CALIFORNIA COMMUNITY COLLEGES
AND
SAN JOSE EVERGREEN
COMMUNITY COLLEGE DISTRICT

#90-0025
**Development of Physics Software**

- **Funding Category & Award**: Grant = $12,062
- **Eligible Program**: A --- Nontraditional Instruction
- **Project Category**: Developmental Model
- **Project Product**: Computer Programs
- **Project Topic #1**: Curriculum Develop
- **Project Topic #2**: Physics
- **Project Director**: R.H. Ibarra, Instructor
- **Project Supervisor**: R. King, Ass’t Dean Math & Science

**Proposal Description**

San Jose City College has examined, adapted and developed physics software for the calculus based introductory physics classes. The software allows students to simulate various physical situations and aids in developing physical intuition.
Educational Program or Service Addressed
The proposed project is intended to provide physics students at San Jose City College (SJCC) and other community colleges with physics software that will enable them to explore physics and gain a better understanding of the world of physics.

Specific Problem(s)
There is a need to develop good physics software in the calculus-based introductory physics that students can use to simulate various physical situations and help in developing their physical intuitions. The few physics models that exist in the market today are not well documented and there has been no concerted effort to determine which of these models are appropriate at the introductory level.

Population to be served
The project seeks to reach principally students taking introductory physics at SJCC. However, instructors and students at other community colleges will be welcome to share and use the software that we will develop.

Objectives/Activities
I) to find out what models and software already exist in the market and whether some of these models can be improved upon, modified and adapted to our needs at SJCC, ii) to design and develop computer models that will simulate physical systems, and iii) to write a documentation of each model that we develop, modify and/or adapt.

Evaluation Plan
The models that we develop will be tested in our physics classes at SJCC. Other physics instructors will be asked to give input and provide written feedback. Students will be asked to complete a survey form that will record their perceptions/awareness on several items. Performance of students who will be using these models will be monitored and compared with those who use the traditional instructional system. A comparison of grade distribution, retention rate, etc. will also be made and evaluated.

Expected Output
We expect students to have better understanding of physical principles and that they will sharpen their intuitive abilities. Moreover this approach will bring new excitement to the
classroom, offering the opportunity to invigorate and improve teaching methods in the physics classroom.

Dissemination Plan
A list of models together with the documentation will be made available to all SJCC and other community colleges. Project outcomes will be reported to instructors through the Northern California Community College Consortium and the American Association of Physics Teachers.
90-0025 --- FII --- NARRATIVE

San Jose Evergreen Community College District

Development of Physics Software

1. Specific Educational Program Being Addressed

Educational Program or Service Addressed.

A major challenge in the application of computers to physics at the calculus-based introductory level is the development of good physics software that students can easily use to enhance their understanding of physical principles. Recognizing this need we have integrated computers into our physics instruction through our Physics 37 Special Topics section which meet one hour per week. Our focus has been on applying numerical methods to nonlinear problems and simulation of physical models with graphical output and computer generated animation. While doing this we have been aware of the need to develop new physics software that would allow students to explore physics on their own and experience "doing physics "with the computer.

Development of Physics Software is a project which directly contributes to professional staff development and is eligible for funding by the Community College Fund for Instructional Improvement (FII).

The project should be viewed as a concerted effort by the entire faculty at San Jose City College (SJCC) to enhance the use of computers; thus greatly enhancing student's computer literacy.
2. Specific Problems Being Addressed

Specific Problem(s)
The American Association of Physics Teachers (AAPT) Announcer (Dec. 1988) reported that "the calculus-level introductory course in physics has existed in a steady-state condition since 1960; the content of the course, the textbooks serving the course, and the style of homework and exam problems employed in the course, have all remained essentially the same ..... hand-held calculators did not exist in 1960 computers hardly existed ... the computer is now changing the way physics is done". It is now clear that the question is not whether the computer can be used to teach physics but rather how the computer can be used to teach physics most effectively.

Referring to recent cognitive research concerning how students learn physics, they added: "There is a body of research data that suggest how students learn physics. As a consequence of these data, we know in more specific terms what alert teachers knew but vaguely in 1960; namely a range of conceptual difficulties plague the learning process. We have also learned that problem-solving skills cannot, in itself, be translated into student understanding. We know that students develop algorithms for solving problems and they can get correct answers without the physical concepts involved." What is needed is a new approach to physics teaching that will free the student from the workaday world of procedural detail, allowing a more focused concentration on underlying physical concepts. The computer is ideally suited to this.

In order to meet this demand we need to develop good physics software that students can use to enhance their understanding of physical concepts and principles. These models will allow students to explore physics on their own and help develop their physical intuitions. The few physics models that exist in the market are not well documented and there is no concerted effort to determine if these models are appropriate at the introductory level.
3. Population To Be Served

Population to be served. The project seeks to reach principally students taking introductory physics at SJCC. However, students at other community colleges are welcome to share and use the software that we will develop. With some modifications some of these models can be adapted to high school physics.
4. Objectives

[SEE “WORKPLAN” SECTION OF THIS DOCUMENT.]
5. Workplan Narrative

WORKPLAN

Objectives/Activities:

Objective 1 ---
To find out what physics software are available in the market and evaluate them in terms of their appropriateness for introductory physics:

1.1 Survey the physics software that are available in the market (Sept.-Oct.'90);
1.2 Evaluate the appropriateness of the above software for adaption in introductory physics (Oct.-Nov. '90);
1.3 Improve, modify and/or adapt some of these models for our physics course offerings (Nov.-Dec '90);
1.4 Write a description of each model (Jan '91).

Objective 2 ---
To develop new physics software for the calculus-based introductory physics (Physics 4A/B/C):

2.1 Identify problems in mechanics, electromagnetism, waves, light and other areas of physics amenable to computer analysis (Oct.-Dec '90);
2.2 Write a computer program that will solve each model problem (Jan-May '91);
2.3 Test each model by making simple test runs (May-June '91);
2.4 Write a description of each model (July-Aug '91).

PERSONNEL
The grant will provide 20% release time for one full-time instructor during the academic year 1990-1991. Personnel required for the activities described above include the project director and an assistant who will help in the programming aspects of the project. The applicant considers himself very qualified to direct the project for the following reasons:

• Ph.D. in Physics;
• More than 26 years of teaching and research experience including several years of research work at the leading physics institutes in Europe;
• More than 15 scientific articles published in leading international physics journals;
• Completed a summer '89 project on computer usage relevant to physics instruction funded by the Staff development Program.
6. Expected Outcomes

Expected Output
We expect students to have better understanding of physical principles and sharpen their intuitive abilities. Moreover, use of the computer models are expected to bring new excitement to the classroom, offering the opportunity to invigorate and improve teaching methods in the physics classroom. We plan to build on the results of the project for future work, including applying for State and/or Federal grants.
7. Evaluation Plan

Evaluation Plan,
The models that we develop will be tested in our physics classes at SJCC. Other physics instructors will be asked to give input and written evaluated feedback. Students will be asked to complete a survey form that will record their perceptions/ awareness on several items. Performance of students who will be using these models will be monitored and compared with those who use the traditional system. A comparison of grade distribution, retention rate, etc. will also be made and evaluated.
8. Dissemination Plan

Dissemination Plan.
A list of models together with the documentation will be made available to SJCC and other community colleges. Project outcomes will be reported through the Northern California Community College Consortium and the American Association of Physics Teachers.
9. Budget Narrative

[NO “BUDGET NARRATIVE” ACCOMPANIES THIS DOCUMENT.]