TAJIK NATIONAL UNIVERSITY
Faculty of Physics
Department of Optics and Spectroscopy

SYLLABUS (PROGRAM)

OPTICS FOR SECOND-YEAR STUDENTS SPECIALTY 31040103-PHYSICS, PHYSICS FACULTY

Subject: Optics

Specialization: Physics

Number of study hours – 6 credits (144 hours)

48 hours lecture, 48 hours practical, 48 hours laboratory

2nd year

Fourth semester

Dushanbe -2025

Syllabus (extensive work program) compiled by assistant of the Department of Optics and Spectroscopy Matrobiyon M. Kh. on the subject of Optics for 2nd year students of the full-time physics department - 1-31 04 01 03.

Full name	**Course**	**2**	**Schedule of classes**
Matrobiyon Mehrob Khurramzod	**Semester**	**4**	
		6	
Address Teacher: Department of Optics and Spectroscopy, faculty of physics 302, TNU	Lecture	48 hours	**Monday 11-12^{50}**
	Practical	48 hours	**Thursday,** 8-9^{50}, 12-13^{50}
	Laboratory	48 hours	**Saturday**, 8-10^{50}
	Independence work	-	
	Consolidated control form	Examination	

The syllabus (extensive work program) is based on the educational program of general physics courses approved by the Methodological Council of the TNU on December 27, 2022 (protocol No. 4/6) and complies with the State Educational Standard of Higher Education. Professional education of the Republic of Tajikistan, direction 3301-"Physical Sciences", specialty 1-31040103-"Physics", approved by the order of the Ministry of Education and Science of the Republic of Tajikistan dated September 16, 2022, prepared for physics students.

The syllabus (extensive work program) was compiled by assistant of the optics and spectroscopy department Matrobiyon M. Kh.

The syllabus (extensive work program) was reviewed and approved at a meeting of the General Physics Department on January 20, 2025, meeting No. 6.

Head of the Department Hodiev M. H.

The Scientific and Methodological Council of the Physics Faculty, January 25, 2025, Protocol No. _5_ recommends for publication.

Chairman of the Scientific and Methodological Council Istamov F.Kh.

SECTION I: ORGANIZATIONAL AND METHODOLOGICAL PART

II. DETERMINING THE PLACE OF THE SUBJECT IN THE EDUCATIONAL PROCESS

The subject "Optics" has acquired the status of a compulsory subject in the curriculum of the physics specialty of the Physics Department and has played a key role in the development of students as highly qualified specialists. In this part of physics, students are introduced to electrical and magnetic phenomena.

III. THE GOAL OF STUDYING THE SUBJECT

The goal of studying the subject "Optics" is to demonstrate the theory of physics as a result of observations and experiments. Physical theory expresses the relationship between physical phenomena and physical quantities from a mathematical point of view. The course of general physics should introduce students to the basic methods of observation, measurement and experimentation through lectures and practical classes. Optics is the fourth part of General Physics. In this section, students should: 1. Familiarize themselves with the laws of optics and their mathematical expressions; 2. Use your theoretical knowledge to learn how to solve practical problems; 3. Become familiar with the structure and operation of physical devices, as well as with the measurement of physical quantities, and methods for processing the results of experiments.

IV. TEACHING OBJECTIVES

In the field of Optics, the teacher must teach students through lectures and practical classes:

- Become familiar with the laws Optics and their mathematical expressions;
- use your theoretical knowledge to learn how to solve practical problems;

He must become familiar with the structure and operation of physical devices, as well as with the measurement of physical quantities, and methods for processing the results

IV. TEACHING OBJECTIVES

Physics is the basis of fundamental natural sciences and plays an important role in the development of engineering and technology. The first part of general physics is mechanics. In this section, the teacher must introduce students to the basics of mechanics through lectures and practical classes:

- creating a sufficiently broad theoretical background in physics for students, allowing future specialists to navigate the flow of scientific and technical information and providing them with the opportunity to use knowledge of physics in engineering;
- providing a certain methodological training that allows understanding the process of cognition and the structure of scientific knowledge, using various physical concepts, determining the limits of applicability of principles, laws and theories;
- systematization and generalization of knowledge from the point of view of general ideas corresponding to the modern level of scientific development;
- familiarization with modern scientific equipment, formation of skills in conducting a physical experiment;
- mastering the methodology of solving specific problems from individual sections of physics;
- developing the ability to assess the degree of reliability of the results obtained in experimental or theoretical studies.

V. FINAL LEARNING OUTCOMES OF THE SUBJECT

Along with mastering the subject of study, the student must:

- learn the basic concepts, equations and relationships Optics;
- know the laws, rules and practices of geometrical Optics, components, lens, photometric laws;
- understand the properties and laws of Optics,
- correctly express the laws of physics, evaluate and solve physical problems;
- conduct experiments in the laboratory using stylistic indicators and physical instruments, calculate and analyze the results of experiments;
- learn to build mathematical models of physical phenomena and learn to use them;
- independently use textbooks.

In the subject, the student must:

- be able to explain the basic concepts, equations and relationships of Optics;
- be able to correctly express the laws of physics, quantitatively evaluate and solve physical problems;
- be able to conduct experiments in the laboratory using stylistic indicators and physical instruments, as well as calculate, analyze and draw conclusions based on the results of experiments;
- be able to build mathematical models of physical phenomena;
- be able to independently use textbooks.

Based on the assimilation of the subject, the student should:

- master the basic concepts, equations and mechanical proportions;
- be able to correctly express the laws of physics, quantitatively determine and solve physical problems;
- be able to conduct experiments in the laboratory using stylistic indicators and physical instruments, as well as calculate, analyze and draw conclusions based on the results of experiments;
- be able to build mathematical models of physical phenomena;
- be able to independently use textbooks.

Prerequisites (connection of the subject with the subjects mastered by the student): subjects studied by the student during the period of study in secondary school: chemistry, physics, mathematics, basics of computer science, mathematical analysis.

Calendar plan - subject of the subject "Optics"

Total number of credits 6 (144 hours)
Auditory lecture-theoretical classes - (48 hours)
Practical auditory classes - (48 hours)
Independent work of students - (48 hours)

1.1. General calendar plan of the subject being read
Subject content

№	Weeks	Title of sections and topics	Classroom's lessons		Laboratory	Literature
			Lecture	Practical		
1.	I	Subject optics. Basic laws of optics. Development of ideas about the nature of light	3	3	3	Literature 1 —7
2.	II	Wave formation. Wave equation. Monochromatic oscillations and waves Photometric concepts and units	3	3	3	Literature 1-7
3.	III.	Lens. Focal length of a thin lens. Image in a thin lens. Increase. Optical devices and their characteristics. Aberration of optical systems	3	3	3	Literature 1-7
4.	IV	Light interference. The concept of coherence. Wave interference. Implementation of coherent waves. Various interference schemes. Interference devices and their applications	3	3	3	Literature 1-7
5.	V	Light diffraction. Princips Hugens and Fresnel. Diffraction in parallel rays Diffraction from the slit, on two slits. Diffraction grating	3	3	3	Literature 1-7
6.	VI	Polarization Light. Light propagation through tourmaline. Malus' Law. Polarization of light with reflection and refraction of light at the boundary of two dielectrics. Law Brewster And Spectra, and their parameters	3	3	3	Literature 1-7
7.	VII	The law of light absorption	3	3	3	Literature 1-7
8.	VIII	Electromagnetic wave scale. IR and UV rays	3	3	3	Literature 1-7
9.	IX	X-rays. The nature of X-rays. X-ray diffraction. Electronic spectroscopy	3	3	3	Literature 1-7
10.	X	Dispersion And Absorption Light . Difficulties of Maxwell's electromagnetic theory. Passage of light through an optically heterogeneous medium. Molecular and combinatorial scattering of light.	3	3	3	Literature 1-7
11.	XI	Speed of light and methods eYo Definitions.	3	3	3	Literature 1-7
12.	XII	Photoelectric effect. Laws of photo effect. Einstein's equation, The hypothesis of light quanta. The dependence of the photocurrent force on the wavelength of light. Photocells and their applications	3	3	3	Literature 1-7

13.	XIII	The essence of Compton's phenomenon and his laws. Doppler effect in optics and acoustics	3	3	3	Literature 1-7
14.	XIV	Thermal radiation. Kirchhoff's law. Absolutely black body. The law of displacement of Wine. Planck radiation formula	3	3	3	Literature 1-7
15.	XV	Luminescence and its types Laws of luminescence.	3	3	3	Literature 1-7
16.	XVI	Optical quantum generators. Principle of operation Main properties of laser radiation Types of lasers and their application	3	3	3	Literature 1-7
In all			48	48	48	

1.2. Contents of sections and topics

Topic 1. Subject optics. Basic laws of optics. Development of ideas about the nature of light

Topic 2. Wave formation. Wave equation. Monochromatic oscillations and waves Photometric concepts and units.

Topic 3. Lens. Focal length of a thin lens. Image in a thin lens. Increase. Optical devices and their characteristics. Aberration of optical systems

Topic 4. Light interfereence.The concept of coherence. Wave interference. Implementation of coherent waves. Various interference schemes. Interference devices and their applications

Topic5. Light diffraction. Princips Hugens and Fresnel. Diffraction in parallel rays Diffraction from the slit, on two slits. Diffraction grating

Topic6. Polarization Light. Light propagation through tourmaline. Malus' Law. Polarization of light with reflection and refraction of light at the boundary of two dielectrics. . Law Brewster and Spectra, and their parameters

Topic 7. The law of light absorption

Topic8. Electromagnetic wave scale. IR and UV rays

Topic9. X-rays. The nature of X-rays. X-ray diffraction. Electronic spectroscopy

Topic 10. Dispersion and absorption Light Difficulties of Maxwell's electromagnetic theory. Passage of light through an optically heterogeneous medium. Molecular and combinatorial scattering of light.

Topic 11. The speed of light and methods of its determination

Topic 12.. Photoelectric effect. Laws of photo effect. Einstein's equation. The hypothesis of light quanta. Dependence of force photo flow from the length of the light wave. Photocells and their application

Topic13. The essence of Compton's phenomenon and his laws. Doppler effect in optics and acoustics

Topic 14. Thermal radiation. Kirchhoff's law. Absolutely black body. The law of displacement of Wine. Planck radiation formula

Topic 15 Luminescence and its types, Laws of luminescence.

Topic16. Optical quantum generators. Principle of operation. Main properties of laser radiation Types of lasers and their application

VI. Tasks of studying the discipline

As a result of studying the discipline, the student should get an idea of the main Optics methods (Basic laws of geometry optics, Photometric concepts and units. Light interference. Light diffraction. Polarization of light. The law of light absorption). The study of the discipline is based on the knowledge acquired by students on the general physics course, which are strengthened, deepened and expanded with the formation of an active style of thinking in students and a stable focus on continuous self-study and self-education. The acquired knowledge and skills are implemented and developed in the process of further education and subsequent employment.

Topics	Weeks	Content Practical Occupation (CPO)
Basic laws of optics. Development of ideas about the nature of light	I	Basic laws of geometry optics
Wave formation. Wave equation. Monochromatic oscillations and waves.	II	Photometric concepts and units
Lens. Focal length of a thin lens. Image in a thin lens. Increase.	III	Optical devices and their characteristics. Aberration of optical systems.
Light interference. The concept of coherence. Wave interference.	IV	Implementation of coherent waves.Various interference schemes. Interference devices and their applications
Light diffraction. Princips Hugens and Fresnel	V	Diffraction in parallel rays Diffraction from the slit, on two slits. Diffraction grating
Polarization Light. Light propagation through tourmaline. Malyus's law	VI	Polarization of light with reflection and refraction of light at the boundary of two dielectrics. . Law Brewster Oh
The law of absorption is light	VII	Spectra and their parameters
Electromagnetic wave scale. IR and UV rays	VIII	Electronic spectroscopy
X-rays. The nature of X-rays.	IX	X-ray diffraction.
Dispersion And Absorption Light . Difficulties of Maxwell's electromagnetic theory.	X	Spectral devices and their characteristics Elementary theory of oscillatory spectra
The speed of light and methods of its determination	XI	Passage of light through an optically heterogeneous medium.Molecular and combinatorial scattering of light.
Photoelectric effect. Photo effect laws	XII	Einstein's equation. The hypothesis of light quanta.
The essence of Compton's phenomenon and its laws The dependence of the photocurent force on the wavelength of light.	XIII	Doppler effect in optics and acoustics. Photocells and their application
Thermal radiation. Kirchhoff's law. Absolutely black body.	XIV	The law of displacement of Wine. Planck radiation formula
Laws of luminescence. Luminescence and its types	XV	FAtJurocentIya And phosphorescence Principle of operation
Optical quantum Generators. Main Properties of laser radiation	XVI	Types of lasers and their application.
In all		**16**

VII. Final results of the study of the discipline

As a result of studying the discipline:

- students should have clear ideas on Optics
- they must understand the essence of the laws of light absorption and interaction light with matter;

• they should understand the basic methods of optical Phenomenon.
• they should have ideas about the main Optical phenomena

Topic name	Assignment	TimeOh Changes	Scope of work
Topic 1. Optics.Basic laws of optics. Development of ideas about the nature of light	Homework — Basic laws of optics	Weeks Ai 1	Delivery of SRS (Not me 4-5 s Tr.)
Topic 2. Wave formation. Wave equation.. Photometric concepts and units	ToMaTask — Monochromatic oscillations and waves.	Weeks 2	Delivery of the SRS in the form of Presentation And
Topic 3. Lens. Focal length of a thin lens. Image in a thin lens. Increase.	Homework- Optical devices and their characteristics Aberration of optical systems.	Weeks 3	Delivery of SRS
Topic 4 Light interference. The concept of coherence. Wave interference ..	Homework - Implementation of coherent waves. Various interference schemes.Interference devices and their applications	Weeks 4	Delivery of the SRS in the form of Presentation
Topic5. Light diffraction. Princips Hugens and Fresnel	Homework -Diffraction in parallel rays Diffraction from the slit, on two slits. Diffraction grating	Weeks 5	Delivery of SRS (not less 4-5 pages)
Topic 6. Polarization Light. Light propagation through tourmaline. Malyus's law	Homework- Polarization of light with reflection and refraction of light at the boundary of two dielectrics. Law Brewster Oh	Weeks6	Delivery of the SRS in the form of Presentation
Topic 7. The law of light absorption	Homework- Lambert Bohr's law	Weeks 7	Delivery of the SRS in the form of Presentation
Topic 8. Electromagnetic wave scale.	Homework- IR and UV rays	Weeks 8	Delivery of SRS (not less 4-5 pages)
Topic 9. X-rays. The nature of X-rays.X-ray diffraction.	Homework- Electronic spectroscopy	Weeks9	Delivery of SRS (not less 4-5 pages)
Topic 10. Dispersion and Absorption Light. Difficulties of Maxwell's electromagnetic theory.	Homework- Spectral devices and their characteristics .Elementary theory of oscillatory spectra	Weeks 10	Delivery of SRS (not less 4-5 pages)
Topic 11. The speed of light and methods of its determination	Homework — Passage of light through an optically heterogeneous medium.Molecular and combinatorial scattering of light.	Weeks 11	Delivery of SRS (not less 4-5 pages)
Topic 12. Photoelectric effect. Photo effect laws	Homework-. Einstein's equation.Hypothesis of light quanta	Weeks 12	Delivery of the SRS in the form of Presentation
Topic 13. The essence of Compton's phenomenon and his laws. The dependence of the photocurent force on the wavelength of light.	Homework- Doppler effect in optics and acoustics Photocells and their application	Weeks 13	Delivery of SRS (not less 4-5 pages)
Topic 14. Thermal radiation. Kirchhoff's law. Absolutely black body.	Homework- The law of displacement of Wine. Planck radiation formula	Weeks 14	Delivery of SRS (not less 4-5 pages)
Topic 15.Laws of luminescence. Luminescence and its types.	Homework- Optical quantum generators.Principle of operation	Weeks 15	Delivery of SRS (not less 4-5 pages)

Topic 16.The main properties of laser radiation	Homework- Types of lasers and their application.	Weeks 16	Delivery of the SRS in the form of Presentation

Laboratory's works

Topics №	**Week**	**Content of laboratory classes (CMRO)**
Familiarization with safety techniques in laboratories.	I	1.Knowledge Safety precautions when working with laboratory devices. 2. Study and development of safety techniques. 3. Use of safety rules in laboratory work.
Laboratory work №1.	II	1. Study of the purpose and theory of laboratory work. 2. Study of the practical part of laboratory work.
Laboratory work №2.	III	1. Acquaintance with laboratory work. 2. Performing laboratory work and obtaining the necessary results.
Acceptance of laboratory work №1. And inSCompletion of lab. work 3	IV	1. Preparation of answers to laboratory test questions. 2. Preparation of a report on laboratory work and its submission.
Laboratory work №4.	V	1. Study of the purpose and theory of laboratory work. 2. Study of the practical part of laboratory work
Laboratory work №5	VI	1. Acquaintance with laboratory work. 2. Performing laboratory work and obtaining the necessary results.
Acceptance of laboratory work №2.3,4. And in SFilling of labs.Works 6	VII	1. Preparation of answers to laboratory test questions. 2. Preparation of a report on laboratory work and its submission.
Laboratory work №7.	VIII	1. Study of the purpose and theory of laboratory work. 2. Study of the practical part of laboratory work.
Performing laboratory work №8.	IX	1. Acquaintance with laboratory work. 2. Performing laboratory work and obtaining the necessary results.
Acceptance of laboratory work №5.	X	Preparation of answers to laboratory test questions. 2. Preparation of a report on laboratory work and its submission.
Laboratory work №9.	XI	1. Study of the purpose and theory of laboratory work. 2. Study of the practical part of laboratory work.
Performing laboratory work №10.	XII	1. Acquaintance with laboratory work. 2. Performing laboratory work and obtaining the necessary results.
Acceptance of laboratory work №6,7.	XIII	1. Preparation of answers to laboratory test questions. 2. Preparation of a report on laboratory work and its submission.
Laboratory work №11.	XIV	1. Study of the purpose and theory of laboratory work. 2. Study of the practical part of laboratory work.

Performing laboratory work №12.	XV	1. Acquaintance with laboratory work. 2. Performing laboratory work and obtaining the necessary results.
Acceptance of laboratory work №8,9,10.	XVI	1. Preparation of answers to laboratory test questions. 2. Preparation of a report on laboratory work and its submission.

IX. Teacher's requirements

The criteria for assessing knowledge include the logic of the answer, the ability to analyze and to grow, active participation in classes.

The result of the assessment will also be affected by the non-fulfillment of the task, classes missed without valid reasons.

At Visit Classes should observe the following rightsAndLa:

1. Don't be late for classes.
2. Do not skip classes without a valid reason.
3. Actively participate in the conscientiously perform all tasks.
4. According to the calendar schedule of the educational process, pass all types of controls on timeЬTasks.
5. Do not leave the classroom without the teacher's permission.
6. Turn off cell phones and players.
7. Behave properly, Observe the ethics of behavior in a public place.

X. ASSESSMENT STRATEGY AND PROCESS

The assessment is given in accordance with the current Regulation on the credit system of education. Current monitoring of students' participation in lectures and practical classes, activity in the independent work system, completion of written homework and assignments on the independent work system is carried out weekly. At the end of the semester, a comprehensive exam is held in various forms (test, oral, written, etc.). At the end of the semester, the student will receive an overall final score, which is an indicator of the results of his efforts during the semester. The summary assessment is given on the basis of the assessment table determined by the Academic Council of the University.The student's academic activity in each round (each week: 2.5 + 6 + 4 = 12.5 points).Including: 4 points - for activity in lectures;6 points - for completed work related to the independent work system (seminars, practical, etc.);2.5 points - for independent work (ISW).Determination of the student's rating in the summary assessment, exam in the academic subject is also carried out on the basis of the requirements of the ECTS point-rating system.Summary assessment, exam in the subject of education are accepted and conducted in the form of a credit or oral. The volume of test tasks in the comprehensive assessment, exam in the academic subject is

25 questions. Less than this is allowed for academic subjects of the exact sciences.For each correct answer, 4 points are awarded. If the test has less than 25 questions, the fixed grade must be equal to 100.Points received by the student during the final assessment, exam in the academic subject, are taken into account as the sum of points for the credit. Rating points received by the student in the comprehensive assessment, exam in the academic subject, are added to the points scored during the semester. The grade awarded for a subject is the sum of the points earned during the week and the result of the final exam. Points are awarded as follows:

№	TYPE OF CONTROL	WEEKS AND MINIMUM POINTS																ИЭ	∑ points
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
1	For activity in lectures	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		**64**
2	For completed work related to the SRSP (seminars, practical work, etc.)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		**96**
3	For completed work on SRS	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5		**40**
4	**In a week**	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5		**200**
5	**All together**																	**100**	**300**

The overall score for a subject is calculated using the following formula: $Ич = \left[\frac{(ИФ_1 + ИФ_2)}{2}\right] \cdot 0{,}5 + Ич \cdot 0{,}5$

Letter and numerical expression of a student's grade

literal expression rating	Numerical expression of the assessment	Points for correct answers	Traditional expression of evaluations
A	*4,0*	*95 ≤ A ≤ 100*	Excellent
A -	*3,67*	*90 ≤ A < 95*	
B +	*3,33*	*85 ≤ B + < 90*	
B	*3,0*	*80 ≤ B < 85*	
B -	*2,67*	*75 ≤ B - < 80*	
C +	*2,33*	*70 ≤ C + < 75*	
C	*2,0*	*65 ≤ C < 70*	
C -	*1,67*	*60 ≤ C - < 65*	Satisfactorily
D +	*1,33*	*55 ≤ D + < 60*	
D	*1,0*	*50 ≤ D < 55*	
F_X	*0*	*45 ≤ F_X < 50*	Unsatisfactory
F	*0*	*0 ≤ F < 45*	

Note: an unsatisfactory grade, which gives the student the right to take the exam in this subject in the trimester (additional session) without paying the fee.

Recommended clothing and student participation in all classes (lectures, seminars, laboratories, etc.) are mandatory. Coming to classes in itself does not mean an increase in grades, that is, the student's active participation in classes is necessary. In case of truancy or failure to complete assignments set by the teacher on time, the student is fined certain points.

Activity in auditing and independent professional work is mandatory and is one of the components of the student's overall score. A mandatory requirement of the subject is preparation for each lesson, since the result of the student's practical auditory preparation are the points received during the current training. As a result of mastering the subject in the classroom, participation and activity - 64 points, independent work of the student under the guidance of the teacher (seminar, practical, etc.) - 96 points and for independent work 40 possible points for each academic period.

Written homework - to complete independent work and write independent work (essay) on a given topic. Completing essays is mandatory for all students. Criteria for assessing written work: completeness of content, volume, logic of presentation, presence of analysis and conclusions, submission on time.

Step-by-step control includes all lecture topics, homework and reading materials that were reviewed during the training, and is implemented in the form of tests and debates related to the topics studied.

Midterm exam is a form of control that is held twice during each semester in order to determine the level of assimilation of the educational subject program by students. Midterm exams are conducted by teachers.

The final exam is conducted orally or in writing and includes different types of tasks: open questions, solving examples and problems. The criteria for assigning exam marks: completeness and correctness of answers, logic and manner of presentation.

Literature

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