The University of Tennessee at Chattanooga Student Technology Fee Funding Request

Proposal

Beginning 2005-2006

Title: Establishing a new computerized laboratory classroom for teaching introductory physics at UTC

Unit Submitting Proposal: Department of Physics, Geology and Astronomy

Briefly summarize the proposed project.

This project is designed to directly improve instructional quality in the introductory physics/astronomy and general science courses. We plan to establish a new introductory physics/general science laboratory in the room 318, Grote Hall and improve instructional technology in the existing labs (rooms 315 and 317 Grote). We request the following computer equipment for use in a classroom setting during lectures and laboratory sessions: 16 PC desktop computers, 2 Dell Laser Jet printers, 2 laptop computers, 16 ULI (data acquisition) boxes, 3 Dell computer projectors. Approximately 900 students per year will benefit from this improvement at UTC. The desktop computers will be used in laboratories for data acquisition and processing, the printers will be networked for the laboratory use, laptop computers will be used in the classroom for multiple purposes (see below). The computer projectors will be permanently mounted in the classrooms (Grote 315, 317, and 318) to project the information on a big screen. We believe that using modern technology in the introductory physics classes will expand student learning by adding a powerful multimedia component to the lecture, teach students to access web-based assignments, and help them use Internet information resources for their education and research. In laboratories students will be able to work in smaller teams, have additional time to access the equipment, and be able to collect and process data much faster, leaving more time for thinking about physical phenomena. The students will learn physics principles in action and become familiar with equipment, informational resources and technology used by scientists in real life. The department will be able to eliminate the schedule conflicts.

We at the Department of Physics, Geology and Astronomy have been very successful in implementing computer technology in teaching introductory level physics. We can use computers extensively in our introductory laboratory experiments for data acquisition and analysis (see Appendix). Faculty members have been giving Internet-based assignments. We have been using the computer stations we obtained from the Student Technology Fee Fund in year 2000. Now we want to establish a new computerized laboratory room (Grote 318) and add 2 more computerized stations to each existing room (Grote 315 and 317): one for the instructor's presentation, another one for student use (we do not have enough stations for highly populated 100 level Physics, Astronomy and General Science classes), and add a big screen projection capabilities to each lab.

We believe that we can dramatically increase the quality and efficiency of our lectures and laboratories if we can establish a new computerized laboratory classroom, update the lab equipment and bring computer-based multimedia approach to all the classrooms.

Identify the project goals and objectives. Briefly describe your goals and objectives. Include in the description how the outcomes of the project will improve teaching and learning. Indicate also the anticipated reach of your project. In other words, how many and what type of students will benefit from the successful execution of the proposed funding? How will they benefit?

This project, if funded, will allow us to optimize the use of computerized activities in our different introductory courses. It will affect approximately 900 UTC students per year of all majors who take physics/astronomy/general science either for general science or major requirement (see enrollment data in the appendix).

Our first-time physics students in introductory classes have the same difficulties commonly found in physics and astronomy courses throughout the United States, such as weak backgrounds in physics, mathematics and science in general. Students have a perception that physics is hard; they are often not familiar with the way we formulate problems in science. They are many times afraid of working with laboratory equipment. Because of their inexperience, they often need more time to become comfortable with apparatus than tight class schedules can allow. They need time to realize that despite their applied efforts, the experimental data may be different from their expectations.

Our first goal is to establish a new computerized laboratory classroom to teach all computer-based experiments we have on hand to all our students in introductory level laboratory courses (see the course description, enrollment and list of available experiments in the Appendix). We started integrating computers into the introductory physics laboratory in 1995. Since 1995 the physics faculty have adopted and/or developed computer-based experiments for all of the introductory level courses: Physics 103, Physics 104, Physics 230, Physics231, Physics 232, General Science 111, Astronomy 101 and 102. The student evaluation of computer-based experiments is overwhelmingly much higher than the old lab activities, which did not involve computers. Expanding the use of computers has become a departmental goal of highest priority. Presently we have 2 computerized rooms with nine stations each. We need to add another room (Grote 318 has been reserved for it) to eliminate schedule conflicts and provide all students access to the computerized experiments. **Modern and reliable computer-assisted laboratories** will allow our students to (1) have additional time to access the equipment, (2) collect and process data much faster, leaving more time for thinking about physical phenomena, and (3) work in smaller teams. Computer technology will bring physics principles to life, and our students will become familiar with equipment used regularly by physicists and engineers.

Our second goal is to incorporate computer-based multimedia technology into the day-to-day teaching of introductory physics courses. The requested equipment (projectors, permanently mounted in the labs, laptops, projection screens for TI calculators) will be used for the following purposes:

1. Classroom demonstrations/simulations/animations will bring physics principles to life for the students. Currently all textbooks come with computer-based audio-visual supplements. For example, the textbook we use for Physics 103/104, "College Physics" by Wilson and Buffa, comes with "Presentation Manager CD-ROM" and "Just-in-Time Teaching: Blending Active Learning with Web Technology." None of our labs has projection capabilities, and funding for this project will provide a major benefit for the student's learning environment.

2. Other educational resources such as "A Multimedia Approach to Material Science" by J. C. Russ or "Protein data bank" from Brookhaven National Lab are widely available on CD-ROM and can be used to illustrate topics being discussed in class.

3. We would finally be able to use the Internet in the classroom. The amount of physics-related

information available from national labs and educational web-sites of other universities is huge, and can be very valuable for the introductory students. Some examples are the National Institute of Standards site (which teaches students about universal physics constants and units), Brookhaven National Laboratory outreach site, Internet accessible laboratory (Net Spectrometer) at UTK, and the Hubble Telescope web site to name a few.

4. Faculty at the Department of Physics, Geology and Astronomy are putting more and more course-related information on the web. Faculty have their course syllabus and class information on their web-site (see, for example, www.utc.edu/Faculty/Tatiana-Allen). Some faculty are now using an Internet-based homework service for introductory courses. Being able to a project computer screen so that students can see material and assignments in real time and be stimulated to ask questions, would be a big advantage.

Describe the method with which you will achieve your goals. Briefly describe your methodology. Include a calendar of target project dates. That is, when will the major steps in the project begin and end?

The requested equipment will be used in the following way:

Room 318 of Grote Hall will be equipped with 12 Desktop computers, which can accommodate up to 25 students (limit enrollment for laboratory classes). Two more computer stations will be added to each of rooms 315 and 317 Grote. Each computer will have data acquisition box. The computers will be networked to a server and connected to the Internet. The networking equipment is available. Networked printers will be used in each room. All three rooms will be equipped with a computer projector and a TI calculator projection screen. Laptop computers will be used in different classrooms, where they will be connected to the Internet.

It will take about a month to set up the laboratory equipment. We will be able to run all rooms starting the fall semester of 2005.

How will you evaluate the success of the project? Describe your evaluation criteria clearly. How will you determine whether the project is successful?

We will consider this project to be successful if:

1. We are able to teach all computer-based experiments we have on hand to all our students in introductory classes, and able to use the computer-based technology in the classroom. Students are able to take advantage of multimedia classroom demonstrations and Internet information resources.
2. Students continue to give high approval ratings to these activities, as evidenced on the student lab evaluations.
3. We successfully eliminate computer equipment conflicts between different courses.
4. We are able to develop/adopt new computer-based experiments, having in mind that we have enough computerized student stations to accommodate all students and avoid computer equipment conflicts. We should be able to bring new computer-based activities into the classroom.

Previous grant(s): If you received a Student Technology Fee grant last year, have you submitted your final report?

The department received the Student Technology Fee grant only once, in the spring of 2000. We have completed the project and submitted the final report.

Proposed location: Describe the proposed location of the equipment, software, etc.

The majority of equipment will be used to establish a new computerized laboratory classroom (in Grote 318). Some equipment will be added to the existing Physics Laboratories, rooms 315 and 317 Grote Hall.

Requested Budget: Clearly identify one-time costs, such as equipment, shipping, and installation. Clearly identify recurring costs, such as maintenance and support, and the source of the funds to cover the recurring costs.

One-time cost:

Dell OptiPlex GX280 Desktop computers	16@$1586 =	$25,376
Dell 1700n printers	2@$653 =	$1,306
LABPRO data acquisition boxes and cables	16@$255 =	$4,080
Dell 4100MP projector	3@$2009=	$6,027
Dell Latitude D400 computers	2 @$2065 =	$4,130
Texas Instruments Projection screens	3@$355=	$1,065
Subtotal		$41,984
Shipping estimated at 10%		$420
Total		**$42,404**

Summary of projected costs

Salaries (if any)	$0
Equipment (hardware and software)	**$42,404**
Complete the following items as appropriate	
Installation	$0
Construction/renovation costs	$0
Annual maintenance/support costs	$0
Training	$0
Recurring costs per year	$0
Total project one-time costs	$**$42,404**
Estimated recurring costs per year	$0

Identify the area(s) responsible for operating and maintaining the equipment.

Department of Physics, Geology and Astronomy. Maintenance and support will be provided by Mr. Jack Pitkin, who is currently employed at the Department, and the Help Desk personnel.

Approval by Dean or Vice Chancellor:_____

Individual responsible to complete proposal if funded: Dr. Tatiana Allen, Dr. Robert Marlowe, Mr. Jack Pitkin

Priority established by Dean or Vice Chancellor:_____

Deans and Vice Chancellors should return completed forms (along with 25 copies) to Provost John Friedl, Chair of the University Technology Committee, prior to **December 13, 2004.**

APPENDIX

COURSE DESCRIPTION AND ENROLLEMENT

ASTR 101 Introduction to Astronomy-The Solar System + Lab Astr 181(4 credit hours with lab, 3 without). Descriptive and conceptual. The structure, nature, and origin of the solar system. Optional 2-hour laboratory illustrates concepts of practical astronomy. On demand. Lecture 3 hours.

ASTR 102 Introduction to Astronomy-Stars to Galaxies + Lab Astr 182(4 credit hours)

The nature of stars and galaxies; the evolution and structure of the observable universe with an emphasis on understanding the experimental foundations of the science. Fall semester. Lecture 3 hours, laboratory 2 hours. Prerequisite: two ye**ars of high school algebra or Mathematics 106. Co-requisite: Astronomy 102 laboratory.**

GNSC 111 The Physical Environment: Atoms to Galaxies + Lab GNSC 181 (4 credit hours)

Explores physical science in three ways: physical science in its historical and sociological significance, the process of science, and the present content of scientific fact and theory. Topics include physics, chemistry, geology, and astronomy. Fall semester. Lecture 3 hours, laboratory 2 hours. Prerequisite: 2 units of college preparatory mathematics or Mathematics 106.

PHYS 103 General Physics - Mechanics + Lab Phys 183 (4 credit hours) Fall, Spring, Summer

An algebra-based introduction to forces and uniform motion, conservation principles, sound, and the law of thermodynamics, with applications to problems of modern science and technology. Required in pre-medical, pre- dental, pre-pharmacy, and physical therapy programs. Fall semester. Lecture 3 hours, laboratory 2 hours. Prerequisites: 3 units of college preparatory mathematics.

PHYS 104 General Physics - Electromagnetism and Optics + Lab Phys 184 (4 credit hours) Fall, Spring, Summer An algebra-based introduction to classical electricity and magnetism, optics, and the concepts of modern physics. Required in pre-medical, pre-dental, pre-pharmacy, and physical therapy programs. Spring semester. Lecture 3 hours, laboratory 2 hours. Prerequisites: 3 units of college preparatory mathematics, Physics 103 or permission of instructor.

PHYS 230 Principles of Physics - Mechanics and Heat + Lab Phys 280 (4 credit hours) Fall (evening), Spring (day). A calculus-based introduction to the laws of classical dynamics, kinematics, and thermodynamics, with applications to simple physical systems. Offered both fall and spring semesters. Lecture 3 hours, laboratory 2 hours. Co-requisite: Mathematics 160 or permission of the instructor.

PHYS 231 Principles of Physics - Electricity and Magnetism + Lab Phys 281 (4 credit hours) Fall, Spring, Summer. A calculus-based introduction to electric and magnetic fields, electric currents, electromagnetic induction and waves. For all engineering students. Fall semester. Lecture 3 hours, laboratory 2 hours. Prerequisites: Engineering 103 and 104, or Physics 104 or Physics 230; Mathematics 150, 160; or permission of the instructor.

PHYS 232 Principles of Physics - Optics and Modern Physics + Lab Phys 282 (4 credit hours) Fall, Spring, Summer. A calculus-based survey of principles of optics, and of the early conceptual advances in 20th-century physics: the Bohr atom, quantum theory, relativity, nuclear physics and elementary particles. For all engineering students. Spring semester. Lecture 3 hours, laboratory 2 hours. Prerequisites:

Engineering 103 and 104, or Physics 103 and 104, or 230; Mathematics 150, 160; or permission of the instructor.

ENROLLMENT

	2000	2001	2002	2003	2004
GNSC/Labs	425	360	341	360	259
Astr 101/102	94	152	142	134	112
Phys 103	170	189	209	185	257
Phys 104	166	169	143	152	171
Phys 230	65	35	56	52	37
Phys 231	112	94	78	86	42
Phys 232	57	60	48	38	22
TOTAL	**1089**	**1059**	**1017**	**1007**	**900**

LIST OF EXPERIMENTS BEING OFFERED IN THE INTRODUCTORY LABS

(Computerized experiments are in bold font and marked with *)

PHYS 103

Human Response
Acceleration of Gravity*
Projectile motion
Incline plane*
Conservation of momentum*
Heat measurement*
Simple pendulum*
Spring constant*
Standing wave

PHYS 104

Magnetic balance
Ohm's Law *
Potentiometer
Wheatstone bridge
RC Time Constant*
Oscilloscope
Diodes power supply
Lenses-Images
Diffraction & Measurement of wave length
Radioactive shielding*

PHYS 230

Human Response
Acceleration of gravity *
Projectile motion
Resolutions of forces
Incline plane *
Energy conservation *
Conservation. of momentum *
Simple pendulum *
Spring constant *
Resonance tube
Standing Wave

PHYS 231

D.C. Circuits *
Temperature dependence of resistance *
Oscilloscopes exercise
RC Circuits *
I-V Curves of Diodes *
Diode Power Supply
Magnetic field & induction*
AC Reactance of C & L
LRC Resonance circuit

PHYS 232

Index of refraction
Thin lens
Michelson Interferometer
Diffraction of light
Spectroscopy of light
Counting statistics*
Beta radiation*
Radioactive decay*
Gamma ray spectroscopy*

GNSC 111

Measurements
Human responses
Projectile motion
Simple pendulum *
Specific heat
Conservation of energy
Standing wave on string
Ohm's law*
Snell's Law
Convex Lens

ASTR 101

Hallo Northern Sky *
The Moons of Jupiter *
Astronomy on the Internet; planetary images from the Hubble Space Telescope *
Acceleration Due to Gravity.*
Cross-staff/Parallax Lab
The Inverse Square Law *
Astrometry of Asteroids *
The Rotation of Mercury *
Energy Flow Out of the Sun *
Dark Sky Observation

ASTR 102

Hallo Northern Sky *
Telescopes: Operation, Polar Alignment, Setting Circles
Spectroscopy of Light *
Photoelectric Photometry of the Pleiades *
Cross-staff/Parallax Lab
Internet Sites for Astronomy Lab *
The Inverse Square Law *
Classification of Stellar Spectra *
The Hubble Redshift Distance Relation *
The Large Scale Structure of the Universe *
Dark Sky Observation