

# QUALITY CONTROL OF ACADEMIC OPTICS PROGRAMS?

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## Abstract

The field of optics is continuing an explosive growth period and is finding new applications every day. The need and demand for educated and trained optical engineers and scientists has caused a significant increase in the number of academic optics programs being offered. The objective of this paper is to put forth the issues and offer a possible course of action.

## Discussion

About a quarter of a century ago, the field of optics began an explosive growth period. Until the mid-1960's, there was only one academic institution of higher education in the U. S. that offered a comprehensive program in optics. That of course was the Institute of Optics at the University of Rochester. Since that time several additional universities have established significant optics programs with outstanding faculty and researchers, facilities and curriculum that cover the broad field of optics. As optics became more pervasive, its applications stretched from space and military to industrial and consumer markets. The need and demand for academic training in the field of optics has increased dramatically over the past several decades throughout the U. S. and many areas of the world. The response to this need and demand has resulted in the dramatic proliferation of short courses, academic course offerings, research associated with thesis and dissertation topics, and establishment of specialized academic and/or research centers dealing with specific topics within optics such as optical signal processing. About four-score U. S. institutions indicate that they have some form of optics program. Interestingly enough, this proliferation of course offerings and research interests has been, in general, reasonably geographically dispersed. This again is an indication of the maturing and pervasive nature of the field of optics. It appears that optics may well become the technology of the 21st century.

As a consequence of the rapid growth and diffusion of optics, it is appropriate to address the issue of quality control in optics programs. The quality of an optics program is important to

students looking for the "right" place to study, and to employers who are looking for competently trained employees. The issue of quality control in optics goes yet farther, since many individuals are self-trained in optics while not having a formal way of asserting their competency (such as by degree in optics).

In addressing the issue of quality control of optics programs, the most basic question that we all must come to grips with is "What is optics?" Development of a practical definition of optics yet needs to be developed, most likely by an appropriate inter-societies committee.

Optics to some people may mean geometrical and instrumental optics, while others may view it as modern optics (holography, optical processing, optical computing, phase conjugation, etc.), while others may view it as astronomy, others as spectroscopy, others as fiber optics communication, others as electro-optics, and so on. Clearly, there are numerous viewpoints of "What is Optics?" However, the fundamental questions regarding what constitutes an optics program are basically:

- how much optics (number of class hours) and what type of courses should a program contain?
- what is the minimum laboratory instruction that an individual should have in an optics program?
- what level of competency should the faculty who are teaching these courses have? and
- what type quality and quantity of laboratory equipment is needed?

The answers to these questions are not simple, nor likely generally applicable to the myriad of programmatic situations faced by academic institutions. Development of the answers will require not only the efforts of the academic community, but that of the business and government communities as well.

Should all academic optics programs provide the same fundamental content? Probably not. Certain optics programs are extensive, while others are very modest and focus on particular subtopics within optics. The issue to address, I submit, is to determine the minimum level of knowledge, in both quantity and quality, that needs to be contained in what can be called an optics program such that an individual will have attained a reasonable level of OPTICS LITERACY. Determination of what constitutes optics literacy will require significant consideration by the aforementioned committee.

When should a person "claim" to be trained or educated in optics? The number of people nationwide who are involved in optics is enormously greater than the people who have received formal education in an optics program at a recognized institution of higher learning. For example, in my own city there are thousands who would readily state they are involved in optics, while the actual number of individuals with formal training in the subject is quite modest. Another ramification of this situation is that it complicates the issue of establishing optics as a profession in contrast to an activity. This can be likened to circuit design within the profession of electrical engineering. Unfortunately, optics is extremely pervasive across the technologies. Optics is not just engineering, nor is it simply science; it is both. This, of course, is another complicating factor. In addition, it should be recognized that many individuals are self-taught in the field of optics and are extremely competent. In other words, formal education is not necessarily a viable criteria to determine when a person is trained or educated in optics.

With the demand for optical scientists and engineers growing at an ever increasing rate, it is little wonder that employers are becoming quite perplexed in trying to understand the quality of graduates that a particular institution is producing. Of the myriad of institutions having optics programs, only a few have well established reputations for the quality of their "optics" graduates. Of course companies that already have a large contingency of highly competent optical scientists and engineers have little difficulty in assessing a candidate for employment capabilities. But when a company has little expertise or background in optics, while yet desiring to become active in the field of optics, it is difficult for such a company to make an assessment of a candidate for employment. Estimates made by many managers in various companies about the cost of making a mistake on hiring an individual begins at several-hundred thousand dollars per year.

With the growing role of optics in the marketplace, it is only a matter of time before some concerted efforts will be made to regulate, in some form, the field of optics. Already ABET has begun exploration of accrediting optics programs within engineering schools. The initial effort by ABET did not result in an accreditation of programs being recommended; however, it is anticipated that the issue will again be revisited with the findings of that study being more likely to recommend accreditation. With tens of thousands of members in the several societies dedicated to optics, is it not time for us, the optics community, to consider the need and desirability to "police" ourselves?

The issue of quality control of optics programs is multifaceted. There are various approaches to dealing with this issue among which include peer review, accreditation, certification, and business as usual. The latter is unacceptable. The matter of accreditation is a particularly sensitive one in that engineering programs are often accredited, while science programs are generally not. The process of accreditation is highly bureaucratic and requires the expenditure of a significant amount of effort on the schools' part, as well as the accrediting body's part. A very fundamental question must be addressed before even considering accreditation, i.e., how many broad-coverage optics programs are necessary? Accreditation of an optics track within an electrical engineering department becomes somewhat questionable. Furthermore, who is the accrediting body? Would the universities with the broad-coverage optics programs support and endorse such an accrediting body? If not, the viability of the accrediting body is highly questionable. Peer review of optics programs is possibly an attractive alternative. Indeed peer review of some optics programs has already occurred to the mutual benefit of all the participants. It has the benefit of being constructive and generally non-threatening. The cost of performing peer review has generally been borne by either a particular government agency or the institution itself.

Certification is another potentially viable alternative. It is particularly attractive to those schools which have small programs and also allows a means of accommodating those people who are self-taught. One approach is to establish a committee or board to administer the certification program. Rather than certifying programs, the committee would provide a means of certifying individuals as to their optics literacy. A periodic examination could be administered at the associate's, bachelor's and master's level. In order to demonstrate additional competency in specific specialties within optics, one could take endorsement examinations, e.g., in lens design, holography, spectroscopy, etc. It should be clearly understood that certification as suggested here is not a substitute for licensing or registration as a professional engineer which is required by some states for those who practice engineering that involves public health, safety, and welfare. Further, certification should have no legal status nor involve liability upon the committee providing the certification. The issue of engineering specialty certification has been discussed in depth using

IEEE's Professional Activities Council for Engineers (PACE) during the last portion of 1988. Anyone who is interested in more indepth reading on this subject should refer to the August, November and December 1988 issues of the IEEE, The Institute. It appears that PACE will continue discussing the issue, but at present it is unclear whether engineering specialty certification will receive adequate backing. It should be noted that several other organizations, among which are the Society of Manufacturing Engineers and the American Society for Quality Control, have implemented successful certification programs.

It is only a matter of time before some group or groups take(s) it upon themselves to begin quality control of optics programs and/or practitioners. Our remaining time is probably short. I suggest that the several optics societies in the U. S. work together to create an intersociety committee or board to deal with this issue. The educational committees in each of these societies would clearly have significant input. Funding could come from grants from the various societies, a minor increase in dues assessments of society members, and/or grants from both government and industry.

The issues discussed in this paper are extremely difficult to resolve. The recognition and destiny of our optics profession may well be determined by the actions taken in response to these issues. It is up to us!