NEW COURSE PROPOSAL

A course may be added to the College catalog once the following steps have been completed:

1. The course proposal has been presented to the department or program awarding credit (or sponsoring the offering of the course). This presentation should address the issues listed below in the section titled--New Course Proposal Form and Issues to Address.

Done.

2. The department or program has considered the proposal at a meeting of its faculty and the course has received approval at that level.

Done.

3. The proposed course, as approved by the department or program, has been circulated among the chairs and program directors of the appropriate school, who have provided feedback to the department or program.

Done.

4. The proposal has received approval from the Dean of that school.

Done.

5. Simultaneously with steps 3 & 4, a library review has been completed.

Done.

6. The New Course Proposal Form has been submitted to the UEPC.

TBD

7. A brief note of support has been submitted to the UEPC by the Chair of the Department hosting the course stating that the faculty in the department are aware of and support the new course. A brief note of support has also been submitted by the dean of the appropriate school.
NEW COURSE PROPOSAL FORM AND ISSUES TO ADDRESS

1. List School, Department, course number and course title

School of Science
Department of Physics
Physics 102: Computational Physics.

[Upper division courses, for purposes of approval, are characterized by at least two of the following guidelines:

.a) have college-level prerequisites;

Phys 1, 3, 60, Math 27, 38.

.b) require an in-depth study of a subject rather than a survey or introduction, and presume the necessary introductory work has been completed;

This course is a deepening of the understanding of topic introduced in introductory physics that is made possible through computational techniques.

.c) demand rigorous reading/writing/discussion skills as well as an intellectual readiness and personal maturity in handling complex issues that are characteristic of advanced students;

The course requires the synthesis of many areas they have studied in investigations of specific applied areas of physics, and to write coherently about this investigation.

2. Justification for the course: In this section explain why the course is being proposed. Grounds may include but are not limited to: new developments in the discipline, the needs of majors/minors, the needs of other departments.

In addition, please address the following specifics:

.a) Objectives of the course: Indicate expected student outcomes, for example, competence in using methodologies specific to this field, assessing data/statistics, survey of literature, in-depth research, etc.

Physics today is critically dependent on the computational power provided by digital computers. This course, which has become a standard course in many departments of physics, introduces
the student to the computational methods is physics by investigating areas of physics that evade a full analytical treatment and which can only be fully understood through computational methods. Along the way the students will learn to write computer programs in Matlab. Matlab has become the standard programming language in Engineering and many areas of science. Indeed our 3+2 engineering students are expected to know how to use Matlab before transferring to one of our affiliated schools. This class will address this pressing need of the engineering students.

b) Describe how the objectives listed above relate to Department, School, or College goals.

This class directly supports the department goal of preparing students to do investigations in physics and the 3+2 engineering programs goal of preparing students to do engineering.

c) Describe the kinds of assignments/tasks that will be typical of those used to evaluate the performance of students in the course. Will the pass/fail grading option be allowed?

The students will be expected to do investigations of different physical systems using computational techniques and to answer substantive questions regarding these systems that can only be answered if they have successfully done the computational analysis. This class will not allow pass/fail grading for credit in the major.

3. Student Population Identify who the anticipated students will be: department majors? majors from other departments? students fulfilling other requirements? Also give an estimate of how many students will be taking the course when offered.

It is expected that mostly physics and engineering students will take the class. The enrollment is expected to be 15-20.

4. Relationship to present College curriculum Indicate where this course fits in relationship to other courses in the department. Identify any needed modification to (or deletion of) existing courses as a result of offering this course. List courses in other departments related to or affected by this course, particularly the potential impact (either positive or negative) of this course on other departments and programs.

This course would be an alternative to the required CS 21 for physics and engineering students. It is expected that there will no longer be a need to teach two sections of CS 21.

5. Any extraordinary implementation costs Indicate whether there will be any special or additional equipment necessary to run the course? special classroom or other physical space requirements?

This course has been taught successfully in the physics laboratory where we already have
installed licensed copies of Matlab.


There is no anticipated resources of the library beyond some standard textbooks in computational physics, some of which are already in the libraries collection. Suggested texts at three levels are:

- **Introductory level:** Paul L. Devires, *A first course in computational physics*
- **Intermediate level:** Rubin H Landau, *Computational Physics*
- **Advanced level:** Jos Thijssen, *Computational Physics*

The intermediate level text is in the library collection.

*7. Course credit.*

This would be a standard 1.0 SMC credit course, meeting for lecture 2250 minutes per semester, with an expected work load outside of class of 4500 minutes. The class will be offered for a letter grade.

8. Prerequisites, corequisites (If applicable)

The prerequisites for the course are Phys 1,3,60, Math 27,38.

9. Course description wording for the appropriate College catalog.

**Physics 102: Computational Physics**

This course will be an introduction to the use of computational techniques to understand physical systems that are unapproachable via analytical methods. The class will also be an introduction to effective programming in Matlab. Topics will include applications of numerical integration, numerical solutions to transcendental equations, ordinary differential equations and partial differential equations, and the uses of Fourier analysis.

10. Course content A syllabus, with tentative reading list, topics to be covered, and major assignments, will normally be expected.

There will be regular assignments requiring the students to apply the techniques of the class to specific physical systems and to answer a question about that system. They will be required to write a report for each study which describes the results of the investigation and the algorithm employed in the computer code used. In addition, there will be a midterm and final exam in which they will be expected to complete a similar study. The exams and homework will be weighted equally in determining the grade for the course.

The text book will be something similar to *A first course in computational physics* by Paul L. Devires.
Example Syllabus

Algebraic Systems

Solving transcendental equations: Finding quantum energy levels

Ordinary Differential Equations

Newton's second law as an ODE

Euler's method

Runge-Kutta method

adaptive step size

Limits of precision

Partial Differential Equations

Laplace's equation: Heat/Diffusion equation.

Minimization

Principle of least action:

Fourier Analysis

Analysis of filters

Evaluation of electro encephalogram data.

Data fitting

Method of least squares deviation

Parameter estimation for theoretical models

Significant wave height from reflected radar signals

11. Review of experimental offering: Address what was learned and if any changes grew out of the experimental offering of the course.

The class has been taught by Chris Ray and by Roy Wensley as a special topics course (Physics 140). We have adapted the course content and the programing language used in response to the experience of teaching these courses. The student evaluations of these course was on a par with other courses taught by the physics department.