GENERAL EDUCATION COURSE PROPOSAL
UNIVERSITY OF MARY WASHINGTON

Use this form to submit **EXISTING** courses for review. If this course will be submitted for review in more than one category, submit a separate proposal for each category.

COURSE NUMBER:	**FSEM 100D**			
COURSE TITLE:	**THE MATHEMATICS OF CHAOS**			
SUBMITTED BY:	Jeff Edmunds, Suzanne Sumner	**DATE:**	1/17/08	
This course proposal is submitted with the department's approval. (Put a check in the box to the right.) ***If part of a science sequence involving two departments, both departments approve.***				**X**

THIS COURSE IS PROPOSED FOR (check one).

First-Year Seminar ***(indicate in the rationale if this will also count for major credit)***				**X**
Quantitative Reasoning				
Global Inquiry				
Human Experience and Society				
Experiential Learning				
Arts, Literature, and Performance: Process		**or**	**Appreciation**	
Natural Science ***(include both parts of the sequence)***				

NOTE: See the report entitled "General Education Curriculum as Approved by the Faculty Senate," dated November 7, 2007, for details about the general education categories and the criteria that will be used to evaluate courses proposed. The report is available at www.jtmorello.org/gened.

RATIONALE: Using only the space provided in the box below, **briefly** state why this course should be approved as a general education course in the category specified above. *Attach a course syllabus*. **Submit this form and attached syllabus electronically as one document to John Morello (jmorello@umw.edu).** All submissions **must** be in electronic form.

Most first-year students with an interest in Mathematics take Calculus at some level. Such a course typically focuses on computation and applications, and does not delve deeply into the underlying principles of the real number system. As a result, many students fail to obtain a solid understanding of the concepts that they apply. The goal of this first-year seminar is to give students the background to better understand the properties of real numbers and thus the concepts behind the techniques that they will learn (or have learned) in Calculus. They will also see some of the topics taught in higher-level Mathematics courses such as Real Analysis and Topology.

While a course on this topic is offered at the senior level (MATH 411), we believe that a first-year course with a different approach will provide an excellent platform for mathematical inquiry and discovery. We will incorporate a number of assignments which will combine computer output with discussion of the underlying mathematical concepts and relevant examples. Each student or perhaps small groups of students will work on a final project which they will present to the class at the end of the semester, and they will prepare a formal write-up of their findings. Jeff Edmunds has taught this course and found it highly successful in exposing first-year students to mathematical inquiry while improving their writing and speaking skills.

FSEM 100 D FALL 2007
THE MATHEMATICS OF CHAOS

Instructor: Dr. Jeff Edmunds **(jedmunds@umw.edu)**

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Office: B32 Trinkle Hall, 654-2028

Office hours: MW 2-3pm, R 1-3pm, F 12-1pm, and by appointment.

Readings to include: *Some Mathematical Models with Very Complicated Dynamics* by R. May
Period 3 Implies Chaos by T. Li and J. Yorke
Chaotic Dynamics in an Insect Population by R. Costantino *et. al.*
selections from *Chaos* by Alligood, Sauer, and Yorke

As there is no formal text for this course, **your notes will be a critical resource.** Make sure that you have access to a fellow student's notes in the unlikely event that you miss a class.

Course Objectives: Chaos theory is dependent on the continuum of the real numbers. The main purpose of this course is to explore the real number system and higher-dimensional Euclidean space in much more detail than a traditional calculus course allows, while focusing on concepts that require no formal background in calculus. This will be accomplished mainly through the study of discrete dynamical systems. Over the course of the semester you will:

- explore the concept of a function beyond what is typically taught in Algebra or Calculus
- learn the process of function iteration
- develop a deeper understanding of the real numbers
- understand the concepts of limits and continuity as they relate to functions
- learn the concept of a metric space
- study some famous results from the genesis of chaos theory
- learn some properties of complex numbers and complex functions
- explore the concept of Julia sets and the Mandelbrot set
- develop an understanding of fractals in Euclidean space
- work with applications using discrete dynamical systems
- learn how to use the software package *Dynamics Solver*
- develop skills to approach mathematical concepts and problems with greater depth
- develop writing skills both general and specific to the discipline of mathematics

Grading: Grades will be based mainly on formal writing assignments throughout the semester. There will be five written assignments in which you will incorporate output from *Dynamics Solver* into a document with thorough explanations of the underlying concepts and relevant examples. These will be worth **10 points each**; deadlines will be given with each assignment and late assignments will **lose two points for every calendar day overdue.** These will be graded on both content and style, so you should be prepared to learn some form of mathematical word-processing software such as the *Equation Editor* package included with Microsoft Word.
There will be a final project with a presentation during the last week of classes and a paper due Monday, December 3rd, which will focus on a topic of your choice. Your idea should fit into one of these three categories:

- a formal research project on some historical topic or scientific field relevant to chaos theory, with a heavy emphasis on primary sources;
- a study of a specific application of dynamical systems;
- a computer exercise with an emphasis on programming and graphics.

You will submit a rough draft of your final paper on Monday, November 19th **worth 5 points; the final paper will be worth 10 points and the presentation also worth 10 points.**

There will also be a cumulative, take-home final exam worth **25 points** that will cover mainly definitions, theorem statements and some simple computations. Though not given formal weight, attendance and class participation will be expected.

Honor System: Students are expected to adhere to the Honor System of the University of Mary Washington. All written assignments and the final exam will be pledged.

Calculators: A TI graphing calculator is required for this course. Any version 82 or higher is fine; I will be using an 83 for in-class presentations.

Software: You will be required to use a software package called Dynamics Solver, which can be downloaded free of charge at: http://tp.lc.ehu.es/jma/ds/ds.html
The current version is 1.70 and works on Windows XP. Dynamics Solver is also available on the computers in the Trinkle labs. You will be expected to complete written assignments in a word processor. If you choose to use *Microsoft Word* you will need access to the built-in *Equation Editor* for this program and will be expected to learn how to use it.

Course Policies:

- Any student with a disability is invited to meet with the Director of Disability Services to discuss potential issues associated with meeting course requirements.

- One purpose of the first-year seminar is to familiarize students with the resources available at the college library and through the library's web page. You will be expected to utilize these resources for this course. There will be one class meeting in Simpson library with the campus Science Librarian to learn some basics.