Course title	**Optics**
Course code	**Fizi 2049 (eks)** **Fizi 2026 (iesk)** **Fizi 2050(DP)**
Scientific field	Physics
Scientific subfield	Optics
Credit points	6
ECTS credits	9
Total contact hours (CH) *Number of hours for lectures* *Number of hours for seminars and practical assignments* *Number of hours for laboratory assignments* *Number of hours for course paper*	96 32 32 32

Course developer (-s)
Dr.paed., doc. Lolita Jonāne

Prerequisite knowledge (course title, part of the program in which the course is learnt)
Highschool physics course

Course abstract:
The course is intended for students of Bachelor study program "Physics". The course of study offers to explore optical phenomena, by using wave and quantum models; to explore properties of light and interaction with the matter. Students learn the laws of optics and developed practical research skills, working out the laboratory works and evaluate results.

Learning outcomes:
Students will: • characterize the nature and technology of the optical phenomena observation. • use a light wave and light quantum model optics concepts, laws and principles of light phenomena in the description and analysis. • demonstrate skills to plan and carry out research in optics, analyze and justify the physical content of the problem. • illustrate with examples the optics research development and use of modern optical technologies. • analyze, summarize and evaluate the theoretical knowledge and experimental skills in optics and will be able to apply in physical content studies.

Course plan:
1. Introduction. Learning about the development of the light. 2. Geometric optics. 3. Light-wave theory. Light interference. 4. The light diffraction. 5. Light polarization 6. The light dispersion and absorption 7. Light-scattering. 8. The thermal radiation. 9. Photon and electron interaction.

Course content:

Lectures – 32 KS, practical assignments – 32KS, laboratory assignments -32 KS.

Topics of lectures

1. **Introduction.** Short historical overview of learning about the light. Light dualism.
2. **Photometry.** Photometric parameters. Photometry laws.
3. **Geometric optics.** Fermat's principle. Light reflection and refraction laws. The complete internal reflection. Reflection and refraction on a plane and spherical surface.
4. **Thin lenses.** Lens systems. Optical instruments.
5. **Light-wave theory**. Wave superposition principle. Light interference. Coherence in time and space. Interference of the clear films. Multipath interference. Interference phenomenon in nature.
6. **Interference** observation methods. Interferometers, interference applications.
7. **Diffraction of light.** Huygens-Fresnel principle. Fresnel zone. Light rectilinear propagation law explanation wave theory. Fresnel diffraction in round diaphragm.
8. **Diffraction grating.** Grid dispersion and resolution. Microscope resolution. X-ray diffraction.
9. **Holography**. Hologramm types. Principles of holographical recording.
10. **Polarization of light.** Natural light, polarized light. Polarized light types. Polarisers, analyzers. Malusa law. Polarization of light reflecting back from the dielectrics. Brewster law. Double refraction of light. Polarized light interference. Rotation of polarization plane. Artificial substances anisotropy. Polarization applications in various devices.
11. **Dispersion and absorption of light.** Light dispersion phenomenon, experimental facts. Normal and abnormal dispersion. Theory of light dispersion and absorption of electrons. Luminescence.
12. **Light absorption laws.** Absorption spectrum. Spectrometers, spectral analysis.
13. **The light scattering.** Light propagation in optically inhomogeneous medium. Distribution in hazy media. Molecular scattering.
14. **Thermal radiation.** Heat radiation - a balanced radiation. Black body. Kirchhoff's law. Stefan Boltzmann and Wien's laws. The energy distribution of black body radiation spectrum. Planck formula. Optical pirometry.
15. **Photon and electron interaction.** Stoletov studies. External photo effect. External photo effect laws. Einstein's equation. Internal and barrier layer photo effect. Photoelements.
16. Lebedev experiments. Light pressure explanation. Compton scattering.

Practical assignments

1. Photometric parametres: luminous flux, luminous intensity, illumination.
2. The rules of geometric optics and their use in physical situation analysis.
3. The lenses and lens systems. Image construction in lenses.
4. The complex problem solving.
5. Problem solving - test.
6. Light Interference.
7. Light interference applications. Clarification of optics.
8. The light diffraction.
9. Holography.
10. Light polarization.
11. The light dispersion and absorption.
12. Problem solving - test.
13. Thermal radiation. Black body radiation
14 . Photoeffect.
15. Pressure of light.
16. Problem solving - test.

Laboratory assignments.

1. Photometry.
2. Determination of spherical mirror focal length and radius of curvature.
3. Determination of lens optical power.
4. Refractometry.
5. Study of microscope.
6. Laboratory assignment defense.
7. Determination of light wavelength by Frensels biprism.
8. Study of diffraction grid.
9. Study of light polarization.
10. The solution to the concentration of photovoltaic calorimeter.
11 Spectroscopy
12. Study of photoeffect.
13. Laboratory assignment defense.

Requirements for awarding credit points:

Differentiated test: regular attendance and active participation – 20%, completed laboratory assignments – 40%, passing three tests - 40%

Oral exam: an oral presentation of two topics from study course. Students are allowed to take an exam after succesfull passing of differentiated test.

Compulsory reading:

1. Grabovskis R. *Physics*. - Rīga: Zvaigzne, 1983. - 644 lpp.
2. *Physics.* A.Valtera redakcijā. - Rīga: Zvaigzne, 1992. - 643 lpp.
3. Jansone M., u.c. *Uzdevumu krājums vispārīgajā fizikā*. – Rīga. RTU, 2000.
4. Kalme I., Ribakovs A. *Metodisks palīglīdzeklis laboratorijas darbiem fizikā. 1. daļa*. Viļņu optika. –Daugavpils.
5. Rēvalds V. *Optika no senatnes līdz mūsdienām*. - Rīga: Mācību grāmata, 2001., 384 lpp.
6. Students O. *Optika*. - Rīga: Zvaigzne, 1971.
7. Trukšāns G. *Laboratorijas darbu aprakstu krājums optikā un kodolfizikā*. 1. un 2. daļa., Daugavpils.
8. Cutnell J D., K.W. Johnson. *Physics. (5-th)* - New York: John Wiley & Sons, 2001., 1002 pp.
9. Jones E., Childers R. *Contemporary College Physics*. - USA: McGraw-Hill,1999, 1025 pp.

Further reading:

1. Krūmiņš J. u.c. *Uzdevumu krājums vispārīgajā fizikā*. - Rīga: Zvaigzne, 1971.
2. Krūmiņš J., Ertele B. *Fizikas uzdevumu risināšanas metodika*. - Rīga: Zvaigzne, 1980.
3. Volkenšteine V. *Uzdevumu krājums fizikā*. - Rīga: Zvaigzne, 1968.
4. Halliday D., Resnich, R. Walker J. *Fundamentals of Physics (Extended*) - New York: John Willey & Sons, Inc., 1997, 1142 pp.
5. Hobson A. *Physics. Concepts and connections*. - New Jersey: Prentice-Hall, 1999., 536 pp.
6. Ohanian H. C. *Physics,* Vol 2. New York: W.W. Norton & Company, 1985, 1012 pp.
7. Standford A.L. Tanner J. M.. *Physics for Students of Science and Engineering*. - Orlando, Florida: Academic Press, Inc., 1985, 804 pp.
8. Merken M. *Physical science with modern application. 5-th edition*. – Saunders College Publish, 1993, 680 pp.

Periodics and other sources of information

1. Opto& Lasers Europe
2. Optic Communications

Study programs and their sections (A, B, C, D) which this course belongs to:
BSP “Physics” section A