

## Curriculum structure of training of optical system designers

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### ABSTRACT

This report in very short way represents the common experience of colleagues of the Chair of the Theory of Optical Devices in their work in the curriculum structure of training the students in optical design. The results of scientific and practical work in the sphere of the theory and methods of the design of optical systems were laid in the base of this training the same as the results of the analysis of the properties of optical elements.

### 2. INTRODUCTION

When compiling a curriculum it is always necessary to bear in mind that one cannot cover the immense ground. Hence it follows that the curriculum should contain only the most important training subjects. But this leads to a natural question: what subjects should be considered necessary for study? It should be also remembered that narrow specialization enables a competent solution of particular problems. However a modern engineer should be capable of conforming the solution of particular problems with solution of general problems involved in development of an optical device representing both a complicated technical system and a merchandise. So, what are the problems facing a designer of optical systems in the process of his work?

### 3. CURRICULUM STRUCTURE

Let us suppose that a designer of optical systems has managed to develop an optical system meeting all the requirements. For competent appraisal of the correspondence of the parameters obtained to the prescribed requirements it is necessary to know the character of the consequent processing of the available information. For this one should know the theory of the optical device functioning. In its turn, this demands erudition in the domain of physics, physical and applied optics, theoretical and applied mechanics, electronics and automatics. The knowledge of the theory of optical devices allows for determining the permissible value of deviations of the parameters achieved in the developed optical system.

Having determined the permissible value of deviations of the parameters achieved we shall define permissible errors of mutual position of the optical system elements as well as the permissible deviations of parameters of individual parts in the process of their manufacture. A proper solution of these problems is impossible without knowledge of manufacturing technology of optical devices, neither it is possible without knowledge of technology of assembly and adjustment of optical devices, manufacturing technology of optical elements as well as methods and means of optical measurements.

The above-listed study subjects make up the basic training in the sphere of the general optical engineering. This is followed by a special course of training aimed at teaching the students how to design optical systems. This course includes such study subjects as methods of calculations of optical systems, methods of automated designing of optical systems, assessment of the image quality and calculation of tolerances, investigation of optical systems.

So, at the first stage the students study physics, chemistry, mathematics and programming.

At the second stage they study physical optics, theoretical mechanics, electrical engineering and foundation of automatics, computing mathematics.

The third stage is devoted to the study of geometrical (applied) optics, mechanics of the solid body under deformation, designing of optical devices and manufacturing technology of optical devices.

The fourth stage includes the theory of optical devices, manufacturing technology of optical elements, optical metrology.

At the fifth stage the students study calculation methods of optical systems, methods of automated designing of optical systems, image quality assessment and specification (tolerating).

At the sixth stage they study synthesis of optical systems, research of optical systems.

The logical sequence of the study subjects in optics can be represented in the following form : physical optics applied (geometrical), theory of optical instruments, optical measurements and manufacturing technology of optical elements. These study subjects form the basic training in optics.

In the process of special training the students study the methods of calculation of optical systems, methods of automated designing of optical systems (in the framework of CAD/CAM), image quality assessment and calculation of tolerances, synthesis of optical systems and research of optical systems. The study course "Synthesis and composition of optical systems" is sufficiently original and delivered only in the Institute of Fine Mechanics and Optics. The course represents summarization of research works which have been carried out in the Department of Optical Instrument Theory by Professor M.M.Rousinov and his students for last fifty years. This course is devoted to the study of properties of individual elements of optical systems and their combinations which defines the logic of efficient construction of optical systems.

Left outside the framework of this report is the immense methodological work which makes up an integral whole of the above-listed subject matters. The main task consists of giving the students profound comprehension of the physical essence of the problems solved at all the stages of designing optical systems, to teach them how to develop mathematical models and study them by means of a computer in search of an optimal solution. Only profound knowledge enables creative efficient work transforming the process of designing optical systems into a fascinating play which can go through the life.

Stage 1: - physics - chemistry - mathematics - programming

Stage 2: - physical optics - theoretical mechanics - electrical engineering and fundamentals of automatics - computing mathematics

Stage 3: - geometric (applied) optics - mechanics of a solid body under deformation - designing of optical instruments - manufacturing technology of optical instruments

Stage 4: - optical instrument theory - manufacturing technology of optical elements - optical measurements

Stage 5: - calculation methods of optical systems - methods of automated designing of optical systems - image quality assessment and tolerance calculation

Stage 6: - synthesis of optical systems - research of optical systems

General training in optics: - physical optics - geometric (applied) optics - optical instrument theory - optical measurements - technology of assembly and adjustment of optical elements

Special training in optics: - calculation method of optical systems - methods of automated designing of optical systems (CAD/CAM) - image quality assessment and tolerance calculation - synthesis of optical systems - research of optical systems.