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THE MASTER'S DEGREE PROGRAM IN APPLIED PHYSICS

The origins and evolution of the master's degree program in applied physics at The Johns Hopkins University G.W.C. Whiting School of Engineering are described with an emphasis on recent developments that have led to a dramatic growth in the number of students. The program offers students a choice of specializing in any of four areas: space and astrophysics, ocean physics, solid-state physics, and optics.

INTRODUCTION

One rarely encounters a person who is classified as an applied physicist. Few universities offer an advanced degree in applied physics, and applied physicists are labeled as such largely because of their on-the-job training rather than their having earned a degree in the field. The reason undoubtedly lies in applied physics being an ill-defined subject area that bridges the gap between pure physics and engineering. The hallmark of the applied physicist is the ability to conceive solutions by applying fundamental physical principles to complex technological problems. It is on the basis of that ability that many industrial and government laboratories, as well as APL, consist of a good many applied physicists. The need for a program in applied physics was therefore obvious.

ORIGINS OF THE PROGRAM

Although courses in physics were offered at the inception of the Evening College at APL in 1964–65, the Master of Science program in applied physics was not offered by the Evening College until the fall of 1967. The program originally consisted of required courses in mathematical methods, four courses on the fundamentals of applied physics, special topics in applied physics, a project, and one elective course. Most of the physics courses were buried in the four courses on the fundamentals of applied physics, which covered thermodynamics and optics; electromagnetic waves; particle and rigid-body dynamics, continuum mechanics, and acoustics; and quantum mechanics, atomic and molecular physics, and solid-state physics. The electives included topics as varied as biomedical engineering, optical systems design and analysis, and microwave systems. Four courses and a project were offered every year. Some of these courses were cross listed with a Master of Science program in space technology, which was offered from 1967 to 1983.

Many changes occurred during the 1983–84 academic year, when the APL Evening College programs became part of The Johns Hopkins University G.W.C. Whiting School of Engineering. A committee under the chairmanship of Vincent L. Pisacane, who had already served as the program coordinator for the Applied Physics Program, was formed to revise the program. The four courses on the fundamentals of applied physics were revised and renamed according to their contents. The program now included eight required courses, a course on special topics, and a project. To oversee the Applied Physics Program, a program committee was formed; its members were Pisacane (chairman), Allan W. Bjerkaas, and Moshe Rosen. Rosen, from the Department of Materials Science and Engineering at JHU, enhanced input from and interactions with the Homewood campus.

Two years later, during the 1985–86 academic year, students were able to choose from an extended menu of 20 courses. They were required to take four core courses, four electives in applied physics, and two additional electives either in applied physics or other areas. The program committee was extended, and Bjerkaas served as its chairman for the 1985–86 academic year. Since 1986, I have served as the chairman, and the current members of the committee are John R. Apel, Allan W. Bjerkaas, Jerry A. Krill, Keith Peacock, Kenneth A. Potocki, and Moshe Rosen.

RECENT DEVELOPMENTS

During the past two years, the Applied Physics Program has grown in both the number of courses offered and the number of students enrolled. The current course offerings are listed in Table 1, which shows 30 courses grouped according to area of specialization. Applied physics encompasses an enormous body of knowledge, and the grouping by specialization allows students who are so inclined to probe one area in depth. Students who plan to pursue a Ph.D. degree also take advantage of the directed studies course to follow a particular subject in depth beyond what is covered in regular courses. The project in applied physics has always attracted students who are involved in an analytical and/or experimental research program at work and who are able to find an expert faculty member to guide them. The research projects have been extremely diverse but are invariably concerned with current research topics, such as "Multiple Photon Optical Processes in Nonlinear Media," "Effects of Recent Volcanic Emissions on the Net Energy Balance of the Earth," "Extending Performance of Charge-Coupled-Device Imaging Arrays," and

Table 1—Course offerings for the master's degree program in applied physics.

Course number	*Course title*	*Instructor*
I. Required Courses		
615.441	Mathematical Methods for Physics and Engineering	P. J. Adelmann
615.442	Electromagnetics	J. A. Krill
615.453	Classical Mechanics	V. L. Pisacane
615.454	Quantum Mechanics	A. N. Jette
II. Elective Courses		
	Space and Astrophysics	
615.444, 615.7XX	Space Systems I	Staff
615.445, 615.7XX + 1	Space Systems II	Staff
615.462	Introduction to Astrophysics	D. M. Rust, K. B. Baker
615.743	Plasma Physics	R. A. Greenwald
615.755	Space Physics	Staff
615.772	Gravitational Collapse and Cosmology	K. B. Baker
	Ocean Physics	
615.456	Introduction to Fluid Dynamics	J. Calman
615.460	Physics of the Lower Atmosphere	Staff
615.770	Satellite Oceanography	R. F. Gasparovic
615.771	Acoustical Oceanography	F. C. Newman
615.774	Physics of the Sea I	J. R. Apel
615.775	Physics of the Sea II	J. R. Apel
615.776	Fluid Dynamics of the Oceans and Atmospheres	D. L. Porter
	Solid-State Physics	
615.756	Bulk Acoustic Waves: Theory and Devices	J. Rosenbaum
615.757	Solid-State Physics	K. Moorjani
615.758	Amorphous Solids	K. Moorjani
615.760	Physics of Semiconductor Devices	H. K. Charles
615.764	Solid-State Physics Laboratory	W. A. Bryden, T. J. Kistenmacher
615.773	Low-Temperature Physics	D. J. Abeshouse
	Optics	
615.751	Modern Optics	K. Peacock
615.762	Quantum Electronics	T. O. Poehler
615.777	Applied Optics	K. Peacock
	General	
575.415	Radiation in the Environment	S. Koslov
615.451	Thermodynamics	L. B. Spornick
	Special Projects	
615.800	Applied Physics Project	K. Moorjani
615.802	Directed Studies in Applied Physics	K. Moorjani

"Multiple-Array Model for High-Temperature-Superconducting Granular Thin Films."

In course development, the Applied Physics Program has aimed to design new courses not only on the basis of students' suggestions, but also to highlight subjects of current interest that were neglected in the past but have matured enough to warrant a new course. For example, the national need for educating students and researchers in the use of modern techniques for measuring the properties of materials is well recognized and documented. In recent years, the condensed-matter sciences have undergone a quiet revolution because of the availability of synthetic materials that can be controllably fine-tuned over an extremely wide range of properties. These materials, however, are inherently complex. Novel concepts have had to be introduced to understand them, and a broad range of experimental tools is needed to characterize them fully. To meet that need, a laboratory course in experimental solid-state physics was introduced, which required considerable financial investment.

The advent of fiber optics and optical, electro-optical, and magneto-optical devices has generated a renewed interest in optical design and instrumentation. Several courses that cover both theoretical and experimental aspects of the modern version of this old subject are therefore offered.

APL has an enviable reputation in space sciences and technology. As already mentioned, a Master of Science program in space technology was offered from 1967 to 1983. Since 1983, some of the courses have been incorporated in the Applied Physics Program, but recently there has been a considerable demand for a detailed and rigorous course in space systems. As a result, a two-semester course was designed for students interested in the fundamentals needed to design and develop space experiments and space systems. The course will be taught by a team of nearly a dozen experts from the APL Space Department, who will teach their areas of specialization.

The ocean physics component of the program is relatively new and relies on the expertise of APL in this area. It offers students the opportunity to study a wide range of topics in modern ocean physics, ranging from the fundamentals of fluid dynamics to satellite oceanography.

FACULTY

The faculty of the Applied Physics Program has been drawn almost exclusively from APL since the program's inception. Of the 36 faculty members teaching at the APL campus, only one is not employed at APL. This aspect should not be construed as a xenophobic response from APL, but instead as a reflection of the variety of expertise in applied physics at APL and the convenience offered to APL employees who teach at APL. Most faculty members hold Ph.D. degrees, many of them are actively engaged in research, and some hold high-level administrative positions at APL. The new JHU campus in Shady Grove, Md., has had difficulty in engaging faculty from APL for the Applied Physics Program courses taught there. Fortunately, very capable individuals with previous teaching experience are available, particularly at the National Institute of Science and Technology. Other government and industrial laboratory employees have also been contacted and have agreed to teach courses for the Applied Physics Program at Shady Grove.

FUTURE

The future of the Applied Physics Program looks bright, not only because of the growth in course offerings and student enrollment and the beginning of the program at Shady Grove, but also because of the desire of the faculty to make the program up-to-date and first-rate. Many new courses aimed at this goal continue to be developed. What would be most desirable—a desire also expressed by many students—is to offer a Ph.D. program in applied physics in the near future. None of the universities in the Baltimore–Washington metropolitan area offers such a program. Obtaining well-qualified, capable, and willing faculty for such a program poses no problem. With education now in the charter of the APL mission, it is hoped that such a program will be implemented in the near future.

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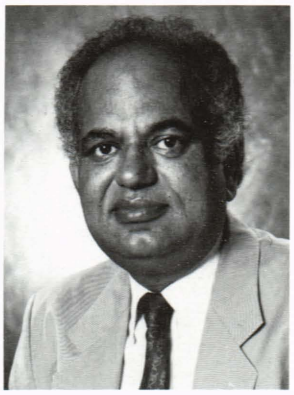
THE AUTHOR



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