ROWAN COLLEGE
CURRICULUM COMMITTEE

(2)

PROPOSAL TITLE: New Course - Advanced Laboratory Physics 1902-340

X UNDERGRADUATE ___GRADUATE ___CREDIT HOURS

SPONSOR(S): Jeff Hettinger

DEPARTMENT & TELEPHONE# Chemistry and Physics - 4855

CHECK ONE: X COURSE ___MINOR PROGRAM ___CONCENTRATION ___SPECIALIZATION

___ACHIEVEMENT CERTIFICATE ___CERTIFICATION PROGRAM ___MAJOR PROGRAM

STEP #1 (DEPARTMENT)	STEP #2 (RECEIPT)	STEP #3 (SCHOOL)
✓ APPROVED/DATE: 10/16/96 ___NOT APPROVED/DATE: [signature] DEPT. CURRICULUM CHR. ✓ REVIEWED/DATE: 10/16/96 [signature] DEPT. CHR.	SCC# 96-97-63 DATE RECEIVED SENATE OCT 17 RECEIVED [signature] SENATE CURRICULUM CHR.	REVIEWED DATE: 11-7-96 X RECOMMEND TO APPROVE ___RECOMMEND NOT TO APPROVE FORWARD FOR OPEN HEARING ___WITHOUT RESERVATIONS ___WITH RESERVATIONS COMMENTS: [signature] SCHOOL COMMITTEE CHR.

STEP #4 (ACADEMIC DEAN)

COMMENTS:

___RECOMMEND

___NOT RECOMMEND

___CONDITIONALLY RECOMMEND (SEE COMMENTS)

DATE & SIGNATURE, DEAN OF SCHOOL [signature]

DEC 03 1996

STEP #5 (SENATE CURRICULUM COMMITTEE)

DATE OF OPEN HEARING 2-13-97

APPROVED BY SENATE CURRICULUM COMMITTEE (DATE) ________

___RETURNED TO SPONSOR(S) FOR THE FOLLOWING REASONS:

SENATE

STEP #6 (SENATE)

DATE PRESENTED TO SENATE 2-26-97 X APPROVED ___NOT APPROVED

NOTIFICATION TO EXECUTIVE VICE PRESIDENT/PROVOST (DATE) ________

SENATE CURRICULUM COMMITTEE CHAIR SIGNATURE/DATE [signature] 4/4/97

STEP #7 (EXECUTIVE VICE PRESIDENT/PROVOST)

DATE RECEIVED ________

APPROVED: ____YES ___NO

IF NO, REASONS ARE AS FOLLOWS:

STUDENT CREDIT HOURS 4

FACULTY LOAD HOURS 5

EQUALIZED CREDIT HOURS ______

OFFICIAL COPY & APPROVAL SHEET FILED (DATE) ______

SIGNATURE, EXECUTIVE VICE PRESIDENT/PROVOST [signature]

REGISTRAR

DATE APPROVED COURSE DESCRIPTION RECEIVED 28 Apr. 97

HEGIS TAXONOMY AND COURSE NUMBER ASSIGNED 1902 · 340

DATE/SIGNATURE OF REGISTRAR [signature]

NOTIFICATION FORWARD:

___SENATE CURRICULUM COMMITTEE CHAIRPERSON

___DEPARTMENT CHAIRPERSON(S)

___ACADEMIC DEAN(S)

___REGISTRAR

___SPONSOR(S)

Advanced Laboratory
New Physics Course for Advanced Science Majors

1.

(a) Course Title:	Advanced Laboratory
(b) Sponsors:	Jeff Hettinger and Physics Section, Dept. of Chemistry and Physics
(c) Credit Hours	4 s.h. (2-three hour sessions; lecture and laboratory)
(d) Course Level:	Junior-Senior
(e) Curricular Effect:	Major Requirement: Reduce free electives from 19-20 to 15-16. Major still requires a total of 120 s.h.
(f) Prerequisites:	1902.300 (Physics III)
(g) Implementation:	Fall 1997; offered every other year (e.g. F97, F99, F01,...)
(h) Adequacy of resources:	Present staffing is adequate and experimental equipment exists to launch the course (upgrades recommended). No addition faculty resources (see attached proposed and existing schedules .)
(i) Recommended Library Resources:	Experimental techniques are established and available in existing library holdings. Techniques which do not appear in books will be copied from journals which are held by our faculty.

2. Rationale:

Learning through direct experience is undeniably an effective mechanism leading to a detailed understanding of any topic. Advanced topics in the sciences are particularly difficult to process into knowledge and by far the most effective means of learning these is through direct experience. Laboratories partially provide the experience needed to grasp these advanced topics.

Advanced laboratory is essential to an undergraduate physics curriculum. It requires students to integrate knowledge from several areas and apply it to a specialized area of physics including Atomic, Condensed Matter, Nuclear and Astrophysics. While this experience will not make our students experts in any of these areas, it will allow them some knowledge of each of these areas and develop an understanding of the options available to them when entering graduate school. Students successfully completing this course will improve their performance in collaborative research with faculty while continuing to solidify their general physics background.

Students who plan to attend graduate school are not the only students benefiting from this course. Students who would like to take their BS degree in physics and become technicians in research groups will develop a better understanding of general experimental techniques and instrumentation. The analysis of the experiments will develop students analytical skills making their liberal arts physics degree more marketable.

Similar courses with varying specialties and structures are offered in many Physics BS programs. Our program is certainly an anomaly in this regard. With existing equipment we are prepared to launch the course at a high level. There are no courses offered at Rowan which reflect the content of this course.

3. Essence of the Course:

A. Objectives

Overall Objective:

After taking this course, students with the appropriate equipment will be able to make a reliable measurements of materials properties in a variable temperature environment, be able to understand and use spectroscopic techniques used in atomic and astro-physics, and be able to measure levels of radioactivity as would be appropriate for a Health Physics Technician.

Individual Objectives:

1. The students will reinforce their knowledge of advanced physics through the measurement of physical quantities in the laboratory providing experiences which transform classroom concepts into reality.
2. The students will develop analytical skills through analysis of measurements.
3. The students will understand the use and operation of several laboratory instruments and develop some experimental intuition which will eventually help them design simple experiments.
4. Students will develop experimental skills which will make collaborative research experiences with faculty more meaningful.
5. Students will learn how to keep a laboratory notebook (sounds trivial but this is difficult and essential).
6. Students will begin developing writing skills appropriate for technical presentations.

B. Topical Outline:

Students will be required to perform from four to six experiments through the semester. Each one requires a paper be written with the following constituents: (a)Introduction (including relevance of the experiment and background); (b) Theory of the experiment;(c) brief procedure; (d) data including plots and tabulated analysis and associated errors; and (e) summary. Oral presentation of results of one of the experiments will be performed by each student during the semester. This will be a presentation in the format of a contributed paper at national meetings such as those sponsored by the American Physical Society or the Materials Research Society.

Possible experiments

*1. AC screening response of a material with very small resistivity.

We have the equipment to perform this measurement at an introductory level. By creating an environment where a magnetic field can be applied at low temperatures, this could be improved. Demonstrates the penetration depth and frequency dependence of the penetration depth of a time varying magnetic field.

*2. Four probe resistance measurement.

We have the equipment to perform this measurement. This technique must be employed to measure very small resistances. Determination of the scattering lengths in various conductors will be made. Measurements of V-I curves for materials with linear response (metals) and non-linear responses (semi conductors) will be made.

*3. Two probe conductivity measurement.

Materials with non-ohmic voltage-current characteristics will be measured using existing electrometers and a constant voltage source. These techniques are important for determining charge transport process in non-crystalline materials.

4. DC magnetization measurements

    This experiment will employ Faraday techniques to measure the force on a specimen using a capacitance transducer. The capacitance will be measured using a Tunnel-Diode-Oscillator circuit. The resonance frequency of this circuit is extremely sensitive to small changes in capacitance allowing a very reliable measurements of very small changes in magnetization.

*5. Thermal Activation over an energy barrier(demonstration of the Grand Canonical Distribution in Statistical Mechanics)

    This can be performed with existing equipment.

6. Tunneling- Typical planar tunneling devices will be measured and tunneling phenomena introduced. The exponential distance dependence of the tunneling probability will be demonstrated.

*7. Doppler broadening of atomic transitions will be measured using techniques of atomic physics. This will be applied to find the statistical distribution of velocities of the molecules in the gas.

*8. Nuclear physics- Mossbauer experiment, decay rates and shielding of various radioactive materials.

*9. Spectroscopic techniques will be introduced through the measurement of the Zeeman splitting in sodium. The subsequent analysis will be applied to spectra measured on interesting Astrophysical entities.

*10. Measurement of lifetimes of excited states in alkali atomic vapors.

*Experiments which can be performed Fall 97.

+general - Actual laboratories will be modified to reflect changes in available equipment.

C. Evaluation Procedures for Students

Evaluation will be based on written work (including laboratory notebook), experimental skills (knowledge of instrument operation) and the oral presentation. Emphasis in written work will be placed on quality compared to professional presentations.

D. Course Evaluation

The department evaluation form will be used at the end of the course. A less formal continuous feedback will be solicited from students throughout the semester.

4. Results of Consultations

The faculty of the Chemistry section of the Chemistry and Physics department approved this course.

5. Additional Information

A. Prof. John Zazasinski, Department of Physics, Illinois Institute of Technology.

At IIT the emphasis of the advanced laboratory is solid state science. This includes thin film materials fabrication, making of tunneling junctions and the physical characterization of tunneling junctions. After completing this course, students are well prepared to step into a solid state laboratory and continue to do meaningful experiments. Those who do research in other areas, have enhanced their general knowledge of science and can understand and communicate about electronic devices used in everyday appliances as well as understand techniques for making uniform thin film reflective coatings on large areas such as is the case for glass used in skyscrapers.

B. Prof. Bennett Goldberg, Department of Physics, Boston University

This is the most extensive advanced laboratory I have seen. The actual laboratory is 2000 sq. ft. and contains experiments relevant to many areas of physics. Students are continually involved in setting up new experiments by resurrecting old equipment. The budget for this advanced laboratory provides new equipment (1 major instrument annually), machine shop time, and cryogens.

C. Prof. George Schmeideshoff, Department of Physics, Occidental College.

The idea here is for each student to have a science project. Students are given a $150 budget and asked to make a model describing a physical process or construct a circuit which performs a certain task. While this forces the students to be creative, I do not think this is the venue of choice for our advanced laboratory.

New page

6. Catalog Description:

Prerequisites: Physics III

This course introduces modern experimental techniques commonly used in physics. Experimental results will be correlated with existing theories. Technical writing skills will be developed and evaluated.