The light fantastic: PHOTON materials for technician education

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Abstract: Project PHOTON has developed a set of instructional materials suitable for a one-semester laboratory based introduction to photonics course. The textbook, laboratory experiment kit and laboratory manual have been thoroughly field tested by participating high schools and two year colleges. All materials have been aligned to national Math, Science, Technology and Language Arts standards.

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Introduction

Project PHOTON is increasing the number of middle schools, high schools and colleges in the six New England states teaching units or courses in optics/photonics. Recognizing that many science and technology teachers either never studied optics or are unfamiliar with modern applications, PHOTON has a strong teacher professional development component, including workshops and ongoing technical assistance. The initial project plan was to create a set of notes for the teacher workshops, and to write detailed instructions for using a PHOTON developed laboratory equipment kit. However, when it became evident that suitable text and laboratory materials for teaching a complete introductory optics course at the high school/two year college level were not commercially available, a PHOTON textbook, laboratory manual and teacher manual were developed.

If high school and college students encounter optics at all, it is usually toward the end of a full year physics course. The PHOTON textbook seeks to remedy this situation by providing an introduction to optical science and technology for students with only a rudimentary knowledge of physics concepts. The math level is algebra/trigonometry, making the book more accessible to high school and first year college students. Practical and natural applications of optics concepts are emphasized, rather than theory and derivations. The text has been thoroughly tested in high school and community college classrooms both as a stand-alone course for non-majors and as the first course in a laser electro-optics technology program. The text has also served as the basis for one-semester online courses delivered to traditional college students and also in a corporate training environment.

The text also includes instructions for hands-on explorations of optical phenomena that can be performed with inexpensive and common materials. End-of-chapter conceptual questions and problems, including answers to odd numbered problems, are also included. An appendix to the text includes a review of important concepts from mathematics and physics including scientific notation, Greek letters used in optical science and technology, right angle trigonometry, energy, and significant digits. An accompanying teachers’ manual contains alignment of the text materials to national science, mathematics, technical literacy and language arts standards for grades 9-12 as well as the complete solutions to all of the chapter problems. Directions for demonstrations using inexpensive equipment are also included to assist teachers in creating stimulating presentations of optical phenomena.

The PHOTON laboratory kit and accompanying laboratory manual provide the equipment and instructions for 21 experiments in basic and applied optics. An unusual feature of the PHOTON kit is the inclusion of components and component mounts of high quality, the type one might encounter in a research lab or in industry, rather than the more commonly encountered aluminum or plastic educational materials. Not only is the equipment more versatile than the "educational" variety, it is similar to equipment students will see on industry field trips, making the school...
laboratory experience more relevant to the world of work. Prior to delivering the PHOTON kit to the participating teachers, the procedure for each experiment was tested, ensuring that the lab experiments would actually work as intended. In addition, suggestions for improvements made by participants have been incorporated into the final version of the laboratory manual.