Florida Atlantic University
College of Engineering and Computer Science
Department of Computer and Electrical Engineering and Computer Science

Course Syllabus – Spring 2010

Course Title: Nature: Intersections of Science, Engineering, and the Humanities

Course Number: ETG 2831
Content Hours: 3 **Contact Hours:** 3 **Lecture Hours:** 3

Instructors: Dr. Michael Van Hilst & TAs

Required Texts:
1. Peter Corning, *Nature's Magic: Synergy in Evolution and the Fate of Mankind*, Cambridge University Press, 2003 (List: $50)
2. Melanie Mitchell, *Complexity: A Guided Tour*, Oxford University Press, 2009 (List $30)

Reference Texts:
1. Brian Swimme , Sid Liebes & Elisabet Sahtouris, *A Walk Through Time: From Stardust to Us--The Evolution of Life on Earth*, Wiley, 1999. (List: $30, Library: QH367 .L525 1998) *
2. Daniel Botkin, *Discordant Harmonies: A New Ecology for the 21st Century*, Oxford University Press, 1990. (List: $26, Library: QH75 .B67 1990) *
3. Tom Butler, ed., *Wild Earth: Wild Ideas for a World Out of Balance*, Milkweed Press, Minnesota, 2002. (List: $19)
4. Nickolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*, Princeton University Press, 2006. (List: $28, Library: R725.5 .R676 2007)
5. William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*, Princeton University Press, 1996. (List: $42)

Course description:

This course will focus on the influences of science in its endeavor to understand nature; engineering, in its attempts to harness nature; and the humanities, in their role as the shapers of values, through an exciting combination of philosophical readings, penetrating discussions, and computer models and tools. This course enhances students' understanding of human experience through the study of literature and the use of modern technologies and tools, piques their intellectual curiosity in the complex world in which we live, and helps to guide them in matching their interests to their academic pursuits.

Course Goals:

At the completion of this course, each student will be able to

- Better understand scientific, engineering, and philosophical views of the evolutionary process from the Big Bang to the 21st Century and the broader trend toward increased complexity in nature and human society alike.
- Articulate current challenges and future prospects for nature and human society.
- Understand and create models of natural phenomena including population dynamics, disease spread, percolation, evolution, predator-prey ecosystems, etc. using deterministic, probabilistic, and cellular automata models.
- Compare and contrast the strengths and weaknesses of various models and perspectives.
- Consider and reflect upon the ethical and philosophical consequences of the various models.
- Consider and reflect upon the implications of the various models, specifically focusing on resultant responsibilities, if any.
- Utilize a modern software package to simulate and visualize rather complex systems, relationships, social interdependencies, etc.
- Improve teamwork and oral and written communication skills.

Furthermore, this course will help each student to develop logical thinking, balanced skepticism, tolerance for ambiguity and uncertainty, and a knowledge and appreciation of the natural world in all its richness and complexity. Students will understand that it is at the intersection of disciplines where the grand challenges are found.

Grading Criteria:

Grading Scale: 90% & Above = A (Excellent performance)
80% to 89% = B (Above average performance)
70% to 79% = C (Average performance)
60% to 69% = D (Below average performance)
0% to 59% = F (Failing)

This grading scale applies to all exams, quizzes, homework, and the final team project.

Quizzes and Midterm Exam – All quizzes and the midterm exam will be closed book. No notes of any kind are allowed for any exam. There are no make-up exams except with proof of illness with a certified medical excuse. The aggregate of the exam and quiz scores will account for 50% of your grade. There will be no final exam. There will be a final team project. It will account for 25% of your grade. Specific directions and the detailed grading scheme for the final project will be handed out around midterm.

Homework – All homework is required. The homework may require the use of a computer in a lab or through Internet access and the use of simulation software for a variety of simulation models. Simulations will include the guided use of the MATLAB® modeling and simulation tool. All homework must be word processed, with 1.5 line spacing and 1.25" margins on all sides, and submitted in class on or before posted due dates (typically the start of the following week). Grammar, spelling, and presentation do count! All homework must be submitted with a title page (showing name of the assignment, course number, due date and your name). The aggregate of the homework scores will account for 20% of your total grade.

Final Team Project – A final team project (2-3 students per team) that addresses various historical, philosophical, ethical, and environmental issues is required. Questions critically treated in the project may include regarding nature as merely a collection of resources, nature as discordant harmonies, the synergy found in nature, increased complexity in nature and human society, economic theories of biological complexity, mainstream and other views of evolutionary biology, computer-centered network and information system formations and how they relate to nature, the ethics of genomics and artificially managed human vital processes, etc. The term project may include a computational or simulation component developed from the Technical Foundation (see below) in which some nature phenomenon is modeled and then critically discussed in respect to the philosophical implications of the result. The final team project will account for 30% of your grade. Specific directions, including paper style template, and the detailed grading scheme for the final team project will be handed our at the beginning of the course. Plagiarism will not be tolerated. All sources of information for your paper MUST be cited! Direct quotations must be between quotation marks.

Technical Foundation:

We seek to develop in students the ability to formulate simple models in a wide spectrum of natural phenomena by building upon classical modeling techniques. We believe that students who take this course will be better humanists, artists, scientists, nurses, engineers, business men and women, and citizens.

In the first several weeks of this course, students will gain confidence in the use of MATLAB® as a software tool. The MATLAB® tools are widely used for modeling complex systems in business, engineering, economics, biology, health, and many other fields. We will be using the tools for simple exercises in population dynamics. A wide variety of tutorials are available at http://www.mathworks.com/academia/ by clicking on Student Center. Specific tutorials will be suggested in class.

Topics covered will include

- Basics of MATLAB programming – by example.
- Plotting, symbolic number, and lists
- 2-D and 3-D graphics
- Using differences ("ODE") to show changes over time

Following the initial tutorials, we will focus on the approaches that have been used and that are presently being used to model natural phenomena, including

- Deterministic models: Malthusian, Verhulst, and Lotka-Volterra
- Probablistic models: random walk, self-avoiding walk, accretion, spreading phenomena (viral diseases)
- Cellular Automata models: game of life, forest fires, predator-prey ecosystems

A homework mini-project is assigned for each of the three modeling approaches. Each student will work independently on the homework mini-project to establish their competence with using the computer and the course material on modeling natural phenomena. The goal of the homework mini-project is not only to ensure mastery of the material, but also to serve as a seed for the proposal that each student team must submit for the final team project.

Tentative Course Outline by Week (<u>TENTATIVE</u>):

1. Introduction and readings in Natural Magic, critical discussion
2. Readings of Cicero & Lucretius, critical discussion
3. Technical Foundation – Demonstration of deterministic and probabilistic computer models
4. Readings – Jewell & Fuller and critical discussion
5. Technical Foundation – Demonstration of probabilistic and cellular automata
6. Readings – Hutchinson, environmental management expert lecture, critical discussion
7. Midterm examination review, final team project discussion, and midterm examination
8. Readings – Natural Magic, critical discussion
9. Readings – Natural Magic, critical discussion
10. Readings – Complexity, critical discussion
11. Readings – Complexity, critical discussion
12. Readings – Ethical issues related to nature, critical discussion
13. Magic Hooey Stick demonstration, critical discussion
14. Final team project presentations
15. Final team project presentations
16. Final team project due

Attendance and Participation: Attendance makes up 5% of the grade. Attendance will be taken at the start of each class. If you arrive late, speak to the instructor at the end of class (2 late arrivals are permitted). Reading email or surfing the Web is not permitted during class.

Assessment Statement:

As part of the FAU campus-wide assessment initiatives (quality assurance program), samples of students' performance such as exam results, project papers, etc. may be used. The data gathers will not identify students and is not related to the students' grade from the course, but will be used to improve student learning at FAU.

(Version 12/09/09)