Study programmes: BACHELOR STUDIES – Astronomy and Astrophysics

Course name: Waves and Optics

Lecturers: Dr Đorđe Spasojević and other lecturers

Status: Compulsory

ECTS: 10

Attendance prerequisites: Physical mechanics, Molecular physics and thermodynamics, Mathematics 1 and 2

Course aims: Adoption of fundamental concepts and laws in the field of waves and optics, and familiarization with more complex phenomena.

Course outcome: Students are trained to independently solve basic problems and gain new knowledge about more complex physical phenomena and laws in the field of waves and optics.

Course content:

1. Free, damped, and forced oscillations of systems with one degree of freedom; resonance. 2. Oscillations of systems with two degrees of freedom; normal modes; resonance; filters; limit to continuous systems. 3. Wave equation in one dimension; transversal oscillations of a wire; standing waves; Fourier analysis. 4. Wave equation in three dimensions; phase velocity; progressive waves; plane waves and plane monochromatic waves. 5. Sound waves; energy and intensity of a sound wave; dispersion relation; group velocity. 6. Maxwell's equations; electromagnetic waves in vacuum and in non-conducting media; energy of electromagnetic waves (Poynting vector and wave intensity); electromagnetic spectrum. 7. Sources of electromagnetic waves; radiation of an accelerated charge; Larmor's formula; Hertz experiment. 8. Geometric optics; eikonal approximation; Fermat's principle; law of reflection and law of refraction; total reflection; lenses and mirrors. 9. Matrix methods in paraxial approximation (formation of image, cardinal elements, thin and thick lenses, and optical systems); optical instruments; lens imperfections. 10. Polarization of light (basic types; partial polarization). 11. Electromagnetic wave at the boundary between two optical media – reflection and refraction; amplitudes and phases of reflected wave and of refracted wave. 12. Superposition of waves; interference of waves; amplitude splitting and wave front splitting; space and time coherence; Young's experiment; Fresnel's biprism; Michelson's interferometer; interference in a slab; Fabry-Perot interferometer. 13. Diffraction of waves (N coherent point sources, thread source); Kirchhoff's formula and Huygens-Fresnel principle; Fresnel zones; diffraction at a circular aperture. 14. Fraunhofer's diffraction at a single slit; diffraction grating. 15. Double refraction of light; polarizers; dichroism; optical activity; Faraday's and Kerr's effect.

Literature:

1. F.S. Crawford, Waves - Berkeley Physics Course - volume 3, McGraw-Hill
2. A.A. Matveev, Optics, Mir publishers, Moscow
3. E. Hecht, Optics, Addison Wesley
4. N.N. Nedeljković, Talasi i optika, skripta (PDF)

Number of hours: 10	**Lectures**: 4	**Tutorials**: 3	**Laboratory**: 3	**Research**: -

Teaching and learning methods:

Lectures (theory and examples), exercises (homework), consultations.

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	10	Written exam	30
Exercises / Tutorials	10	Oral exam	40
Colloquia	-	Written-oral exam	-
Essay / Project	10		