GLASSBORO STATE COLLEGE #7 13-78

Proposal for Physics Program

May 1969

I. Introduction:

This proposal is sponsored by the Science Department and is initiated by the Department Chairman, Dr. Robert Renlund, and the physics teaching members of this department: Dr. Alexander Borowec, Dr. Lawrence Delaney and Mr. Leon Goldberg. Because of the broadness of this proposal, the latter three members will act jointly as representatives of the Science Department in matters which pertain to this proposal.

II. Department Chairman's Statement:

A. Position of the program in the departmental curricular structure.

The Science Department plans a degree program in each of the following areas: biology, chemistry, geology, and physics. This proposal is concerned only with the physics program.

B. Suggested time and scale of implementation of the plan.

In order to permit students entering Glassboro in the fall of 1970 to formally enter a degree program in physics, the description of the program should be included in the next printing of the College catalog and the program should be approved prior to this printing. The Science Department is, therefore, requesting that the Curriculum Committee consider this proposal prior to the fall of 1969 printing of the College catalog.

Early implementation would be on a small scale since courses beyond the fundamental year of physics are not scheduled until the junior year of the program (See "Outline of the Program" in this proposal). It is likely that some students in the current science program at Glassboro and some transfer students will have the prerequisites for, and will desire to take, physics courses beyond Physics II prior to the time that students admitted as freshmen to the proposed physics program would take them. For these students, Physics III will be offered

in the 1969-70 year (as per recent approval of the Curriculum Committee). Approval of this proposal would extend the approval of Physics III and would make it possible for some of these students to go beyond Physics III before they graduate.

C. Adequacy of staff and resources for implementation

The Science Department has sufficient staffing for anticipated enrollment in physics for the next two or three years. Additions would be made thereafter, as needed, to keep pace with program implementation and enrollment.

With the exception of storage space, current resources such as teaching spaces, equipment, supplies, and library holdings are adequate for current course offerings and enrollment, The renovation of Bosshart Hall, now in progress, will make available additional spaces to meet the needs of increasing enrollment. The basic laboratory equipment is on hand, on order, or will be on order this spring for implementing Physics III. Additional library holdings are being suggested for this course. Funds are being requested in the next "asking budget" for the equipment needed to implement Optics and Light and Electricity and Magnetism.

In addition to these more conventional resources, it is also planned to take advantage of the computer on campus by integrating its use into the various courses in physics beginning with the introductory ones. In the computational mode the computer can be used to solve problems too complex to solve by hand but which give additional insight into the nature of the fundamental physical principles involved. Under proper circumstances the speed of the computer will enable the student to see the solution of many more problems than he can be expected to do by hand calculation, thus helping to speed his understanding. In the laboratory the computer will be used to simulate real or imaginary experiments not accessible at present because certain expensive equipment is not available or does not exist. With the aid of computers certain standard

experiments will be carried out in greater depth which could be handled otherwise only in a more superficial way. In general, the fascination of the computer, which many students feel, will be exploited for pedagogical purposes throughout the physics curriculum.

III. Outline of the Proposed Physics Program

A. The Program

First Semester		Second Semester	
Freshman (L.A. & S. - Secondary)			
Communications (comp)	3	Communications (comp)	3
Humanities (fund)	3	Humanities (fund)	3
H & PE (comp)	1.5	H & PE (comp)	1.5
Inorg Chem I (fund)	4	Inorg Chem II (deriv)	4
Free elective	3	Calc I (fund)	4
	14.5		15.5
Sophomore (L.A. & S. - Secondary)			
Physics I (fund)	4	Physics II (derived)	4
Calc II (derived)	4	Calc III (derived)	4
Soc Sci/Psych (fund)	3	Soc Sci/Psych (fund)	3
Humanities (fund)	3	Humanities (fund)	3
Free elective	3	Free elective	3
	17		17
Junior (L.A. & S.)			
Physics III (spec)	4	Electric & Mag (spec)	4
Differ Equns (deriv)	3	Analyt Mechan (spec)	3
Arts (comp)	3	Soc Sci/Psych (fund)	3
Optics and Light (spec)	4	Free elective	3
Free elective	3	Restricted elective	3 or 4
	17		16 or 17
Senior (L.A. & S.)			
Intro Quan Mech (spec)	3	Nuclear Physics (spec)	3
Electron Physics (spec)	4	Heat and Thermo (spec)	3
Restricted elective (spec)	3 or 4	Advanced Physics Lab (spec)	2
Restricted elective (spec)	3 or 4	Free elective	3
		Restricted elective (spec)	3 or 4
	13 to 15		14 or 15

Junior
(Secondary)

Physics III (spec)	4	Optics & Light (spec)	4
Differ Equat (derived)	3	Curric & Methods Sec Sch (spec-prof)	4
Adol & Learn (spec-prof)	3	Restricted elective (spec)	3 or 4
Arts (comp)	3	Restricted elective (spec)	3 or 4
Restricted elective (spec)	3 or 4	Soc Sci/Psych (fund)	3
	16 or 17		17 to 19

Senior
(Secondary)

Student Teach (spec-prof)	7	Issues in Found of Ed (spec-prof)	3
Practicum (spec-prof)	5	Free elective	3
Reading in Sec Sch (spec-prof)	2	Restricted elective (spec)	3 or 4
	14	Restricted elective (spec)	3 or 4
		Restricted elective (spec)	3 or 4
			15 to 18

In the Liberal Arts and Science program, restricted elective courses are chosen, with advisement, from courses in physics and/or courses closely related to physics such as the following:

Physics: Solid State Physics, Radiation Science, Mathematical Physics, Physics Seminar

Other Science: Most courses in Earth Science, Biological Science and Chemistry

Mathematics: Introduction to Computer Science, Linear Algebra, Probability and Statistics, Numerical Analysis

In the Secondary Science Teaching Program, restricted elective courses are chosen, with advisement, from physics courses with numbers higher than 200 and from most courses in earth science, chemistry, and biological science. At least one of the courses selected must be a physics course.

Choices should be guided by plans for graduate study and/or employment. The Secondary Physics major may also wish to consider requirements for teaching certification: -- the New Jersey Department of Education lists the following subject matter requirements for the several science teaching certificates:

1. Physical Science: 24 S.H. of science including physics and chemistry
2. Science: 30 S.H. of science including biology, chemistry, and physics
3. General Science: 24 S.H. of science
4. Earth Science: 24 S.H. of science including geology, geography, astronomy, and physiography

Note that the requirements for the first and third of these certifications are met by the above outlined program for the Secondary Physics major. The second and fourth can also be achieved by a proper choice of electives.

The minimum number of S.H. of physics required for entrance to graduate studies in physics varies among institutions. Some graduate schools require as few as 24 S.H. of undergraduate physics. Note that the above secondary teaching program requires a minimum of 19 S.H. of physics but that as many as 38 S.H. may be obtained without recourse to the use of free electives. Thus, with the proper choice of restricted electives, the secondary program can meet the subject matter entrance requirements in physics for most graduate programs.

Some graduate schools require that entering students in physics have proficiency in a language. In both of the above outlined physics programs, this proficiency may be gained, if desired, through use of free electives.

B. Credit Distribution

Both Programs

	Stipulated by Catalogue	Provided by Proposed Program
1. General Education	60	64
A. Fundamental	30	33
(1) Social Sci/Psych	9	9
(2) Humanities	12	12
(3) Mathematics	3	4
(4) Science	6	8
B. Derived	18	19
(1) Science	--	8
(2) Social Sci/Psych	--	0
(3) "Other Choices"	--	0
(4) Humanities	--	0
(5) Mathematics	--	11

	Stipulated by Catalogue	Provided by Proposed Program
C. Competence - Creative	12	12
(1) Communications	6	6
(2) Creative Arts	3	3
(3) H. & P.E.	3	3

Liberal Arts and Science

2. Prescribed Specialization	30 max.	30
3. Supplementary Specialization Electives	12 min.	12 to 16
4. Free Electives	18	18
TOTAL	120	TOTAL 124 to 128

Secondary Physics Teaching

2. Specialization		
A. Science	30	26 to 32
B. Professional	24	24
3. Free Electives	12	12
TOTAL	126	TOTAL 126 to 132

C. Physics Offerings

* 57.100, 57.101 — 4 S.H. each semester

Physics I and Physics II

These two courses together are designed to provide a thorough introduction to classical physics. Mechanics, heat, sound, electricity, magnetism and light are studied. Stress is placed on problem work and laboratory experiments. Physics principles, rather than technological applications, are emphasized. Students with calculus preparation are sectioned separately from those without this preparation. The purpose of this sectioning is to provide instruction which

permits the student to do physics at a level consistent with his training in mathematics.

Prerequisites: For Physics I (non-calculus) - algebra and geometry
For Physics I (calculus) - 65.130 or concurrent 65.130
For Physics II (non-calculus) - 57.100
For Physics II (calculus) - 57.100, 65.130

* 57.110 3 S.H.

Principles of Physical Science

The general principles of physics which undergird the larger scientific structure are emphasized and their influence in the development of all the physical sciences is stressed. Problems in elementary physics are assigned and reviewed in class. Demonstrations are performed in class, but there is no laboratory.

Prerequisites: Algebra and geometry are strongly recommended

57.200 4 S.H.

Physics III

Concepts of modern physics, treating topics such as relativity, wave and particle aspects of electrons and radiation, atomic theory, quantum theory of the hydrogen atom, X rays, spectra, solid state theory and nuclear theory. Emphasis is on fundamentals. Students complete four or five experiments selected from among the topics covered. Prerequisites: 57.101, 65.131

57.205 4 S.H.

Optics and Light

Reflection, refraction, dispersion, diffraction, interference, polarization, aberration, scattering, absorption, wave theory and an introduction to quantum optics. This is a laboratory course. Prerequisites: 57.200, 65.241

57.210 4 S.H.

Electricity and Magnetism

Classical electromagnetism. Topics include the laws of electromagnetic force, Maxwell's equations, electromagnetic induction, interaction of currents, electromagnetic energy, and waves. This is a laboratory course.

Prerequisites: 57.200, 65.241 or concurrent 65.241

57.215 3 S.H.

Analytical Mechanics

Particle dynamics, central forces, statics and dynamics of rigid bodies, waves, Lagrange's and Hamilton's equations. Extensive problem work is done in this course.

Prerequisites: 57.200, 65.241

* 57.220 4 S.H.

Selected Topics in Physics

The topics to be studied are chosen from among the following: mechanics, heat, sound, electricity, magnetism, light and atomic physics. The fundamental principles underlying the chosen topics are stressed and problem work is done. This is a laboratory course; the experiments are chosen to correlate with the topics studied. Prerequisites: Algebra and geometry.

* 57.300 4 S.H.

Electron Physics

A theoretical and experimental treatment of the following topics: electric and magnetic fields, electrodynamics, network theory, conduction and emission in gaseous and solid state devices, amplification and oscillation. The laboratory uses about one-half of the total class time.

Prerequisites: 57.101, 65.130.

57.305 3 S.H.

Introductory Quantum Mechanics

Basic postulates, the experimental basis of quantum mechanics, angular momentum, steady-state perturbation theory and the Schrodinger equation.

Prerequisites: 57.215

57.310 3 S.H.

Nuclear Physics

Atomic shell structure, molecular binding and spectra, properties and structure of nuclei, nuclear models, radioactivity, nuclear forces, nuclear reactions, interactions of particles and radiation with matter and particle physics.

Prerequisites: 57.205, 57.210, 57.215

57.315 3 S.H.

Heat and Thermodynamics

The laws of thermodynamics, equations of state, specific and latent heats, entropy and introduction to kinetic theory and statistical mechanics.

Prerequisites: 57.200, 65.241

57.320 2 S.H.

Advanced Physics Laboratory

This is primarily a laboratory course in which advanced experiments in heat, electricity and magnetism, light, atomic physics and nuclear physics are performed. Statistical methods of analyzing experimental data are stressed.

Prerequisites: 57.205, 57.210, 57.215

57.325 3 S.H.

Mathematical Physics

The following topics are studied as they apply to the solution of problems in physics: partial differentiation, matrices, spinors, vectors, tensors, Fourier series and integrals, orthogonal functions and eigen values.

Prerequisite: 57.215

57.330 3 S.H.

Solid State Physics

Diffraction of X rays, crystallography, lattice vibrations, electrical and thermal properties of solids, free electron theory, band theory, dislocation theory, nuclear and electron spin resonance. Prerequisite: 57.215

* 57.465 4 S.H.

Radiation Science

The basic information and skills necessary for the intelligent and safe use of radioisotopes in investigations of physical, chemical and biological problems in the laboratory. Prerequisite: 57.101

57.335 4 S.H.

Current Courses in High School Physics

Familiarization with subject matter, laboratory and philosophy of the new and traditional courses in high school physics through direct experience with the materials used in these courses. Activities include experiments, demonstrations, problem work and seminar-type discussions.

* These courses have full approval. They are included in this list in order that the entire program may be seen as a unit.

D. Special Provisions of the Program

1. The first two years are the same in both programs.

2. A free elective has been moved into the first semester of the freshman year to give the student a chance to strengthen himself (say in mathematics, prior to taking Calculus I in the second semester) or to begin broadening himself.

3. The freshman year is light, especially the first semester, in order to provide time for orientation, strengthening, and the opportunity to easily leave or enter the program. Since specialization does not begin until the junior year, juniors entering from community colleges should find little

difficulty in making the transfer provided they have had a year each of fundamental chemistry, physics, and calculus.

4. In the Secondary Program, enough restricted electives are provided to give students the requirements to enter graduate physics program, meet all New Jersey science certifications, if desired, and/or take a broad range of courses in science other than physics. Likewise, the Liberal Arts and Sciences program provides the opportunity for courses in mathematics and in other sciences without touching free electives.

E. Rationale

Glassboro's current program for the preparation of secondary school teachers of physical science, mandates only eight semester hours of physics instruction. This is for below an acceptable minimum of preparation for a competent physics teacher. Consequently, the Science Department has not been able to recommend, except in very unusual cases, that our students practice teach or take positions in physics teaching.

The situation at Glassboro in this regard is not unusual. The National Academy of Sciences reported in 1966 that "a severe educational crisis for physics appears to be in the making in our high schools, where the fraction of students having a course in physics -- never large in the past -- has been seriously declining. A major cause for the decline . . . is the shortage, or even absence, of competent physics teachers in many secondary school systems."**

The proposed program requires a minimum of nineteen semester hours in physics. This follows the recent recommendation of the Commission on College Physics that eighteen semester hours be a "threshold" requirement.***

**National Academy of Sciences, Physics: Survey and Outlook (Washington, D. C., 1966), p. 23.

***Commission on College Physics, Preparing High School Physics Teachers (Departmetn of Physics, University of Maryland, 1968), p. 5.

F. Consultations

The chairmen of most New Jersey colleges offering programs for physics majors have been contacted for information about their curricula. Dr. Fred Pregger, Chairman of the Department of Physics at Trenton State College, was particularly helpful in providing an excellent description and analysis of the Trenton physics program which was recently approved by the State Board of Higher Education.

Out-of-state schools, like Austin Peay State University of Tennessee, Kansas State College at Emporia, and Indiana State University at Terre Haute, all of which are noted for progressive programs in the preparation of physics teachers, have been consulted.

Because the title of the proposed course, Current Courses in High School Physics, might suggest overlap with the existing course, Teaching Science in the Secondary School, the counsel of Dr. Lawson Brown, Dean of Professional Studies at Glassboro, was sought. This consultation helped to more clearly define the scope and intent of the proposed course: emphasis would be on direct experience with the experiments, specialized laboratory and demonstration apparatus, problem work, programmed instruction, etc. of introductory courses such as PSSC Physics, Harvard Project Physics, and traditional (Dull and Metcalfe). The comparison of various treatments would extend to the actual performance of lecture demonstrations and laboratory experiments as well as to working selected problems and taking suggested examinations. An intent of the course would be to develop the prospective physics teacher's proficiency in the use of laboratory instruments and tools, used in measurement and repair work, to the level of sophistication necessary for him to provide advanced laboratory work for his academically talented students.

Since the proposed course, Mathematical Physics, is interdisciplinary in nature, Dr. Warren Roome, Chairman of the Mathematics Department, was consulted. The result of this consultation was a mutual understanding that the course would properly be taught as a physics offering since the topics considered would be chosen and sequenced on the basis of their use in the solution of physics problems, rather than on the basis of a logical development of an area in mathematics.