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THE IMPORTANCE OF MODERN PEDAGOGICAL TECHNOLOGIES IN LABORATORY CLASSES IN OPTICS

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ABSTRACT

This article analyzes the importance of modern pedagogical technologies in laboratory lessons from optics. In this regard, the improvement of the educational process in pedagogical universities includes not only the explanation of the essence of the laws of physics, but also the teaching of students in their future teaching activities on the basis of modern pedagogical technologies. Such conditions, called Gaussian optics, are fulfilled in limited cases, and in practice aberrations (image defects) are inevitable . Spherical aberration is considered to be one of the various defects of the image observed in the lens.

KEYWORDS: *Optics, Laboratory, Pedagogical Technology, Universities*

INTRODUCTION

Laboratory classes on the course of optics are a necessary and effective form of study in the study of physics. In the process of applying the theoretical knowledge acquired by students in practice, knowledge is built on a solid content, a solid foundation. In this regard, the formation of laboratory classes in physics is one of the most important issues.

Pedagogical universities have a specific pedagogical direction of training specialists, which requires in-depth, multifaceted knowledge of the teaching profession, as well as high pedagogical skills [1]. In this regard, the improvement of the educational process in pedagogical universities includes not only the explanation of the essence of the laws of physics, but also the teaching of students in their future teaching activities on the basis of modern pedagogical technologies. Therefore, as a problem, we set ourselves the task of improving the laboratory classes in physics using modern pedagogical technologies, as well as to increase the level of mastery by students.

Conducting laboratory classes in physics is an important way to improve the quality of knowledge that a future physics teacher will receive in professional training.

Performing laboratory work in physics will be the basis for creating a combination of theoretical knowledge and practical skills.

To this end, in order to successfully conduct laboratory work and experiments in optics, we have used a method based on modern technologies, which, if systematically monitored student achievement throughout the semester, will ensure students' interest in the basics of science.an important factor in providing and ensuring that students have a consistent knowledge system is achieved. In this method we used "integral elements of pedagogical technology", namely:

- A differentiated approach to education ;
- Gradual application of students' theoretical knowledge in practice ;
- The issue of career guidance of students .

In this regard, in our work we used the method of portion assignments to conduct laboratory classes in general physics. One of them is the stage of *preparation for the work, which we called the* " *preparation* " stage. At this stage, students prepare to get permission to do the work. At the same time, students use innovative technologies such as "mental attack", "Wheel", "BBB" and "Venus diagrams", "Step by step" [2].

The second stage is the process of performing a *physical experiment directly*. Before carrying out this stage, students observe the prepared virtual laboratory (animated mode of laboratory work) on the computer, experiment with the location of the equipment and the principle of operation.

The third stage is the *final stage* after the student completes the laboratory work , in which a report on the completed work is submitted. We *test* this stagephasewe called. In this case, the student provides information about the application of theoretical knowledge in practice, experimental skills and abilities. Performs a theoretical question, test, or non-standard test assignment on a laboratory topic. Based on this structure, a curriculum was developed for all laboratory work in the optics department of the general physics course, which included the following:

1. To deepen the knowledge gained from the textbooks heard and recommended in the lecture course;

2. Independent acquisition of theoretical knowledge by students using the proposed program and recommended textbooks;

3. Creative consolidation of the acquired theoretical knowledge in practice;

Content questions and answers focus on understanding the physical laws, formulas, and their significance of the laboratory work being performed, analyzing a physical process or event, and finally understanding the characteristics of the experiment [3].

The student can use the teacher's advice on the content of assignments that encourage the application of practical knowledge in their work. This should be given special attention by teachers conducting laboratory classes in their work.

The advice given can guide students to apply the theoretical knowledge they have acquired in practice, helping them to think about the essence of this or that pedagogical activity. To this end, in the "teacher-student" dialogue, the teacher should strive to consistently ask students a system of more problematic questions. For example:

- What is the purpose of laboratory work?

- Necessary equipment for laboratory work-equipment optionssay.

- What other methods can be used to determine this physical magnitude (refractive index)?

- Do you know the physical meaning of the detected physical magnitude (refractive index) and so on.

Research conducted with the above methods shows an increase in students' interest in physics to consciously perform laboratory work. It is this increase in conscious interest and aspiration that increases efficiency, both qualitatively and in terms of the time spent on each task. This idea is confirmed by the results of several years of pedagogical experiments. Each laboratory work is performed independently by the student, making full use of their individual abilities. It is here that the student's activity, independent thinking develops, in which the desire to achieve the goal is formed.

The following is an example of one of the tasks that prepares students majoring in methods of teaching physics and astronomy to perform and submit laboratory work in the "Optics" section of general physics.

Optical systems are based on lenses. Optical systems are systems used in most devices, such as lenses (digital) cameras, microscopes, telescopes, spectroscopes, and optoelectronic instruments. Optical systems are based on lenses and mirrors. Some defects in the structure of lens systems or optical errors and reflection errors are observed [5]. A spherical lens describes a point as an ideal point if the light path intersects the optical axis at a small angle and the angle of incidence and refraction angle for the light passing through the lens is not too large. Such conditions, called Gaussian optics, are fulfilled in limited cases, and in practice aberrations (image defects) are inevitable . Spherical aberration is considered to be one of the various defects of the image observed in the lens. Not all rays incident parallel to the optical axis accumulate at the focal length after passing through the lens. The aberration of the lens can be reduced in various ways, for example by selecting the radii of curvature of the front and back surfaces of the lens. We know that convex lenses have spherical aberrations in both concave lenses. Usually, a system of adapted lenses is used to correct spherical aberrations. Of these, 15 laboratory works belong to the department of optics. These laboratory works are laboratory works related to geometric optics and wave optics. One of these works allows to observe the aberrations of optical systems. There are a number of aberrations related to optical systems, which are observed on the main optical axis of the lens (spherical, chromatic) and outside the main optical axis (distortion). Only theoretical information on these aberrations was given. In the new laboratory work, one of these aberrations is observed in the laboratory work on "***Spherical distortions in the image of the lens .***" Now students have the opportunity to observe all the information about lenses and optical systems, both theoretically and experimentally.

Tools needed to perform **laboratory work on spherical distortions in the lens image ;**

- a pair of bases for spherical aberration,
- A set of 2 slides,
- lamp body,
- lamp 6 V \ 30W,

- aspherical capacitor,
- transformer 6V \ 12V,
- lens f = + 150mm,
- diaphragm,
- semi-transparent screen,
- small (optical course) base,
- V-shaped stendas 20 cm,
- multi-layered Laybold.

The purpose of the work : to get acquainted with the shape of lenses, to study ways to find their focal lengths, to study the distortion of the image due to the parameters of the lens and the spherical aberration.

Experimental device:

-Aspherical capacitor lamp is adjusted in the optical course as shown in Figure 2.

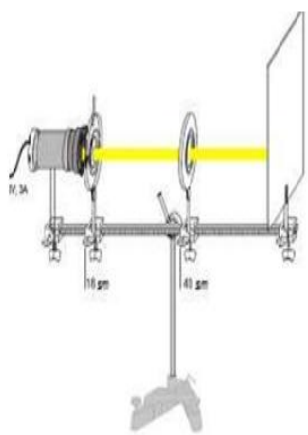
- When a 6-volt lamp is switched on, turn the lamp bulb in the housing so that a bright image of the lamp fiber is observed on the opposite side of the wall (the distance between the lamp and the wall should be 3 m in order to receive parallel light beams).

-Adjust the bulb flow so that the image of the lamp fiber is horizontal.

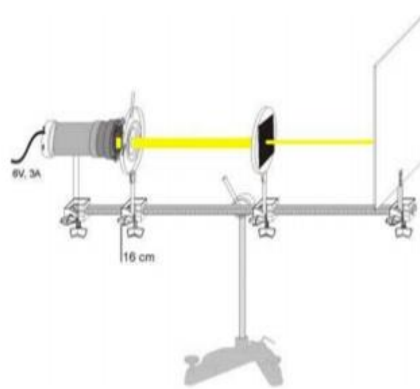
-Adjust the semi-transparent screen and place the lens with the convex side of the lamp between the lamp and the semi-transparent screen.

-Mount the mesh (spaced in the range of 5mm * 5mm) on a holding bracket attached to a diopasitive aspherical capacitor (Figure 2).

-Place the diaphragm in front of the lamp and open it completely. Slide the lens towards the lamp until a clear image of the net is formed on the semi-transparent screen (Figure 3).



2-расм:Линзанинг сферик аберациясини ўрганиш учун курилмада равшан тасвир хосил қилиш учун лизанинг ўрни



3-расм:Линзанинг сферик аберрациясини ўрганиш учун тажриба курилмаси.

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It is advisable to determine the parameters of the convex and concave lenses before performing this laboratory work and then observe the aberration.

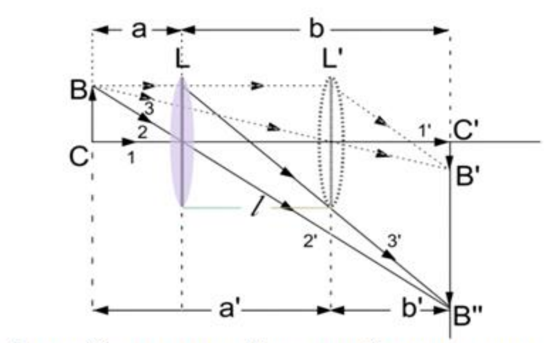
Methods for determining the focal length of convex and concave lenses are given in several ways. The following tools are used to perform this laboratory work. Convex and concave lenses, light source and fixture, optical base, screen, ruler and caliper.

Using the results of the experiment ***in method 1, the distance from the object to the lens - a*** , the distance from the lens to the image - ***b*** is determined using a ruler $f=\frac{ab}{a+b}$ (1), based on the expression find the numerical value of the focal length of the lens (Figure 4). calculating the average value of the distance, the mean square error is found.

2- method. Determine the focal length of the condenser lens using the object and its image sizes (H, h) and the distance ***b from the lens to the image,*** and determine the focal length using the following expression $f=\frac{bh}{H+h}$ (2) To find the focal length of the condenser lens: it is sufficient to know the numerical values of the linear dimensions of the distance ***b .*** The height of the object is measured several times with a caliper to find its average numerical value. Connecting the light source to the mains creates a clear image of the appliance. Measure the height of the image several times using a caliper to find its average numerical value. The distance to the lens and the image is measured 6-8 times by moving the lens or moving the screen. Based on the results obtained, the focal length of the condenser lens is found using expression (2).

Method 3 The Bessel method is to find the focal length of the condenser lens by moving it along the principal optical axis. In this method, if we set the distance from the lens to the image as A-, it must be 4f <A. the numerical value of f is assumed to have been found in the previous methods.

$\frac{1}{f}=\frac{2}{A-l}+\frac{2}{A+l}=\frac{2A^2+2l^2+2A^2-2l^2}{A^2-l^2}=\frac{4A^2}{A^2-l^2}\Rightarrow f=\frac{A^2-l^2}{4A}$ (3) The expression allows you to find the focal length of the collecting lens.This method is performed in the following order. The distance between the light source and the screen on the optical base, using the focal length of the condenser lens found by previous work methods . We place **A** greater than **4f** . By sucking on the optical base of the condenser lens, an **SV** image (miniature) of **the SV** object is formed. **SV is the** distance from the object to the screen **b, the distance from the** lens to the screen is **a** , the distance from the object to the lens is measured with a ruler and recorded in a notebook. After looking at the source on the optical base of the collecting lens (Fig. 5) to accurately generate an enlarged image of the **SV object S'B " , the ruler measures the distance *a ' from the*** **SV** object to the lens and the distance **b'**



5-расм.Бессел усили ёрдамида буюм тасвирини ясаш

from the lens to the image C'V" . Based on the results obtained, $l = b - b' = a' - a$ find the focal length of the condenser lens using expression (3). Find the focal length 3-4 times experimentally. Determine its mean numerical value and its mean square error. The focal lengths of the condenser lens found by the three methods are compared with each other.

Method *4* Determine the focal length of the scattering lens **.** Even when creating an image of an object using a scattering lens, it is sufficient to know the direction of the three rays, such as a condenser lens. The procedure is as follows;

Using an optical base and a condenser lens, an image of the AV **object is created on the A'V '** screen (Figure 6). A scattering lens **L** $_{\mathbf{1}}$ **is placed between the** collector **L** $_{\mathbf{2}}$ **and the screen and** is displayed on the screen. The distance from the scattering lens to the screen is measured several times using a ruler, which is **equal** to a.

Scrolling the screen creates an "A" image. The distance from the scattering lens to the image "A" V is measured using a ruler, which is equal to **b .** Based on the results obtained and using the lens expression, the focal length of the scattering lens is determined. $\frac{1}{f} = \frac{1}{a} - \frac{1}{b}$.

The experiment is repeated 3-4 times and the mean value and quadratic error of the scattering lens focus are found.

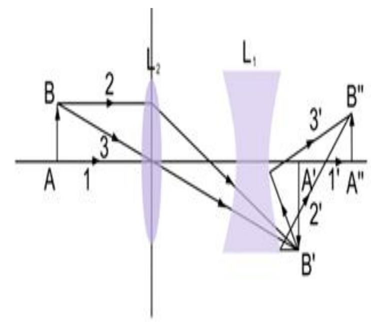
Optical power, magnification, light power for a given lens based on the collected results

$$E = \frac{D^2}{f^2}$$

Let D be the diameter of the lens and f be the focal length

Analyzing the results of the conducted experiments, the quality of optical instruments increases the geometric similarity of the images with the possible reduction of spherical aberration. Students will fully understand the role and importance of aplanate and anastigmatic systems in any optical instrument in future work.

Laboratory training has its own characteristics compared to other types of courses. Skills and abilities related to manual labor are formed in the application of the acquired theoretical knowledge in practice. In the process of doing the work, attention should be paid to the correct execution of the work, diligent handling and management of manual labor. develops skills and abilities to apply the knowledge acquired in the specialty disciplines



6-расм. Сочувчи линзада буюм тасвирини ясаш

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