EL CAMINO COLLEGE
NATURAL SCIENCES DIVISION

INSTRUCTIONAL PROGRAM REVIEW

ACADEMIC YEAR: 2009-2010

DEPARTMENT: PHYSICS

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I. Overview

A. Description of Program

- For majors in Engineering, Physics, Chemistry and Mathematics, the Physics department offers four courses: Physics1A- Mechanics; Physics1B-Fluids, Heat, Sound; Physics1C-Electricity; and Physics 1D -Optics, Modern Physics.

- For pre-professionals, Architecture majors, Physical Therapy majors and others transferring to institutions that require algebra-based physics, the department offers Physics 2A and 2B. 2A includes mechanics, fluids, heat and sound, and 2B electricity, optics, and modern physics.

- For pre-professionals transferring to institutions that require two semesters of physics with calculus, the department offers Physics 3A and 3B. 3A includes mechanics, fluids, heat and sound, and 3B electricity, optics, and modern physics.

- Physics 11 and Physics 12 are offered to meet requirements of transfer students in non-science majors.

- Physics 13 is a class designed to develop problem solving skills and is a preparatory course for Physics 1A.

- For students preparing to teach at the elementary and middle school level the department offers Physical Science 25. Topics include energy, magnetism, electricity, gravity, the periodic table of elements, and physical and chemical changes.

B. Status of Previous Recommendations (Program Review 2004-2005)

The twelve recommendations from the previous Program Review are listed below along with a summary of their status.

1. Promote Physics 12.

   Attempts have been made to promote Physics 12 by announcing the class to students taking Physics 11. Three sections of Physics 12 are offered each academic school year. One section is offered in the spring, one in the fall and one in the summer. The summer section has strong enrollment, but enrollment in the spring and fall sections tend to vary greatly from semester to semester probably due to lack of promotion and scheduling conflicts. The fall section was cancelled this semester due to cuts in funds to the school. In addition to regularly announcing the class to Physics 11 students we should also contact local high schools, where many of our summer Physics 12 students come from, with information about Physics 12.

2. Determine the need to add another section of Physics 2A.

Four sections of Physics 2A are offered in the fall, two are offered in the spring and one in the summer. The classes fill every semester. The waiting list of students requesting enrollment is usually full. Many students attempt to enroll the first week of class but have to be turned away. Not only have we not added another Physics 2A section but one of the two summer sections and a spring section has been cancelled. There is a need to restore the cancelled section and possibly add another section when funds become available.

3. Determine the need to add another section of Physics 3A.

We offer two sections of Physics 3A. One section is offered in the spring semester and one in the fall semester. Enrollment is strong in both sections but no more sections are needed. An additional summer section should be considered when funds become available.

4. Determine the need to add another section of Physics 1D.

A Physics 1D section has been added. We now offer two Physics 1D sections, one section is offered in the fall and one in the spring semester. Both sections have strong enrollment.

5. We should consider offering Physics 13. Many instructors believe that Physics 11 and Physics 13 offer stronger preparation for Physics 1A than does Physics 2A. Promoting Physics 13 would be necessary in order to have adequate enrollment.

There has been no progress on this recommendation. Attempts to promote Physics 13 have been unsuccessful. Members of the physics department need to make a decision on whether to permanently delete this course from the list of courses offered. The possibility of including eligibility for Math 191, combined with the completion of Physics 11, is now being explored as an alternative prerequisite to Physics 1A.

6. Submit the proposed change in prerequisite for Physics 3A to the curriculum committee. The prerequisite for Physics 3A currently is Mathematics 160 or Mathematics 190 with a minimum grade of C. The prerequisite should read: Mathematics 160 or Mathematics 190 with a minimum grade of C or concurrent enrollment.

This proposal has been completed.

7. Explore new technologies that will enable the instructor to interact more and in a more meaningful way with students.

This proposal continues to be a priority. New equipment has been purchased to modernize lab work. Computerized experiments have been introduced when appropriate. All physics labs need to be current and much work is continually needed to improve the labs and to make up more interesting labs that can be done with reasonably inexpensive equipment by students with little experience.

We believe this recommendation has been and will continue to be fulfilled.

8. The need for more physics tutors should be addressed.

The physics department has had, for the past few years, excellent tutors. Jan Ball, of the Learning Resource Center, has done an outstanding job hiring highly qualified tutors. At the moment, however, we only have one paid physics tutor and a volunteer tutor. The low retention rate in Physics 1A, Physics 2A and Physics 3A indicate that the students would benefit from additional tutors.

The physics department addresses the lack of tutors by referring students to the MESA program. The MESA program provides our students with peer tutoring and with a place where students can study in groups. The MESA program has been important, and sometimes crucial in the success of some of our students. (The Mathematics Engineering Science Achievement program, MESA, supports community college students to help them transfer to four-year institutions as majors in math, engineering, science, and technology).

9. Develop a plan to identify and replace older or antiquated equipment with more modern equipment.

This continues to be a priority item. We have added a green laser, 30 multimeters, and we now have access to logger pro and a web camera. We expect to continue to fulfill this priority as funds become available. The equipment still needed is listed in Part V of this document as well in the Program Plan Builder.

10. Install gas and water in the workshop.

No progress has been made on this proposal.

11. Write a department policy book.

Leon Leonardo, along with Dan Wright, have completed the department policy book.

12. Improve communication with counselors working in areas other than science and mathematics.

No progress has been made on this recommendation. Students report that counselors other than those in engineering/physical science have advised some

of our students to transfer to 4-year schools as soon as possible after having completed the maximum number of transferable units without regard to their readiness to transfer as determined by their grades in science courses and the science courses they have taken. We believe this advice is not in the best interest of the students. Transferring under those circumstances may put the students at a disadvantage because of lack of background in science.
Even though members of the physics department communicate often with mathematics and engineering/physical science counselors, practically no communication exists with counselors who work in other areas.

Physics faculty should invite mathematics and engineering/physical science counselors to our first department meeting every fall to further facilitate communication.

II. Program Statistics

A. Demand: FTES by Course/Program

Course	Maximum number of students per section	Year 1 (Fall semester 2005)	Year 2 (Fall semester 2006)	Year 3 (Fall semester 2007)	Year 4 (Fall semester 2008)
Physics 11	35	14.23 (four sections)	14.12 (four sections)	13.31 (four sections)	14.07 (four sections)
Physics 12	30	1.38 (one section)	2.44 (one section)	1.17 (one section)	1.17 (one section)
Physics 1A	30	21.44 (four sections)	21.44 (four sections)	22.72 (four sections)	24.42 (four sections)
Physics 1B	30	5.17 (one section)	5.34 (one section)	5.70 (one section)	6.41 (one section)
Physics 1C	30	11.67 (two sections)	10.38 (two sections)	12.97 (two sections)	10.81 (two sections)
Physics 1D	30	(offered spring)	(offered spring)	(one section)	4.13 (one section)
Physics 2A	35	28.46 (four sections)	28.88 (four sections)	25.06 (four sections)	28.88 (four sections)
Physics 3A	35	10.75 (one section)	7.75 (one section)	9.00 (one section)	8.25 (one section)
Physics Total:		**93.10**	**90.36**	**89.93**	**98.14**

The following table includes the courses that are only offered during the spring semester. Each column includes the FTES for each course and the total FTES for all physics courses in the spring semester.

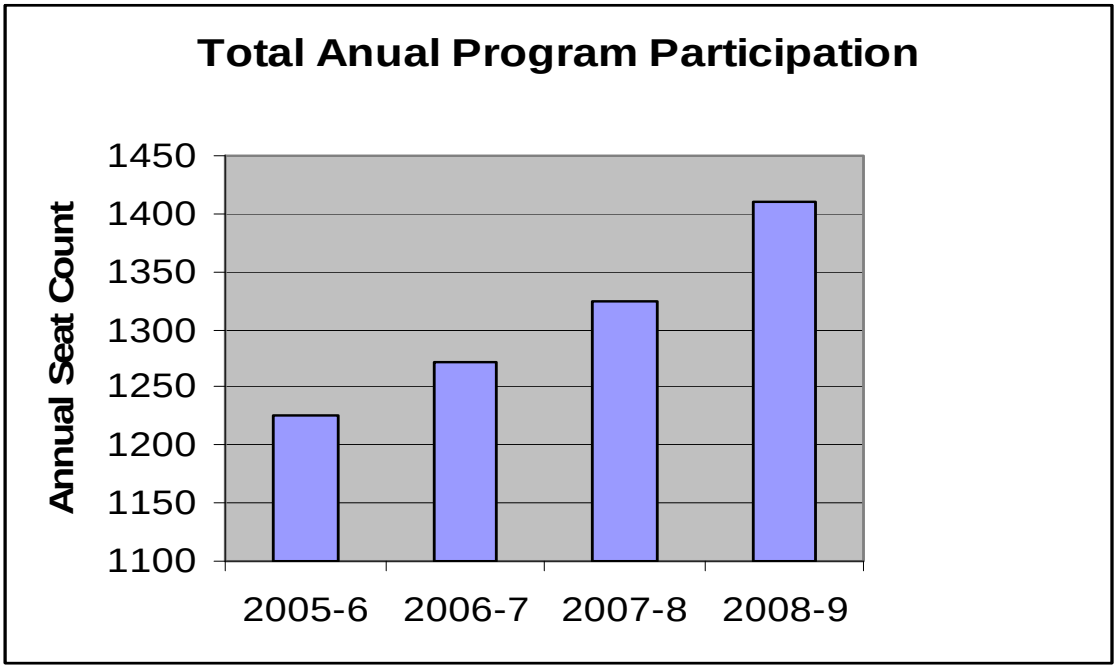
Course	Maximum number of students per section	Year 1 (Spring semester 2006)	Year 2 (Spring semester 2007)	Year 3 (Spring semester 2008)	Year 4 (Spring semester 2009)
Physics 2B	35	5.31	5.26	5.26	5.09
Physics 3B	35	9.00	8.25	8.75	5.76
Physics Total:		**104.55**	**99.68**	**103.68**	**111.44**

B. Offerings: Fill Rate*

The graph and the table below show that the number of seats taken by students has increased every year for the past four years. The annual seat count has increased by 15% from 1225 to 1411.

Total Annual Program Participation

	2005-6	2006-7	2007-8	2008-9	4 Yr Average
Annual Seat Count	1225	1271	1325	1411	1308



The table below indicates that the increase in demand may be due to an increase in the number of students that take physics as well as an increase in sections offered.

Academic Year	2005-06	2006-07	2007-08	2008-09	4 Yr Average
Annual Section Count	41	44	45	44	44
Annual Seat Count	1,225	1,271	1,325	1,411	1,308
Unduplicated Students	965	972	1,008	1,115	1,015
Avg Seats/Unduplicated Students	1.3	1.3	1.3	1.3	1.3

As the data in the above tables and the graph indicate, the demand for physics classes has been increasing for the past three years. The greatest increase in demand occurred in the academic years 2007-8 and 2008-9. Physics 1A is a prerequisite for Physics 1B, 1C and 1D; Physics 2A is a prerequisite for Phys 2B. Strong demand for Phys 2A and Phys 1A indicates that many students would be affected if we don't provide enough sections of these courses. Sadly, two sections of Phys 2A have been cancelled this school year, and even though demand for our Physics 1-series is growing, our fall 1B class has been cut so the course will only be offered in the spring for 2010-2011. These cuts will affect our ability to meet student demand.

The table below shows that the fill rates for all years are high, but not impacted.

Course Fill Rates

	Fall 2005	Fall 2006	Fall 2007	Fall 2008
	90.6%	89.5%	83.9%	90.3%

C. Retention and Success Rate

RETENTION:

The table below shows that the retention rate of the students taking physics varies from semester to semester. The courses with lowest retention rates are usually Physics 1A, Physics 2A, and Physics 3A.

The Physics overall retention average rate is lower than the Natural Sciences Division, which in turn is lower than the overall ECC retention rate. The state average retention for Physics is larger than the overall retention for ECC.

Retention Rate (census vs. end of course)

Course	Fall 2005	Fall 2006	Fall 2007	Fall 2008
Phys 11	71.6 %	70.7 %	76.0 %	76.3 %
Phys 12	61.5 %	82.6 %	81.8 %	72.7 %
Phys 13	-	-	75.0%	-
Phys 1A	66.6 %	57.6%	73.1 %	66.7 %
Phys 1B	93.1 %	73.3 %	51.5 %	80.0 %
Phys 1C	57.4 %	63.3 %	71.7 %	72.0 %
Phys 1D	-	-	-	78.3 %
Phys 2A	73.1 %	73.5 %	62.7 %	53.0 %
Phys 3A	72.1 %	58.1 %	75.0 %	45.5%
Physics Overall	70.4 %	68.0 %	70.1 %	66.3 %
State avg.- Physics	81.1 %	81.5 %	80.1 %	81.2 %
Division Overall	71.9 %	72.4 %	74.8 %	75.1 %
ECC Overall	77.7 %	77.6 %	77.3 %	80.9 %

Physics 12, Physics 1B, Physics 2A and Physics 3A show more variability in the retention rate than might be expected. Further analysis of the date shows the following: Physics 12: The variability in retention rate is possibly due to small class sizes. The retention rate is significantly reduced when only a few additional students drop in such a small class.

Physics 1B: The drop in retention rate from 73.3% in fall 2006 to 51.5% in fall 2007 was due to an increase in the ratio of students receiving a W grade to total number of students enrolled in the class (8/30 students in 2006 and 15/33 students in 2007). The reason for the increase in W grades in 2007 is unclear.

Physics 2A: The decrease in retention rate in fall 2007 and fall 2008 from fall 2005 and 2006 was due to an increase in the ratio of students dropping the class and students receiving a W grade to total number of students enrolled in the class. The ratio of students either dropping the class or receiving a W to total number of students was as follows: 35/130 in fall 2005; 35/132 in fall 2006; 44/118 in fall 2007; 63/134 in fall 2008. For fall 2009 the ratio was 59/155 (61.9% retention rate); a significant increase from fall 2008 (53.0% retention rate). Success rate for 2009 was 45.2%.

Physics 3A: The ratio of students either dropping the class or receiving a W to total number of students in the class was as follows: 12/43 in fall 2005; 13/31 in fall 2006; 9/36 fall 2007; 18/33 fall 2008. For fall 2009 the ratio was 10/38 (73.7% retention rate). Success rate for fall 2009 was 60.5%. The reason for the decrease in retention rate in fall 2008 is unclear.

The retention rate for all the physics courses for fall 2009 was 68.9%, up from 66.3% in 2008. Retention rate varied from a low of 66.3% to a high of 70.4% in 2005-2009. Physics faculty believe that the retention rate did not significantly change in those years. It may be useful to contact local colleges to compare topics covered in our lowest retention courses. In addition, state average retentions and success rates are determined by comparing community colleges; four-year institutions are not included. It may be useful to have data on the retention and success rate for lower division physics students in four-year institutions. This data is not now available but may become available in the future.

SUCCESS:

The table below shows that the success rate of the students taking physics varies from semester to semester. The courses with lowest success rates are usually Physics 1A, Physics 2A, and Physics 3A.

The Physics overall success average rate is lower than the Natural Sciences Division which in turn is lower than the overall ECC success rate. The state average success rate for Physics is higher than the overall success for ECC.

Success Rate (census vs. received C or better)

Course	Fall 2005	Fall 2006	Fall 2007	Fall 2008
Phys 11	54.5 %	62.4 %	64.8 %	61.8 %
Phys 12	61.5 %	82.6 %	81.8 %	63.6 %
Phys 13	-	-	75.0%	-
Phys 1A	52.0 %	43.4 %	57.7 %	50.5 %
Phys 1B	86.2 %	46.7 %	45.5 %	57.1 %
Phys 1C	53.7 %	61.2 %	63.3 %	60.0 %
Phys 1D	-	-	-	65.2 %
Phys 2A	62.3 %	67.4 %	46.6 %	41.8 %
Phys 3A	62.8%	58.1 %	69.4 %	36.4%
Physics Overall	58.6 %	59.6 %	58.4 %	52.5 %
State avg.- Physics	70.4 %	70.5 %	68.3 %	68.9 %
Division Overall	59.0 %	59.5 %	61.3 %	60.3 %
ECC Overall	63.3 %	62.8 %	62.8 %	63.8 %

Faculty is concerned that many students lose a semester by enrolling in and then dropping Physics 1A, Physics 2A and Physics 3A. One of the reasons for that students drop is that sometimes they have weak or distant background in mathematics. Most Physics instructors encourage students to make use of instructors' office hours as well as of the tutoring services offered at the library and at MESA. Physics faculty continue to evaluate pedagogical methodology and communicate frequently with colleagues to share ideas on how to present certain topics to students and on how to improve the teaching of those topics. Physics faculty agree that competent teaching requires commitment and hard work on the part of the teacher. Lack of enough time or motivation of students to do the work is another reason for not succeeding in Physics.

Most Physics 1A instructors warn students with a weak background in physics that they are likely to drop the class, and recommend that they take preparatory courses such as Physics 11 and Physics 13 (not currently offered because of low enrollment) or Physics 2A, but many students persist in continuing with Physics 1A.

There was a decrease in success rate in Physics 2A in fall 2007 and fall 2008. Physics 3A experienced a decline in success rate in fall of 2008. No clear trend or explanation is obvious. Faculty has continued to maintain high standards to better prepare students for transfer to universities. Lower retention and success rates are expected in physics courses, but the reason for the drop in both, retention and success rate in 2008 remains unclear.

The success rate for all the courses for fall 2009 is 56.4%.

III. Curriculum

As the table below shows, all of our courses have been reviewed and the course outline updated within the last three years.

Course Number	Course Title	Course Outline Date
Phys 11	Descriptive Introduction to Physics	July 2009
Phys 12	Laboratory for Introductory Physics	Dec 2008
Phys 13	Quantitative Aspects of Elementary Physics	July 2009
Phys 1A	Mechanics of Solids	Spring 2009
Phys 1B	Fluids, Heat and Sound	Feb 2009
Phys 1C	Electricity and Magnetism	Feb 2009
Phys 1D	Optics and Modern Physics	Spring 2009
Phys 2A	General Physics	July 2009
Phys 2B	General Physics	April 2009
Phys 3A	General Physics with Calculus	Oct 2006
Phys 3B	General Physics with Calculus	Feb 2007

Concerns and Recommendations

a) Physics 13 has not been offered in the last three semesters. Enrollment in this class is usually low and class is generally either cancelled, or not offered. A decision needs to be made on whether to promote Physics 13 or to permanently delete this course from the list of courses offered. This will be a topic of discussion in physics meetings.

b) Physics 1D (Optics and Modern Physics), a 3-unit course with 3 hours of lecture and 2 hours of lab should be changed to a 4-unit course with 4 hours of lecture and 2 hours of lab. Physics 1D covers three major subject areas: optics, special relativity, and quantum mechanics. While the time allowed by the official course outline for covering optics and special relativity is adequate, and in line with time allotments at other institutions, the time allotted to quantum mechanics allows only for very superficial coverage of the material, and does not allow us to provide our science and engineering students with the training in quantum mechanics that they would receive in the equivalent courses at most transfer institutions. The current time allotment of 15 hours is inherited from the 1965 course outline. Such a limited presentation of the material can no longer be considered adequate or appropriate. Nearly all of the four-year schools allow more time to lower-division quantum mechanics than ECC. If an extra unit of lecture time is added to Physics 1D, we will offer approximately as much quantum mechanics instruction as Berkeley, UCSB, and UCR, but still substantially less than CSUDH, Cal Poly Pomona, CSULA, UCI, UCLA, and UCSD. Many community colleges in our area, including SMC, also offer substantially more instruction time in lower-division quantum mechanics than ECC.

The physics faculty has submitted a proposal to Dr. Arce requesting the increase of the number of units for Physics 1D from 3 units to 4 units. The proposal will be submitted to Curriculum Committee during the 2010-2011 school year.

c) The current prerequisite for physics 2A is mathematics 170 (trigonometry) with a minimum grade of C or equivalent. Students who have taken the more advanced mathematics 180 (precalculus) are unable to enroll in the class because the computer system does not recognize mathematics 180 as a prerequisite. This computer problem needs to be resolved by the college.

IV. Student Learning Outcomes

The Physics Department has written and submitted proposals for Student Learning Outcomes for each of our courses. Nine of our courses have been fully assessed and the data analyzed. The proposed SLO for Physics 13 has been submitted and will be assessed and analyzed if the course is offered. In addition, we have written our first program-level SLO. It will be assessed and analyzed in spring 2010.

Course Number	SLO	Completion date
Phys 11 Descriptive Introduction to Physics	Given a description of a physical situation (floating ice cube, falling body,…) the student should be able to recognize the basic physical principles involved and explain how they are manifested in, and influence the behavior of, the situation.	July 2009
Phys 12 Laboratory for Introductory Physics	Given the units and proper number of significant figures for data that might be collected during a Physics 12 level lab, the student should then be able to take a provided relationship between the data (i.e., a formula) and properly determine the units, value, and correct number of significant figures of the calculated result.	In progress
Phys 13 Quantitative Aspects of Elementary Physics	Given a situation involving an object or objects in static equilibrium, the student will be able to draw a diagram or diagrams illustrating all forces acting on the object(s). The diagram(s) will correctly illustrate the line of action of each force. The student will introduce a well-defined coordinate system, pivot point, and sign convention for torques. For each force, the student will correctly compute all relevant Cartesian components and associated torques. The student will be able to use the force components and torques in association with Newton's laws to compute a quantitative result.	In progress
Phys 1A Mechanics of Solids	Given a situation involving an object or objects in static equilibrium, the student will be able to draw a diagram or diagrams illustrating all forces acting on the object(s). The diagram(s) will correctly illustrate the line of action of each force. The student will introduce a well-defined coordinate system, pivot point, and sign convention for torques. For each force, the student will correctly compute all relevant Cartesian components and associated torques. The student will be able to use the force components and torques in association with Newton's second law to compute a quantitative result.	Fall 2009
Phys 1B Fluids, Heat and Sound	Given a verbal description of a sequence of connected ideal-gas processes operating as an engine, construct a PV diagram for the cycle and determine the state of the gas at specified	June 2010

	points on the cycle. Indicate where heat enters and leaves the cycle, and calculate the cycle's thermodynamic efficiency.	
Phys 1C Electricity and Magnetism	Given a complex Circuit, the student will be able to simplify the circuit, write the appropriate equations, and solve for the desired currents, voltages, energies, and/or power.	January 2009
Phys 1D Optics and Modern Physics Optics and Modern Physics	Given a situation where an image is formed by two optic elements (either two mirrors, two lenses, or a mirror and a lens) the student will be able to determine the position and size of the final image, given the position and size of the object. The student will be able to graphically illustrate the formation of the image using ray-tracing diagrams.	June 2010
Phys 2A General Physics	Given a word problem, students will identify the physical principles required to solve the problem, they will then model the physical principles, and formulate te equations necessary to solve the problem. Students will correctly solve the equations and report the answer using correct units.	July 2008
Phys 2B General Physics	Given a word problem, students will identify the physical principles required to solve the problem, they will then model the physical principles, and formulate the equations necessary to solve the problem. Students will correctly solve the equations and report the answer using correct units.	Aug 2009
Phys 3A Genera Physics with Calculus	Given a word problem, students will identify the physical principles required to solve the problem, they will then model the physical principles, and formulate the equations necessary to solve the problem. Students will correctly solve the equations and report the answer using correct units.	Jan 2009
Phys 3B Genera Physics with Calculus	Given a word problem, students will identify the physical principles required to solve the problem, they will then model the physical principles, and formulate the equations necessary to solve the problem. Students will correctly solve the equations and report the answer using correct units.	August 2009

The course-level SLO's for Physics 1A, 1B, 1C and 1D; Physics 2A, 2B and Physics 3A, 3B regard skills related to problem solving such as identifying important physical concepts needed to solve a problem, modeling the problem using equations and solving such equations to obtain the answers to the problems. The kind of problems presented to students depends on the course. Problem solving is a very important part of every one of these courses. The overall results of the course level SLOs along with numerous anecdotal comments from past students indicate that Physics faculty is adequately preparing our successful students in key aspects of problem solving. Support in the form of additional tutors may be needed to increase retention, but overall, the students that don't drop learn some basic problem-solving skills. We are currently evaluating the program-level SLO. We have proposed the following two SLOs:

Program SLO #1:

Upon completion of their course of study in the Physics Department, students will be able to identify the physical principles which are relevant to or responsible for given physical phenomena

Program SLO #2:

Upon completion of their course of study in the Physics Department, students will be able to identify and apply the applicable laws of physics along with the necessary mathematics to successfully solve a physics problem.

V. Facilities and Equipment

The following table shows items requested by faculty for the improvement of instruction:

ITEM	AMOUNT	PURPOSE	COST
1. Micrometers (0-1 inch)	5	Lab experiments and demonstrations	$1250
2. Sodium ballasts and Lamps	5 ballast 10 lamps	Lab experiments and demonstrations	$ 2200
3. 140 Watt digital power supply WLS-30972-50 (Sargent Welch)	1	Lab experiments and demonstrations	$ 900
4. Radiological Survey Meter CP7152-02	1	Lab experiments and demonstrations	$ 1000
5. 6000g Ohaus Scout Pro Balance WLS-1761-57 (Sargent Welch)	1	Lab experiments and demonstrations	$ 650
6. Wave Motion Demonstrator SE9600 (Pasco)	1	Lab experiments and demonstrations	$ 800
7. Balloon Popping Green Laser-Elite 125 plus from wickedlasers.com	1	Lab experiments and demonstrations	$ 800
8. Ray Optic Laser System-SE 8506 (Pasco)	1	Lab experiments and demonstrations	$ 800
9. 2-meter tracks (Pasco, ME-6954)	5	Lab experiments	$ 1600
10. UV source for photoelectric effect demo	1	Demonstration	
11. Large Capacitor	1	Demonstrations	$ 400
12. Scanner	1	Data collection in lab	$ 150
13. Millikan oil exp (SW)	1	Demonstration	$5000
14. x-ray diffraction demo using microwaves (PASCO)	1	Demonstration	$1600
15. Blood pressure measurement apparatus	1	Demonstration	$50

The Physics department has shop facilities that are used to build, repair, and maintain equipment. We have a wide assortment of lecture demonstration equipment and lab equipment. Some of the equipment has been constructed over the years by our technicians and instructors, and all of the labs are routinely maintained and improved by technicians and instructors. In addition, our technicians sometimes assist other departments in the Natural Sciences Division to repair equipment.

The shop needs water and gas to facilitate maintenance, repairing and construction of equipment. The gas and water lines were severed during renovation and not reconnected. This has been an unacceptable hardship for the technicians.

The following table shows the items needed to improve our facilities:

EQUIPMENT	PURPOSE	COST
Belt sander, small welding set, miter saw, circular saw, good quality hammer drill, router.	Equipment to upgrade the physics shop	$ 2000
Installation of gas and water in the shop	To facilitate maintenance, repairing as well as construction of equipment.	$ 5000

Physics faculty believe that day and evening technicians' job list should be extended to include being available for the first hour in 1C, 3B and 2B labs to assist students with electrical equipment when the instructor cannot get around to all groups needing help.
Also, technicians should post, and constantly update, a list of the current projects along with the technician primarily responsible for the individual projects. The status of individual projects and the expected dates of completion should be included. There should also be a place where instructors may post, in writing, requests for new projects/demos/repairs.

VI. Staffing

The Physics Department has four full time instructors and is currently adequately staffed. However, two of our full time instructors will retire within the next two years. Faculty believes that maintaining high standards is paramount to helping students succeed at transfer institutions. In order to continue to serve our students adequately, retiring full time faculty must be replaced promptly. This becomes more important now that the demand for physics courses is increasing. Currently only three part-time instructors are teaching courses. These instructors tend to teach only early in the morning or evening class.

VII. Planning

The future goals and continued success of our department depends on the replacement of our full-time faculty. We have had difficulty in the past few years hiring competent adjunct faculty. In addition, adjunct faculty are not required to hold office hours, and in order to be successful many students need to attend office hours.

The department believes that it would be useful if we could obtain meaningful statistics from 4-year schools about our transfer students. This information would give an indication of the effectiveness of our courses and would allow us to focus more effectively on needed improvements. We need to know how our students are doing, compared with transfer students from other community colleges and from students who took lower-division at the 4-year school, as well as how their GPA's in their upper-division major courses compare with their math-physics-chemistry grades at ECC. We also need to know how these results vary for students who took the complete lower-division program (pre-professional or pre-engineering/science) at ECC and students who transferred after only one or two math courses at ECC. We requested this information from the Research department but it is not available. We may get valuable information in the future.

VIII. Recommendations and Conclusions

- Replace full time instructors with other full time instructors in the event that such instructors retire or resign.($80,000 per FT faculty).
- More tutors are needed to help students who need review work in courses in which they are enrolled.($10-$15 per hour)
- Day and evening technicians' job list should be extended to include being available for the first hour in 1C, 3B and 2B labs to assist students with electrical equipment when the instructor cannot get around to all groups needing help.
- Technicians should post, and constantly update, a list of the current projects along with the technician primarily responsible for the individual projects. The status of individual projects and the expected dates of completion should be included. There should also be a place where instructors may post, in writing, requests for new projects/demos/repairs.
- Adjunct instructors should keep at least one (paid) office hour per week for each class they teach.($70 per hour).
- Acquire equipment for lab work and for demonstrations when funds become available.($17 200)
- Physics 1D should change from being a 3-unit course to a 4-unit course to allow adequate time to cover quantum mechanics.
- Continue to improve the labs and to make up more interesting labs that can be done with reasonably inexpensive equipment by students with little experience.
- Continue to explore new technologies, and improve upon old technologies, with the goal being to enable the instructor to interact more and in a more meaningful way with students.

- Continue to read articles in The Physics Teacher, or elsewhere, describing new approaches to physics instruction in both the lab and lecture settings.
- Consistently promote Physics 12. Place a statement in the catalog to the effect that Physics 12 is NOT recommended, either as a stand alone course or in conjunction with Physics 11, as preparation for Physics 1A. So don't take it if you are engineering major!
- Determine whether we should promote Physics 13 or permanently delete this course from the courses offered by the department. Alternatively, we could let the course remain inactive for a few years and let the new instructors replacing retiring instructors decide what to do with it.
- Improve communication with counselors working in areas other than science and mathematics.
- Install gas and water in the workshop.
- Maintain current high level of instruction in Physics by,
    - maintaining ECC's four-semester sequence for our Physics1
    - supporting a dedicated lab technician
    - maintaining course-specific rooms
    - utilizing a wide-range of examples, problems and topics designed to challenge our best students without overwhelming our weakest students
    - encourage students to attend class, do the work, interact with the instructor and each other in and out of class