

Optics education at Tianjin University

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ABSTRACT

The optics education programs for undergraduates and graduates at Tianjin University are introduced. Some teaching experiences with students, and practice with modern optical technology are presented in the paper. The combination of optical education with academic research works are described as well.

1. INTRODUCTION

Great progress has been achieved in teaching and research works in the aspects of optical principle, optical instruments, opto-electronic devices and laser technology at Tianjin University since the optical section was established in 1960. We have good knowledge of carrying on optics education programs in every aspect of the teaching plan, for instance, how to offer the optics courses and put optics in proper position in the curriculum referred to the different degrees required, how to combine optical theory with practice successfully, which are important matters concerned through the education plan. The aim of our optics education is not only providing the best way for students to understand the fundamentals of applied optics, physical optics and modern optics, but also teaching them how to implement their optical technology to handle some problems which may occur in the field of optical engineering and techniques in the future. Therefore, some basic optics courses, such as applied optics, optical design, physical optics, optical metrology, laser principle and modern optics are considered as the 'core' courses in the teaching plan of undergraduates; and for graduates, Fourier optics, optical information processing, optical holography and optical and digital images processing are referred to as core courses listed in graduates teaching plan.

Meanwhile, some mathematics related closely to optics and optical engineering have been stressed in the teaching plan. There is a large variation of mathematics needed in optics, including calculus mathematics, matrices, linear algebraic, matrix theory, optimization design, integral transformation, field theory and mathematics equations. It is well known that the fundamentals of optics is mathematics. For example, optical automatic design and modern optics theory greatly depend on mathematics. In order to succeed in optics education, first of all, the students must well command the mathematics courses. That is the reason why we have to pay a great attention to mathematics teaching courses in optics education. In addition, the basic principle of computers and its program languages courses are also of great significance to optics education.

While we emphasize theoretical teaching, how to combine theory with practice and to obtain the practical knowledge and experiences in the field of optical engineering are important things which we have investigated for many years. What have been done for optics education at Tianjin University are as following:

4. APPLICATION OF COMPUTERS TO OPTICAL DESIGN

Since computers have special performance characteristics, such as high calculating speed, big volume of storage, easy to operate, it has promoted optical design, which was tedious but useful work before, to develop rapidly. But it seems to be even more important that how to apply computers to the teaching course of optical lens design. In recent years we take computers as teaching medium. After the students finish the theory study of applied optics and optical design course, they will learn to compose computer programs for ray tracing and calculation of aberrations in optical systems. Using their own results on the first stage, each student will design a real optical system by himself. The contents of the optical design cover working out the parameters of Gaussian of optics, correcting varied optical aberrations, designing different types of optical lenses, investigating ways for correcting aberrations. Computers play an important role in optical design course. Because of using computers as teaching medium in optics courses, the students will be able to grasp the basic methods of optical design, to handle not so complicated problems in optical design.

As a matter of experience, applications of computers to optical design teaching have following advantages:

1. 1 Taking computer as teaching medium for optical design course extensively reduces the practical training period, originally half year, even an year round teaching work, which now can be finished within one or two weeks by computers.
1. 2 Since microcomputers or computer terminals are used in optical design teaching, the students can not only raise their ability and the art of optical design, but also have a good command of computer program composition and skill of computer operation.
1. 3 It raise interests of the students for optical design course
1. 4 The combination of teaching with research works can be realized. For instance, while the students participate in optical design practice, they complete the project of optical lens design for researching or industry requirement.

3. COMBINATION OF OPTICS EDUCATION WITH RESEARCH

In attempt to combine fundamental theory teaching with practice and technology, we have made an arrangement of numerous laboratory experiments in the process of optical theory teaching, besides, in writing text book, we pay a great attention to introducing some typical projects into the optics text book as teaching examples, and also putting real calculating problems into exercises at the end of each chapter. We have created a suitable environment for the students to understand the applications of optical engineering and techniques while they study optics theory. A design program providing the students a comprehensive training in the field of optical engineering is available for further training of the students in the teaching plan. After the students have the training of designing a microscope optical system or a photographic optical system, they will be able to resolve the problems raised in optical engineering and technology. In addition, when the students do graduate projects or write theses or dissertations, each student will have a particular supervisor, who will be the tutor for the student in carrying on practical projects which come from production or academic research work. Some typical design projects as following:

particles measuring instruments
opto-electronic measuring instruments
photographic instruments
fiber optical instruments
medical optical instruments

Through the project designs and investigations, the students have the potential ability to handle some problems of optical engineering independently.

4. ADVANCED-CLASS OPTICS EDUCATION

To meet the high degrees required in the field of optical engineering and technology, Tianjin University offers the courses and research leading to BS, MS and PhD degrees. The courses consist of basic theoretical lectures and contemporary optics research subjects. The courses include optical computing, optical nervous networks, integral optics, optical fiber theory, nonlinear optics, optical quantum theory and opto-electronic hybrid processing etc. Besides, we try hard to select some advanced projects in optical science and technology as the topics of the theses or dissertations of MSc and PhD, most of which come from research projects supported by the State fund of Natural Science Committee or by the State departments of P. R. China.

The advantages summarised as following:

1. fulfilling the state research projects
2. stressing the academic research capacity of optics and optical engineering
3. training the engineers and scientists with advanced optics and optical engineering.

Considered as the topics of the theses or dissertations, the following research projects have been conducted:

1. laser particles measuring system
2. portable holographic camera
3. optical fiber holographic interference endoscope
4. electronic endoscope images testing system
5. holographic interference non-spherical surface testing system
6. optical nervous recognition system

Completion of the above research projects not only prove or develop the optical and engineering theory, but also provide the valuable instrumentation systems for industry inspection or monitoring, for health and medicine purpose. It strongly boost national economic construction.

In addition to optics education of undergraduates and graduates, the continuing education opportunities are available for junior teachers and staff at Tianjin University. Optical theory and technology are continuously developed and expanded day by day. To meet the great challenge of the situation, as the educators and researchers in the field of optics and optical engineering, we should work hard to keep our knowledge always up to date.

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