COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
General physics III (Optics)	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: Doc. Aidas Matijošius **Other(s):**	VU FF Department of Quantum Electronics

Study cycle	Type of the course unit (module)
First	Compulsory

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Auditorium	3 semester (autumn)	Lithuanian/English

Requirements for students	
Prerequisites: Mathematics I, Mathematics II (linear algebra and geometry, mathematical analysis, differential equations, General Physics I	**Additional requirements (if any):**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	149	80	69

Purpose of the course unit (module): programme competences to be developed		
This is a shorten optics an atomic physics course with an intend to give the basic of theoretical and practical knowledge for the students of the main optics chapters like geometrical optics, polarization, photometry, interference, diffraction in order for the future (advanced) studies, understand the principles of various optical devices.		
Learning outcomes of the course unit (module)	**Teaching and learning methods**	**Assessment methods**
By the end of the course the students are expected to be able to: explain optical processes around us (1.1, 3.1) describe electromagnetic waves, their interaction and interaction with matter(1.1, 3.1) understand light polarization and explain the polarization methods (1.1) explain the light absorption, reflection, emission and scattering (1.2, 3.1) understand and analyze various interference patterns (1.2, 3.1) evaluate the diffraction pattern appearance conditions (1.2, 3.1) understand the principles of holography (1.1) explain the basic of laser physics (2.1)	Teaching modes: lectures with demonstrations, practical, laboratory work, consultations. Students could arrange simple optical projects by themselves. Methods: problem teaching. Laboratory work defense.	Final mark consists of practical mark (mid-term test) (25%), laboratory work mark (25%) and exam or optical project presentation mark (50%).

Students will be able to apply general physics knowledge to practical situations (1.1, 3.1)		

Content: breakdown of the topics	Contact hours							Self-study work: time and assignments	
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	**Contact hours**	**Self-study hours**	**Assignments**
1. One-dimensional, harmonic waves. Phase and phase velocity. The complex representation. Plane, spherical and cylindrical waves. The three-dimensional differential wave equation. Scalar and vectorial waves. Electromagnetic wave, wave equation.	3			2			**5**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
2. Energy and momentum of radiation. The addition of waves of the same frequency. The algebraic method. Standing waves. The addition of waves of different frequency, beats, phase and group velocity. Anharmonic periodic waves, Fourier series. Coherence duration and length.	3			2			**5**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
3. Principles of interference. Constructive and destructive interference. Conditions for interference. Wavefront-splitting interferometers, two beams interference in a thin-film. ringes of equal inclination and equal thickness. The Newton's rings. Mirrored interferometers. Multiple beam interference. The Fabry-Perot interferometer, chromatic resolving power, free spectral range.	5			2			**7**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
4. Diffraction. The Huygens-Fresnel principle. Fraunhofer and Fresnel diffractions, the single slit, many slits, the rectangular and the circular apertures. Resolution of imaging systems, diffraction grating, angular dispersion, chromatic resolving power, limit of resolution, free spectral range.	6			2			**8**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
5. Light polarization. Linear, circular and elliptical polarization. Natural light. Light double refraction, birefringent crystals, polarizers. Fresnel equations.	5			2			**7**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
6. Light dispersion. The electromagnetic spectrum. Light absorption. The rainbow theory. Colors (RGB, CMYK) conception, subtraction, addition. Light scattering. Rayleigh and Mie scattering.	4						**4**	**2**	In lectures students gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
7. Laser, population inversion, optical pumping,	6						**6**	**2**	In lectures students

optical resonant cavity, longitudinal and transverse cavity modes. Holography, transmission and reflection holograms.									gain theoretical knowledge about the topic, while skills are developed by solving selective exercises.
Laboratory works - (randomly selected 6 laboratory works) from the list: 1. Parameters of the optical systems. 2. Aberrations of optical systems. 3. Investigation of Fresnel lens. 4. Microscope. 5. Parameters of prism. 6. Investigation of interference with double prism. 7. Investigation of interference with double lens. 8. Air refractive index measurement with Rayleigh interferometer. 9. Liquid refractive index measurement with Abe interferometer. 10. Fabry-Perot interferometer. 11. Investigation of chromatic polarization. 12. Spatial filtering. 13. Investigation of interference filter. 14. Optical thickness measurement of a thin-film. 15. Investigation of light diffraction. 16. Diffraction grating. 17. Investigation of light reflection. 18. Brewster angle measurement. 19. Polarized light investigation. 20. Investigation of polarization plane rotation with a polarimeter. 21. Faraday effect. 22. Polariscope investigations. 23. Pockels effect.					32		**32**	**30**	
Mid-term test				2			**2**	**10**	
Final test		4					**4**	**15**	
Total	**32**	**4**		**12**	**32**		**80**	**69**	

Assessment strategy	Weight,%	Deadline	Assessment criteria
Laboratory work	25	End of semester	The completeness of the laboratory work, correctness of conclusions, answers to theoretical questions.
Mid-term test	25	Semester	Mastered half course knowledge (%)
Final exam or optical project presentation	50	End of session	Mastered full course knowledge (%)

Author	Year of publication	Title	Issue of a periodical or volume of a publication	Publishing place and house or web link
Compulsary reading				

E.Hecht	1990	Optics		Addison-Wesley, Reading
V.Šalna	2004	Optika		Vilnius
E.Hecht	1990	Optics		Addison-Wesley, Reading
Optional reading				
F.Pedrotti, L.Pedrotti,	1993	Introduction to optics		New Jersey
P.Brazdžiūnas	1936	Bendroji fizika III		Vilnius