Teaching Statement
Fall 2007 - Spring 2009

François Blanchette, School of Natural Sciences, UCM

Over the period covered by this statement, I have taught the following courses:
- Math 24, lower division undergraduate, 4 credits, Fall 2007
- Math 298, graduate directed group study, 1 credit, Fall 2007
- Math 122, upper division undergraduate, 4 credits, Spring 2008
- Math 131, upper division undergraduate, 4 credits, Fall 2008
- Math 298, graduate directed group study, 1 credit, Fall 2008
- Math 122, upper division undergraduate, 4 credits, Spring 2009
- Math 91, undergraduate lower division, 1 credit, Spring 2009

In addition, I have taught a directed independent study course, Math 295, which formed the basis of the project used by the student, David Hambley, to fulfill his capstone requirement for his Masters degree (completed in Spring 2009). I also gave an independent study course (Math 099) covering the contents of Math 23 over the summer of 2008. I will describe the main contributions I made to teaching at UC Merced through each of those courses, with the exception of the individual courses.

The course Math 298 is an directed group study of fairly unique character. This course was envisioned by the applied math group to help prepare our incoming graduate students for their preliminary exams held in January. The course was meant to be a review of undergraduate material that is to be tested in the preliminary exams. The ambitious objective of this course is to level the field and bring all the incoming graduate students at a similar degree of competence in the 4 majors topics considered (calculus, linear algebra, differential equations, and complex variables). However, the diverse background of our students and their varied degree of readiness for graduate school has transformed parts of this course from a review into a crash course in some topics. I spend the first lecture of this course assessing the students' needs and abilities. In 2007, the group was fairly strong in all topics but one, so we decided to spend half our time on complex variables. The students elected, at my suggestion, to take turns teaching the topic using notes I provided them. The other topics were reviewed based on my notes, and on question sessions. This approach proved quite successful. In 2008, the students as a group had a weaker preparation, although this was not clear at first. We begun along the same lines as in 2007, but it soon became clear from the students' questions and comments that more time was required on nearly all topics. Given this state of affairs, I elected to concentrate on 3 out of the 4 topics, and to leave the fourth, complex variables, for the Spring semester, where a course (Math 122) covering this very topic was offered. This realignment proved very useful and allowed the students to adequately prepare the other 3 topics. I also offered extra lessons in complex variables to the 2 strongest students, so that their preparation was complete.

This narrative shows that Math 298 is a rather difficult course to teach as it requires unusual flexibility, and an ability to determine the best course of action for the entire class from a whole range of possibilities. I have been able to exercise the necessary leadership and flexibility to make this course a success, and when needed I have also been willing to spend the extra time to ensure all students ended getting the most out of this course. I have overall received very positive feedback from the students. I should also mention that I am the only one who has ever taught this course at UC Merced.

In the fall of 2007, I also taught Math 24, a rather standard lower division course. A good structure for the course was already in place and I mostly kept it. I wanted to encourage attendance to discussion sections though, so I introduce quizzes that amount for 20% of the final grade to be taken in discussion sections. These quizzes consisted of 3 exam-level questions given in advance to the students. On quiz day, only one question is randomly chosen and asked (with no notes allowed). This forced the students to review a

variety of subjects, while allowing the graders to provide useful feedback as they were grading only one question a week. I found this approach to yield good results and would use it again in a similar course. During this course, students complained that the teaching assistants were not as useful as they could be. In addition to the weekly meeting I had with them, I then visited their discussions sections and provided constructive criticism to both. The students reported improvement in the discussion sections, although one of the teaching assistant proved under qualified and was let go at the end of the semester. I now have as a policy to visit the discussion sections of my teaching assistants early in the semester to help steer them in the right direction. I also used this course to generate interest in the Applied Math major and used every opportunity to show students how the subject could be taken further. I have since supervised an undergraduate research project with a student, Sydney Montroy, I first taught in Math 24 in the fall of 2007.

I have taught Math 122, basically an introduction to complex variables and rigorous mathematical thinking, twice over the last two years. While the contents have remained very similar, I believe I have greatly improved the manner in which it is presented. The first year I taught the class, the students seemed to misunderstand the usefulness of going over mathematical proofs. I had made no particular effort to justify their study, and the students' response was somewhat apathetic. To counter this, I later introduce a more applied project for students, and it was met with some enthusiasm. In 2009 however, I took great care to explain why it was important to go over those proofs: firstly to justify beyond any doubt the results obtained, and secondly to develop the conception of what a valid proof was, and thereby develop their critical sense. I also introduced a more direct method of testing their understanding of proofs. In exams, I give a complete proof where all the statements are correct, but with no justifications. I ask the students to justify each statement. This method, which I have not seen employed elsewhere, verifies directly whether or not they understand the idea of a proof, while avoiding the meaningless learning-by-heart of a few proofs. The students' did not perform very well on such questions in the midterm exam, as it was their first exposure to such questions, but they improved at the end of the course. I plan to promote similar questions from an earlier point next year so that students can develop more rigorous mathematical thinking. Lastly, to allow more opportunity for the students to go through examples, a discussion section was added in 2009, and worksheets were developed under my supervision by my teaching assistant, Haik Stepanian. I sincerely hope that budgetary compressions will not result in the cancellation of this discussion, as it was much appreciated by the students.

I taught an introduction to numerical analysis (Math 131) for the first time in the Fall of 2008, and I am scheduled to teach it again in Fall 2009. This is a large (50+) class for an upper division math course, and it is mostly attended by mechanical engineers. There is general agreement among the applied math faculty that it would be beneficial to offer this class twice a year to reduce its size, but at present this is not feasible. The objective of the course is to get students to be able to answer math questions using their own computer programs. I have modified the contents of the course to ensure that the students who do not go on to Math 132 would still have some exposure to numerical methods applicable to differential equations, as I consider this topic very likely to be encountered by engineers. I have also modified the syllabus to explicitly include the learning outcomes of this course. I found out that even though the vast majority of students have passed a programming course, they have virtually no programming skills at the onset of the class. Therefore, this year the first week will be spent teaching them how to write basic programs in *matlab*. A large portion of their grades comes from weekly homeworks, and roughly half of those homeworks involve programming and analyzing the results. Students have complained that these homeworks are too time consuming, particularly given the time they have to spend debugging. However, I believe that this is the essence of the course, and long homeworks are the best way to learn numerical analysis. Therefore, I have elected to modify the homework policy to allow students to work in pairs, which should reduce the total time they spend on the homework, while additionally teaching them about team work. This policy also has the non-negligible benefit of reducing the grading load, which is now quite larger than it was last year.

The course I taught most recently, Math 91, is a new addition to the curriculum at UC Merced, and is a

non-standard course I created to serve two purposes: 1) help our students bridge the gap between lower and upper division math courses and 2) promote the applied math major at the sophomore level. This one credit course is unique in that it is effectively a "sophomore seminar" course. In each weekly meeting, a new topic is presented, so as to cover a wide variety of mathematical fields. The students are assigned a short homework, and each student must also give a presentation at some point during the semester. From the student's assessment, I think this new addition was a success and served to increase their interests and competence in mathematics. One important point to improve is its publicity, as enrollment was disappointing in 2009. I will work with the lower division instructors to advertise this course to their students in the fall semester.

Finally, the independent study course I taught to David Hambley, focusing on fluid dynamics, was an integral part of his Master's degree. His capstone project followed directly from this course. The personality of the student required me to provide ample motivation, a task that surprised me at first, but which I ended up performing sufficiently well that David graduated even though his chances of doing so had seemed slim. In future independent study courses, I will try to set more frequent deadlines to ensure a closer monitoring of the student's efforts as part of the course itself.

Overall, I think my teaching has been well received from students, and has served to educated them well. I believe I am developing a reputation as a tough but fair teacher, which I find very appropriate. My objective is not to be the most popular teacher, but to be the one who teaches them the most. To do so, I will continue to listen to the students' feedback and maintain the flexibility required to take their comments into account. However, I will continue to have high expectations from my students, and maintain a high academic standard in my classroom. My approach is to focus on developing a thorough understanding of the fundamentals, as I believe that a higher education can only be built over a strong foundation.

A slimmed-down version of a syllabus for each of those courses is attached.

Instructor. François Blanchette (e-mail: fblanchette@ucmerced.edu, phone: 228-4062)
Discussion section leaders. Shelley Rohde (e-mail: srohde@ucmerced.edu)

. Brett Jones (e-mail: bjones3@ucmerced.edu)

Course Goals. Learn the fundamentals of ordinary differential equations (ODEs) and linear algebra as it applies to ODEs. An important component of the course deals with modeling phenomena in terms of ODEs; it is essential for understanding ODEs and what they represent in real world phenomena.

Topics covered. Solution of first-order ODE's by analytical, graphical and numerical methods; Linear ODE's, especially second order with constant coefficients; Undetermined coefficients and variation of parameters; Sinusoidal and exponential signals: oscillations, damping, resonance; Linear algebra: Gaussian Elimination, basis and dimension, eigenvalues and eigenvectors, complex exponentials; Nonlinear phenomena: limit cycles and chaos.

Textbooks. *Differential Equations and Linear Algebra*, 2nd edition, by Farlow, Hall, McDill and West. We will cover most of Chapters 1-7.

Course webpage. The Math 24 website is part of the UCMCROPS course management system. It is available automatically to all students enrolled in this class. The website contains the course calendar, announcements, a chat room and email list. We will use this site for distributing course materials.

Discussion sections. In discussion sections, you will develop and practice your problem solving skills by working with your classmates to solve challenging problems. *Your presence in the discussion sections is crucial as this is were most students actually* **learn** *the material.* Also all the quizzes (worth 20% of your grade) will be administered in discussion.

Quizzes. Quizzes will be given in the first 15 minutes of most discussion sections. These quizzes will be graded as if they were exam questions. A list of three potential quiz questions will be posted the week before each quiz. Each quiz will require students to answer one, randomly selected, posted questions. It is highly recommended that you work out solutions to all three potential questions in advance, on your own or in groups. However, no notes will be allowed during quizzes. The lowest grade obtained in the quizzes will be dropped when computing your final grade.

Homework. Homework will be assigned almost every Friday during lectures and be due the following Friday at the start of the lecture. *Late homework will not be accepted nor graded.* Graded homework will be returned during the discussion section.

Exams. There will be two unit exams and a ccomprehensive final. The unit exams will be given during lectures the on **Friday October** 19^{th} and **Friday November** 30^{th}. These will be 50 minutes exams. To avoid disturbances over this short examination period, students will not be permitted to enter the room late or to leave early. The final exam date, time and place will be announced shortly.

Grade determination. Your final grade in the course will be based on homework assignments (10%, 1% per HW), quizzes (20%, dropping the worst quiz out of the 10 administered), two unit exams (each worth 20%), and a cumulative final exam (30%). If you obtain 90% of the total points, you will definitely receive an A in the course. If you obtain less than 55% of the total points, you will definitely receive an F. For everything in between, letter grades will be determined depending on the specific distribution of grades obtained.

COURSE GOAL. Develop an ability to understand and express abstract and logically organized mathematical thought through the study of functions complex variables.
Instructor. François Blanchette (e-mail: fblanchette@ucmerced.edu)

Learning outcomes

1. Know the basic properties of functions of complex variables.
2. Be able to use the Residue theorem to solve real integrals.
3. Understand the representation of complex functions as mappings form $\mathbb{R}^2$ to $\mathbb{R}^2$.
4. Recognize and formulate correct mathematical proofs.

Lectures. Lectures will introduce new concepts, emphasize important aspects of the theory, and provide examples.

Discussion sections. Discussion sections will help review concepts introduced in lectures and most importantly allow you to solved problems in collaboration with your peers and under the supervision of the discussion leader.
Discussion section leader. Haik Stepanian (e-mail: hstepanian@ucmerced.edu)
Section Math 122-001 W 4:30 pm – 5:20 pm, COB 129
Section Math 131-002 R 10:30 am – 11:20 pm, COB 264

Textbook. *Complex Variables and Applications* , 8th ed. (7th acceptable too), by Churchill & Brown, edited by McGraw-Hill, 2008, Chapters 1 through 10.

Topics covered. Complex plane, functions of one complex variable, limits, differentiability, contour integration, Taylor and Laurent Series, Poles, Cauchy Residue Theorem, applications to real integrals, mappings, harmonic functions, Poisson formula.

Homework. Homework will be assigned almost every week during lectures (11 assignments in all) and will be due the following week at the start of lecture. Late homework will not be accepted nor graded, so you should turn in whatever you have completed by the due date. Homeworks will be graded by Mr. Haik Stepanian. You are encouraged to work in groups. However, **all work turned in must be your own**. At the end of your written homework, you must identify explicitly all individuals with whom you worked for each problem. You must also **list explicitly any outside sources employed** (e.g. websites, Mathematica, book other than the textbook, etc.) for each problem you solve. This does not mean that you are allowed to copy a solution should you find it posted elsewhere.

Exams. There will be one midterm exam and a ccomprehensive final. The midterm exam will be given during lecture on Wednesday March 18th and will be an 80 minutes exam. The final exam date, time and place will be announced shortly. If you are sick the day of the exam, please bring a note from your doctor verifying your illness. A special needs room for people with documented disabilities will be provided for each exam. See your instructor and the course web page for more information.

Grade determination. Your final grade in the course will be based on homework assignments (45 % for homeworks, the worst homework grade will be dropped, 4.5 % per HW), midterm exam (15 %), and a cumulative final exam (40 %). If you obtain 90 % of the total points, you will definitely receive an A in the course. If you obtain less than 55 % of the total points, you will definitely receive an F. For everything in between, letter grades will be determined depending on the specific distribution of grades obtained.

COURSE GOAL. To enable students to answer mathematical problems using numerical tools.
Instructor. François Blanchette (e-mail: fblanchette@ucmerced.edu)

Learning outcomes Given a reasonable mathematical problem, graduates from Math 131 should be able to:

1. Devise an algorithm to solve it numerically.
2. Implement this algorithm.
3. Analyze an algorithm's accuracy, efficiency and convergence properties.
4. Describe classic techniques and recognize common pitfalls in numerical analysis.

Lectures. Lectures will introduce new concepts, emphasize important aspects of the theory, describe methods used to solved common problems, focusing on outcomes 3, and 4.
Lecture time. MWF, 10:00 am – 10:50 am in room COB 113.
Office hours. M 12:30 pm - 1:30 pm and F 1:30 pm - 2:30 pm in SE1 348, focuses on outcomes 1, 3, and 4

Discussion sections. Discussion sections will help review concepts introduced in lectures and most importantly develop your programming skills, focusing on outcomes 1 and 2.
Discussion section leader. Shelley Rohde (e-mail: srohde@ucmerced.edu)
Section Math 131-001 T 10:30 am – 11:20 am, Kolligian Library 208
Section Math 131-002 R 6:30 pm – 7:20 pm, Kolligian Library 208

Textbook. *Numerical Analysis* , 8th ed., by Burden & Faires, edited by Brooks & Cole 2001, Chapters 1 through 7, focuses on all outcomes.

Topics covered. Computer arithmetic, solutions of one algebraic equation, interpolation and polynomial approximation, numerical differentiation and integration, initial value problem differential equations, direct solution of linear systems, iterative techniques in linear algebra (Chap 1-7).

Course webpage. The Math 131 website is part of the UCMCROPS course management system.

Homework. Homework will focus on outcomes 1, 2, and 3 and be assigned nearly every Monday during lectures and be due the following Monday before 4 pm. Late homework will be penalized at a rate of 25% penalty for each day late. Parts of the homework assignment will ask you to submit computer programs.

Exams. There will be two unit exams and a ccomprehensive final. All exams will focus on outcomes 1, 3, and 4. The unit exams will be given during lectures the on Friday October 3^{rd} and Friday November 21^{st}. These will be 50 minutes exams. To avoid disturbances over this short examination period, students will not be permitted to enter the room late or to leave early.

There will be no make-up exams or early exams! If you are sick during a unit exam, please bring a note from your doctor verifying your illness. Your course grade will be determined by the rest of your course work.

Grade determination. A combination of the 11 homework assignments (50%, the worst homework grade will be dropped), two unit exams (each worth 12.5%), and one cumulative final exam (25%).

Programming. All required programming will be done in Matlab, Matlab student version, or its free alternative Octave. Matlab can be found on computers in rooms COB 281, KL 202 and KL 208.

COURSE GOAL. Present students with preview of advanced mathematics.
Instructor. François Blanchette (e-mail: fblanchette@ucmerced.edu)

Learning outcomes

1. Understand the main idea behind a variety of mathematical topics.
2. Be able to express mathematics clearly both in writing and verbally.
3. Appreciate the breadth, usefulness and elegance of mathematics.

Lectures. Lectures will introduce new concepts, present an overview of a topic and give examples of its applicability.
Lecture time. F, 11am – 11:50am in room COB 276.
Office hours. Upon request.

Discussion sections. There are no discussion section in this class.

Textbook. There are no textbooks for this class, but access to a calculus textbook is recommended.

Topics covered. Logic operators, set theory, numerical estimation of functions, proof techniques, random walks, transforms, real numbers, series solutions to differential equations, graph theory, image processing, math softwares, large scale simulations.

Course webpage. The Math 91 website is part of the UCMCROPS course management system.

Homework. Brief homeworks (1 question) will be assigned after every lecture. They will largely be graded on whether or not a serious attempt was made at solving the problem. **Particular attention will be given to the logical structure of your assignments.**

Presentation. Every student will be required to prepare a 5-10 minute presentation of a mathematical problem of his/her choice or suggested by the instructor. Whenever possible, the subject should correlate with what we are doing in class, although it is not necessary. The presentations should be sufficiently prepared as to be comparable in style to the lecture of a professor. The topic chosen may be anything that you find interesting, involves mathematics, and goes beyond lower division math course (Math 21-24 and math 32).

Grade determination. Your presentation will receive a Pass/No Pass grade. If you receive a No pass grade, you will be required to give a second presentation. Each homework will be given a Pass/No pass grade. If no more than 2 homeworks receive a failing grade, you will pass this class.

COURSE GOAL. To enable students to adequately prepare for their preliminary exams held in January by reviewing undergraduate material.
Instructor. François Blanchette (e-mail: fblanchette@ucmerced.edu)

Learning outcomes

1. Have a working knowledge of Calculus.
2. Have a working knowledge of Differential Equations.
3. Have a working knowledge of Linear Algebra.
4. Have a working knowledge of Complex Variables.

Lectures. Lectures will review material, delve deeper on difficult topics and allow for lots of questions. You should come prepared with questions regarding the material we have covered thus far. On topics where students are more familiar, you may be the ones giving lectures.
Lecture time. F, 10:00 am – 11:50 am in room COB 261.
Office hours. On demand.

Recommended Textbook (equivalent textbooks may well be used)
Calculus, J. Stewart, any edition.
Linear Algebra and Its Applications , G. Strang, any edition, Chapters 1-6.
Elementary Differential Equations and Boundary Value Problems, Boyce & Diprima, any edition.
Complex Variables and Applications, Churchill & Brown, any edition.

Topics covered. We will cover, briefly, the following: Calculus, including vector calculus and the divergence, Stokes and Green's theorems. Linear Algebra, including complex matrices and positive definite matrices. Differential equations, first and second order, systems of linear equations, and interpretations of vector fields. Complex variables, analytic functions, mappings, residue theorem. The emphasis in all these topics will be on understanding the principles at work and on being able to use these tools to solve problems, and not on deriving the results themselves. A more detailed list of topics will be provided in class.

Course webpage. The Math 298 website is part of the UCMCROPS course management system.

Grade determination. Your grade will be entirely determined based on your participation in class. In particular, you may be asked to present a topic to the class, and you will certainly be asked to answer questions at the board. If your participation is not satisfactory, you will be given a warning during the semester. If the situation does not improve, you will receive a second and last warning.

You are STRONGLY encouraged to work in groups to review the numerous topics covered in this class. You will have to study for severals dozens of hours to prepare your preliminary exams, and this is better done with a friend or more. You are also STRONGLY encourage to begin reviewing early (Aug 28th is a good day to start), particularly the topics you are not comfortable with. And ask lots of questions.