues with a development of the method of Lagrange multipliers for constrained optimization of functions of several variables. This is done in complete generality, and it would be helpful if students understood something about the rank of a matrix or of a system of *m* equations in *n* unknowns. It took nearly half the semester to complete this material, but I think it was essential to invest in this preparation before trying to analyse the "infinite dimensional" situation of the fundamental problems of the calculus of variations.

Pinch's approach to the calculus of variations and optimal control aims to make the skeleton of the subject clear. The focus of optimal control is on the Pontryagin Maximum Principle. Examples and exercises are purely mathematical and the amount of technique required from differential equations is fortunately very limited. However, some acquaintance with the classification of planar linear systems is definitely helpful.

Remarks: I think that the way this course draws so much material together puts it into a class different from Math 471 and, perhaps, Math 472 also. (I haven't had the opportunity to teach either of these.) If Math 392 has been uncoupled from Math 291, then we should contemplate adding Math 291 to the prerequisite list for Math 473, for the sake of ensuring the students have prior exposure to directional derivatives, the Hessian, and, at least, linear approximation of functions of several variables. The version of Math 392 we are currently teaching from the book by Blanchard and Devaney presents all topics needed for Pinch's book adequately, though more sophistication in handling differential equations is demanded by Troutman and by Wan. I had 9 students, all from various engineering departments, graduates and undergraduates, and the biggest hangup was the lack of preparation in linear algebra.

Revised 1/00 by Ross Staffeldt
Approved by the Undergraduate Curriculum Committee
Posted on 3/15/00 by Liz Eres

NEW MEXICO STATE UNIVERSITY

Department of Mathematical Sciences

Mathematics 480 - Vector Spaces and Matrix Algebra

3 credits

Information For Instructors

Catalog Description: Matrices, determinants, vector spaces, characteristic values, canonical forms; applications.

Prerequisite: Grade of C or better in any MATH or STAT 300-level course.

Text: Gilbert Strang, *Introduction to Linear Algebra*, Second Edition.

Objectives: This course may be take for graduate credit, but it is *not a graduate course*. For the majority of students, who are mostly science and engineering majors, it will be a formal course in matrix algebra. However, they will all be familiar with Gaussian elimination, matrix multiplication, and determinants. Many will also be familiar with eigenvalues.
The objective of the course is to learn the concepts underlying the uses of matrices, vector spaces, and eigenvalues, and to see how those tools work in real-life situations. Students will study the basic techniques of matrix algebra and will learn how to use them in various applications. They will gain skills in solving applied problems and in dealing with abstract mathematical concepts.
Theoretical considerations should be treated so as to enhance conceptual understanding, not just formal theorems and proofs. The theory has to be motivated and reinforced by a variety of applications.
Emphasize use of computers in matrix calculations. Take the class to the student computer lab and introduce them to Scientific Workplace and Maple. (Many students will already have their favorite computer package, but they may want to use Scientific Workplace after they have seen it.)

Content: NOTE: This is a lower division text - it is supposedly more readable than Strang's upper division text - so the pace must be fast to ensure that the latter chapters are covered.
Relationships between matrix algebra and Gaussian elimination (2.3-2.7); Vector spaces and linear equations (3.1-3.6); Spaces with inner products (4.1-4.4);. Use 8.4 as an application of this material. Determinants (Chapter 5 - skim through this chapter whose purpose is to introduce concepts needed for applications in chapter 6). Eigenvalues (Chapter 6): Be sure to cover this chapter thoroughly. It has many of the topics in which students are interested. Chapter 7: Sections 7.1 and 7.2 are important. Section 7.4 is popular and useful. Try to cover several topics from the remainder of the text. Popular ones are 8.1, 8.4, 8.5, and 10.3. Cover *at least* this many applications. It is best to integrate them along the way with corresponding theoretical concepts. It helps to survey the students early to gauge which applications will be most relevant to the individuals in the class.

Comments: The depth in rigor of this course is not great. The students want to learn some new topics and techniques that they have not seen in their previous engineering, science, and math courses. So don't get bogged down in Chapters 1-5.

Revised 11/99 by Frank Williams
Approved by the Undergraduate Curriculum Committee
Posted 3/15/00 by Liz Eres

Stat 371 **New Mexico State University**
Statistics for Engineers and Scientists **XXXXX**

Instructor:

Dr. Robert Smits
e-Mail: rsmits@emmy.nmsu.edu
office: Walden Hall 211
office hours: XXXXX
office phone: 646-2884

Lectures:

Science Hall XXXXX

Undergraduate Catalog Description:

Modern probability and statistics with applications to the engineering sciences

Prerequisite:

Grade of C or better in Math 192; double integration will be briefly overviewed

Textbook:

Probability and Statistics for Engineers, Fourth Edition, by R. Scheaffer and J. McClave, 1995, Duxbury Press

Course Objectives:

The subject of statistics deals with unpredictable events which taken as a whole have a well-defined structure. The language of statistics is meant to capture this structure and use it to communicate and explain sets of data that have been collected. Students should be able to formulate problems given in words as statistical problems, solve these problems using various methods and relate the solutions in a descriptive manner.

Contents:

The course will cover selected material from chapters 1-9 of the textbook. Topics include: data analysis, probability, random variables and distributions, sampling distributions, estimation, hypothesis testing and simple linear regression and correlation.

Homework Assignments:

- ❑ Homework will be assigned every lecture and is due the following lecture
- ❑ Make sure to write your names on all homework
- ❑ You are encouraged to discuss amongst yourselves, but you must write up your solutions in your own words. You are expected to write well-organized and readable solutions

Office Hours & Outside Class Help:

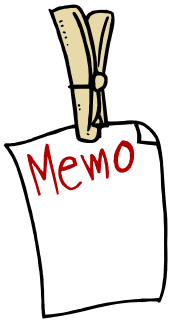
- ❑ Office Hours: XXXXX
- ❑ For help you can stop by my office or set up an appointment or send an e-Mail

Tests:
Three one-hour tests will be given in-class. Details such as the material that will be covered will be given later. The tests are tentatively scheduled for XXXXX

Final Examination:
The Final Exam is scheduled for XXXXX

Course Evaluation:

Homework	10%		
Quizzes			10%
Tests 1-3 (15 % each)	45%		
	Final Exam		35%
Total		100%	



Cell phones and PDAs are not allowed during exams

The last day to withdraw from the course with a grade of "W" is XXXXX

(The responsibility for withdrawal from the class is entirely left up to the student)

Make-up Work/Excused Absences:
Late homework will be accepted and make-up exams will be provided only in the case of a documented excused absence. Excused absences are absences due to illness, travel on university or career-related business and death in the immediate family. (See also the section Attendance and Student Performance in the Undergraduate University Catalog) No make-up work may be submitted after grades have been posted, unless you have been awarded an Incomplete grade

Incomplete Grades and S/U Standards:
An incomplete grade may be given only if you have passed the first half of the course, and you are precluded from successful completion of the course due to circumstances beyond your control that the instructor believes genuinely precluded successful completion. The minimum standard for an S grade in the class is a C. (Please refer to the sections Incomplete Grade and S/U Option in the Undergraduate University Catalog)

Ethics:
Please read carefully the section on Academic Misconduct in the Undergraduate University Catalog. Should any student infringe on any of these resolutions, the instructor reserves the right to initiate a statement of the student misconduct including a recommendation of expulsion from the class

IE 310 G: Continuous Quality Improvement

Catalog Description

Deming's philosophy, Malcolm Baldrige national quality award, probability theory, discrete and continuous distributions, parameter estimation, hypothesis testing, control charts, design of experiments, analysis of variance, factorial experiments. 3 Credits.

Prerequisites

MATH 192

Text

Kiemele, Mark J. and Schmidt, Stephen R. (1997). *Basic Statistics: Tools for Continuous Improvement*, 4th Edition, Colorado Springs, CO: Air Academy Press. This text includes a set of software programs for statistics, process capability analysis, and statistical process control that will be used in class.

Course Objectives

To learn the strategies and tactics of continuous quality improvement and statistical thinking.

To learn the quantitative and qualitative techniques used to improve quality and their application in a variety of engineering, manufacturing, and other environments.

To develop skills in teams and teamwork that are based on current industry best practices.

Topics

Introduction and Background, including why continuous quality improvement.

Quality Improvement in industry.

The role of quality awards such as the Malcolm Baldrige National Quality Award and New Mexico Quality Awards.

Quality Standards such as ISO 9000 and QS 9000 as currently used in industry.

Basic Quality Improvement Tools: Flowcharts, Pareto Charts, Cost-of-Poor Quality Analysis, Matrix Charts, Statistics, Process Capability Analysis, and much, much more.

Statistical Applications in CQI: Hypothesis testing, Statistical Process Control (SPC), Design of Experiments, including Graphical Methods, and design optimization for product and process improvement.

Class Schedule

Two 75-minute sessions per week.

Contribution to Meeting the Professional Component

This course introduces you to the application of statistical thinking (including probability, statistics and design of experiments) to engineering problem solving. For ABET purposes, this course offers two credits of mathematics.

Relationship to Program Objectives

This course relates to your department's program objectives by introducing concepts of design and analysis of experiments, communication of experimental results, working in teams, and product/process analysis using quality improvement as a strategy.