

Medicinski fakultet u Rijeci

**IZVEDBENI NASTAVNI PLAN  
2024/2025**

Za kolegij

**Medical Physics and Biophysics**

Studij:	<b>Medical Studies in English (R)</b> Sveučilišni integrirani prijediplomski i diplomski studij
Katedra:	<b>Katedra za medicinsku fiziku i biofiziku</b>
Nositelj kolegija:	<b>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije</b>
Godina studija:	<b>1</b>
ECTS:	<b>6</b>
Stimulativni ECTS:	<b>0 (0.00%)</b>
Strani jezik:	<b>Mogućnost izvođenja na stranom jeziku</b>

**Podaci o kolegiju:**

Medical Physics and Biophysics is an introductory course, which gives students an insight into the physical principles required for a better understanding of processes in other fields, such as anatomy, biochemistry, physiology, histology, pathology, etc. The purpose of this course is to motivate students to use the analytical and quantitative approach in the research of human body functions.

**COURSE STRUCTURE**

Lectures: 30 hours

Seminars: 20 hours

Practicals: 25 hours

Total hours: 75

The lectures and practicals will be held at the University Campus on Trsat at the Faculty of Physics (Address: Radmile Matejčić 2, 51000 Rijeka).

During practicals, students will develop abilities and skills in using various measuring devices, which are a part of different medical devices. Upon completing this course, students will be able to collect data, critically evaluate and interpret the results, as well as correctly use the International System of Units and Measurements in medicine.

**Popis obvezne ispitne literature:**

I.P. Herman. Physics of the Human Body, Springer, Berlin, 2016

**Popis dopunske literature:**

R. K. Hobbie, B.J. Roth. Intermediate Physics for Medicine and Biology, Springer, New York, 2015

## **Nastavni plan:**

**Predavanja popis (s naslovima i pojašnjenjem):**

**L1 Introduction. SI Units.**

-

**L2 Optics in Medicine. Laws of Refraction and Reflection: Image Formation by Plane and Spherical Surfaces of Refraction**

-

**L3 The Human Eye - the Optical Model**

-

**L4 Errors of optical systems**

-

**L5 Image Formation by Lens and Microscope**

-

**L6 Types of Optical Microscopes. Electron microscopes**

-

**L7 Fundamental Forces. Statics of the Body. Review of Forces, Torques and Equilibrium**

-

**L8 Mechanics of the Human Body. Implementation of Newton's Laws: Levers in the Body, Passive Walking and High Jump.**

-

**L9 Mechanical Properties of Tissues. Elasticity and Strength of Materials. Viscoelastic Properties of Body Tissues - Mechanical Models.**

-

**L10 Fluids. Hydrostatics. Surface Tension and Its Implications. Law of Laplace.**

-

**L11 Hydrodynamics. Bernoulli's Equation, Viscosity and Poiseuille's Law. Turbulent Flow**

-

**L12 Rheological Properties of Blood. Physics of the Circulatory System. Consequences of Clogged Arteries**

-

**L13 Ideal and Real Gases. Gas Laws. Physics of Breathing**

-

**L14 Basic Principles of Thermodynamics: I and II Law.**

-

**L15 Thermodynamics of a Biological system. Transfer of Heat.**

-

**L16 Transfer of Particles and Ions through Membranes. Action Potential.**

-  
**L17 Physical Basis of Electro- and Magneto- Diagnostics (EKG, EEG, EMG).**

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**L18 Dielectric Properties of Tissues. Tissues in Electric Field.**

-  
**L19 Oscillations and Waves d Waves.**

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**L20 Sound Waves: The Physics of Hearing. Intensity of Soun. Connection between Physical and Physiological Parameters of Sound.**

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**L21 Therapeutic Applications of Electric Fields.**

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**L22 Matter in the External Magnetic Field: A Biological System in the Electric Circuit, Magneto therapy**

-  
**L23 Structure of Atom and Molecule: Molecular Bonds and Energy States**

-  
**L24 Electromagnetic Waves**

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**L25 Medical Use of X Rays**

-  
**L26 Structure of the Atomic Nucleus. Nuclear Decay. Decay Rate and Half-life**

-  
**L27 Radioactivity. Alfa, Beta and Gamma Decay.**

-  
**L28 Interaction of Photons with Matter. Detection and Dosimetry of Ionizing Radiation.**

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**L29 Application of Ultrasound in Medicine.**

-  
**L30 Final Lecture and Preparation for Final Exam.**

**Seminari popis (s naslovima i pojašnjenjem):**

**S1 Calculating Measurement Errors and Estimating Measurement Accuracy**

-  
**S2 Optics**

-  
**S3 Vectors and Operations with Vectors. Graphical Representation of Measurement Results and Interpretation of Graphs. Differential Calculus.**

-

**S4 Levers in the Human Body**

-

**S5 Hydromechanics**

-

**S6 Physics of Breathing**

-

**S7 Diffusion and Osmosis. Transport of Energy and Matter through Cell Membranes**

-

**S8 Sound. Hearing and the Ear.**

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**S9 Medical Use of X-Rays**

-

**S10 Application of Radioactive Isotopes in Nuclear Medicine**

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**Vježbe popis (s naslovima i pojašnjenjem):**

**P0 Introduction to Practicals. General Laboratory Safety Procedures and Rules.**

-

**P1 Mechanical Waves**

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**P2 Audiometry**

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**P3 Surface Tension and Viscosity**

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**P4 Calorimetry**

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**P5 Thermal Environmental Conditions**

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**P6 Index of Refraction. Spectroscopy**

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**P7 Spherical Mirrors and Lenses**

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**P8 Electric Circuits**

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**P9 Measurement of Resistance. The Wheatstone Bridge Method**

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**P10 Ionizing radiation**

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**P11 Compensation**

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**P12 Compensation**

-

**Obveze studenata:**

The attendance at lectures, seminars and practicals is mandatory. If necessary, a student can be absent from 30% of the classes of the overall course workload but has to make up for the practicals he/she failed to attend. Students' obligations are course attendance and active participation in all practicals and seminars.

Throughout the course, students have two midterm exams (tests) consisting of 14 questions each.

Test 1 covers the topics presented in seminars 1-5.

Test 2 covers the topics presented in seminars 6-10.

The completion and proper documentation of each practical as well as the consent of the course instructor are required for course completion.

Evaluation of students' work:

Students can obtain a total of 100 credits (a maximum of 50 credits during the course and a maximum of 50 credits on the final exam). Students are allowed to take the final exam if they acquire a minimum of 25 credits during the semester.

Students who did not gain 50% on each midterm exam may retake their midterm exams. A student can repeat the mid-term exam a maximum of two times, and if he/she still does not pass it, he/she must re-enrol for the course.

On the final exam, students can obtain a maximum of 50 credits. The final exam is oral.

**Ispit (način polaganja ispita, opis pisanog/usmenog/praktičnog dijela ispita, način bodovanja, kriterij ocjenjivanja):**

**Assessment (exams, description of written / oral / practical exam, the scoring criteria):**

	<b>Assessment</b>	<b>Grade Point Maximum</b>
<b>Midterm Exams</b>	Midterm 1 (14 questions)	14
	Midterm 2 (14 questions)	14
	<b>total</b>	<b>28</b>
<b>Practicals</b>	Accepted practicals and reports 10 x 5 x 0.4 credits	20
	<b>total</b>	<b>48</b>
<b>Active participation</b>	Active participation during seminars	<b>2</b>
<b>TOTAL</b>		<b>50</b>
<b>Final exam</b>	Oral part	50
	<b>total</b>	<b>50</b>
<b>TOTAL</b>		<b>100</b>

**Partial exams:**

Two midterm exams are scheduled during the trimester.

1. Midterm exam. 14 questions
2. Midterm exam. 14 questions

**Practicals:**

Throughout 10 practicals a student can obtain a maximum of 20 credits.

Each completed and accepted practical is assessed. A student may miss a maximum of two practicals, which he/she must make up in order to fulfil the requirements for taking the final exam.

**Active participation during seminars:**

During the trimester student participation and dedication will be monitored. A maximum of 2 points is awarded through active participation.

**Final exam:**

The final exam is oral.

**Assessment of the oral part of the final exam:**

<b>Grade on oral exam</b>	<b>Credits</b>
sufficient	10-20

good	21-30
very good	31-40
excellent	41-50

**Assessment of the oral part of the final exam:**

<b>Grade on oral exam</b>	<b>Credits</b>
sufficient	10-20
good	21-30
very good	31-40
excellent	41-50

The ECTS grading system is defined by the following criteria:

A (5) - 90 - 100 credits

B (4) - 75 - 89,9 credits

C (3) - 60 - 74,9 credits

D (2) - 50 - 59,9 credits

**Ostale napomene (vezane uz kolegij) važne za studente:**

Retaking the course: A student who acquires less than 25 credits during the course has failed the course, is graded with F, and must retake the course MEDICAL PHYSICS AND BIOPHYSICS.



# SATNICA IZVOĐENJA NASTAVE 2024/2025

Medical Physics and Biophysics

<b>Predavanja</b> (mjesto i vrijeme / grupa)	<b>Vježbe</b> (mjesto i vrijeme / grupa)	<b>Seminari</b> (mjesto i vrijeme / grupa)
<b>05.03.2025</b>		
L1 Introduction. SI Units.: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul> L2 Optics in Medicine. Laws of Refraction and Reflection: Image Formation by Plane and Spherical Surfaces of Refraction: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul>		
prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup>		
<b>12.03.2025</b>		
L3 The Human Eye - the Optical Model: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul> L4 Errors of optical systems: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul>	P0 Introduction to Practicals. General Laboratory Safety Procedures and Rules.: <ul style="list-style-type: none"><li>• Kampus O-162 (10:00 - 11:00) <sup>[457] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP P A</li></ul></li><li>• Kampus O-162 (12:00 - 13:00) <sup>[337] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP V B</li></ul></li><li>• Kampus O-162 (13:00 - 14:00) <sup>[337] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP P C</li></ul></li></ul>	S1 Calculating Measurement Errors and Estimating Measurement Accuracy: <ul style="list-style-type: none"><li>• Kampus O-152 (10:15 - 12:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP S B</li></ul></li></ul>
Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup>		
<b>14.03.2025</b>		
		S1 Calculating Measurement Errors and Estimating Measurement Accuracy: <ul style="list-style-type: none"><li>• P08 (09:15 - 11:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP S A</li></ul></li></ul>
prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup>		
<b>19.03.2025</b>		
L5 Image Formation by Lens and Microscope: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul> L6 Types of Optical Microscopes. Electron microscopes: <ul style="list-style-type: none"><li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP</li></ul></li></ul>	P1 Mechanical Waves: <ul style="list-style-type: none"><li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP P A</li></ul></li><li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP V B</li></ul></li><li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup><ul style="list-style-type: none"><li>◦ MPBP P C</li></ul></li></ul>	S2 Optics: <ul style="list-style-type: none"><li>• Kampus O-152 (10:15 - 12:00) <sup>[149]</sup><ul style="list-style-type: none"><li>◦ MPBP S B</li></ul></li></ul>
Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup>		
<b>21.03.2025</b>		

		<p>S2 Optics:</p> <ul style="list-style-type: none"> <li>• P06 (09:15 - 11:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup></p>		
<p><b>26.03.2025</b></p>		
<p>L7 Fundamental Forces. Statics of the Body. Review of Forces, Torques and Equilibrium:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L8 Mechanics of the Human Body. Implementation of Newton's Laws: Levers in the Body, Passive Walking and High Jump.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P2 Audiometry:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S3 Vectors and Operations with Vectors. Graphical Representation of Measurement Results and Interpretation of Graphs. Differential Calculus.:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (10:15 - 12:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>
<p>Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup></p>		
<p><b>28.03.2025</b></p>		
		<p>S3 Vectors and Operations with Vectors. Graphical Representation of Measurement Results and Interpretation of Graphs. Differential Calculus.:</p> <ul style="list-style-type: none"> <li>• P05 (09:15 - 11:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup></p>		
<p><b>02.04.2025</b></p>		
<p>L9 Mechanical Properties of Tissues. Elasticity and Strength of Materials. Viscoelastic Properties of Body Tissues – Mechanical Models.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L10 Fluids. Hydrostatics. Surface Tension and Its Implications. Law of Laplace.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P3 Surface Tension and Viscosity:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S4 Levers in the Human Body:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (10:15 - 12:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>
<p>Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup></p>		
<p><b>04.04.2025</b></p>		
		<p>S4 Levers in the Human Body:</p> <ul style="list-style-type: none"> <li>• P08 (09:15 - 11:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup></p>		
<p><b>09.04.2025</b></p>		

<p>L11 Hydrodynamics. Bernoulli's Equation, Viscosity and Poiseuille's Law. Turbulent Flow:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L12 Rheological Properties of Blood. Physics of the Circulatory System. Consequences of Clogged Arteries:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P4 Calorimetry:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S5 Hydromechanics:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (10:15 - 12:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>
<p>Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup></p>		
<p><b>11.04.2025</b></p>		
		<p>S5 Hydromechanics:</p> <ul style="list-style-type: none"> <li>• P06 (09:15 - 11:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup></p>		
<p><b>16.04.2025</b></p>		
<p>L13 Ideal and Real Gases. Gas Laws. Physics of Breathing:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L14 Basic Principles of Thermodynamics: I and II Law.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P5 Thermal Environmental Conditions:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	
<p>Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup></p>		
<p><b>23.04.2025</b></p>		
<p>L15 Thermodynamics of a Biological system. Transfer of Heat.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L16 Transfer of Particles and Ions through Membranes. Action Potential.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[2300]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P6 Index of Refraction. Spectroscopy:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	
<p>Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup></p>		
<p><b>30.04.2025</b></p>		

<p>L17 Physical Basis of Electro- and Magneto-Diagnostics (EKG, EEG, EMG):</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) [2300] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L18 Dielectric Properties of Tissues. Tissues in Electric Field.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) [2300] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P7 Spherical Mirrors and Lenses:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) [457] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S6 Physics of Breathing:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (10:15 - 12:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>
<p>Majetić Marijana, viša laborantica [1458] · Musulin Marija, laborantica [2812] · Pribanić Ivan, mag. edu. phys. et math. [457] · dr. sc. Čargonja Marija, mag. educ. phys. et math. [337] · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije [149] · prof. dr. sc. Žuvić Marta, prof. matematike i fizike [2300]</p>		
<p><b>02.05.2025</b></p>		
		<p>S6 Physics of Breathing:</p> <ul style="list-style-type: none"> <li>• P09 - NASTAVA NA ENGLSKOM JEZIKU (09:15 - 11:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije [149]</p>		
<p><b>07.05.2025</b></p>		
<p>L19 Oscillations and Waves d Waves.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (10:15 - 12:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L20 Sound Waves: The Physics of Hearing. Intensity of Soun. Connection between Physical and Physiological Parameters of Sound.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (10:15 - 12:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P8 Electric Circuits:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (08:00 - 10:00) [457] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S7 Diffusion and Osmosis. Transport of Energy and Matter through Cell Membranes:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (14:15 - 16:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP S A</li> </ul> </li> </ul>
<p>Majetić Marijana, viša laborantica [1458] · Musulin Marija, laborantica [2812] · Pribanić Ivan, mag. edu. phys. et math. [457] · dr. sc. Čargonja Marija, mag. educ. phys. et math. [337] · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije [149]</p>		
<p><b>09.05.2025</b></p>		
		<p>S7 Diffusion and Osmosis. Transport of Energy and Matter through Cell Membranes:</p> <ul style="list-style-type: none"> <li>• P07 (11:15 - 13:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije [149]</p>		
<p><b>14.05.2025</b></p>		
<p>L21 Therapeutic Applications of Electric Fields.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) [2300] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L22 Matter in the External Magnetic Field: A Biological System in the Electric Circuit, Magneto therapy:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) [2300] <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P9 Measurement of Resistance. The Wheatstone Bridge Method:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) [457] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) [337] [1458] [2812] <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	<p>S8 Sound. Hearing and the Ear.:</p> <ul style="list-style-type: none"> <li>• Kampus O-152 (10:15 - 12:00) [149] <ul style="list-style-type: none"> <li>◦ MPBP S B</li> </ul> </li> </ul>

Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup> · prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup> · prof. dr. sc. Žuvić Marta, prof. matematike i fizike <sup>[2300]</sup>

### 16.05.2025

S8 Sound. Hearing and the Ear.:  
 • P09 - NASTAVA NA ENGLESKOM JEZIKU (09:15 - 11:00) <sup>[149]</sup>  
 ◦ MPBP S A

prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup>

### 21.05.2025

L23 Structure of Atom and Molecule:  
 Molecular Bonds and Energy States:  
 • Kampus O-029 (08:15 - 10:00) <sup>[252]</sup>  
 ◦ MPBP

L24 Electromagnetic Waves:  
 • Kampus O-029 (08:15 - 10:00) <sup>[252]</sup>  
 ◦ MPBP

P10 Ionizing radiation:  
 • Kampus O-162 (10:00 - 12:00) <sup>[457]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP P A  
 • Kampus O-162 (12:00 - 14:00) <sup>[337]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP V B  
 • Kampus O-162 (14:00 - 16:00) <sup>[337]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP P C

S9 Medical Use of X-Rays:  
 • Kampus O-152 (10:15 - 12:00) <sup>[252]</sup>  
 ◦ MPBP S B

izv. prof. dr. sc. Jurković Slaven, spec. med. fiz. <sup>[252]</sup> · Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup>

### 23.05.2025

S9 Medical Use of X-Rays:  
 • P09 - NASTAVA NA ENGLESKOM JEZIKU (09:15 - 11:00) <sup>[252]</sup>  
 ◦ MPBP S A

izv. prof. dr. sc. Jurković Slaven, spec. med. fiz. <sup>[252]</sup>

### 28.05.2025

L25 Medical Use of X Rays:  
 • Kampus O-029 (08:15 - 10:00) <sup>[252]</sup>  
 ◦ MPBP

L26 Structure of the Atomic Nucleus.  
 Nuclear Decay. Decay Rate and Half-life:  
 • Kampus O-029 (08:15 - 10:00) <sup>[252]</sup>  
 ◦ MPBP

P11 Compensation:  
 • Kampus O-162 (10:00 - 12:00) <sup>[457]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP P A  
 • Kampus O-162 (12:00 - 14:00) <sup>[337]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP P C  
 • Kampus O-162 (14:00 - 16:00) <sup>[337]</sup> <sup>[1458]</sup> <sup>[2812]</sup>  
 ◦ MPBP V B

S10 Application of Radioactive Isotopes in Nuclear Medicine:  
 • Kampus O-152 (10:15 - 12:00) <sup>[252]</sup>  
 ◦ MPBP S B  
 • Kampus O-152 (12:15 - 14:00) <sup>[252]</sup>  
 ◦ MPBP S A

izv. prof. dr. sc. Jurković Slaven, spec. med. fiz. <sup>[252]</sup> · Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup>

### 04.06.2025

<p>L27 Radioactivity. Alfa, Beta and Gamma Decay.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[252]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L28 Interaction of Photons with Matter. Detection and Dosimetry of Ionizing Radiation.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[252]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>	<p>P12 Compensation:</p> <ul style="list-style-type: none"> <li>• Kampus O-162 (10:00 - 12:00) <sup>[457] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P A</li> </ul> </li> <li>• Kampus O-162 (12:00 - 14:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP V B</li> </ul> </li> <li>• Kampus O-162 (14:00 - 16:00) <sup>[337] [1458] [2812]</sup> <ul style="list-style-type: none"> <li>◦ MPBP P C</li> </ul> </li> </ul>	
<p>izv. prof. dr. sc. Jurković Slaven, spec. med. fiz. <sup>[252]</sup> · Majetić Marijana, viša laborantica <sup>[1458]</sup> · Musulin Marija, laborantica <sup>[2812]</sup> · Pribanić Ivan, mag. edu. phys. et math. <sup>[457]</sup> · dr. sc. Čargonja Marija, mag. educ. phys. et math. <sup>[337]</sup></p>		
<p><b>11.06.2025</b></p>		
<p>L29 Application of Ultrasound in Medicine.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul> <p>L30 Final Lecture and Preparation for Final Exam.:</p> <ul style="list-style-type: none"> <li>• Kampus O-029 (08:15 - 10:00) <sup>[149]</sup> <ul style="list-style-type: none"> <li>◦ MPBP</li> </ul> </li> </ul>		
<p>prof. dr. sc. Žauhar Gordana, prof. fizike i kemije <sup>[149]</sup></p>		

### Popis predavanja, seminara i vježbi:

PREDAVANJA (TEMA)	Broj sati	Mjesto održavanja
L1 Introduction. SI Units.	1	Kampus O-029
L2 Optics in Medicine. Laws of Refraction and Reflection: Image Formation by Plane and Spherical Surfaces of Refraction	1	Kampus O-029
L3 The Human Eye – the Optical Model	1	Kampus O-029
L4 Errors of optical systems	1	Kampus O-029
L5 Image Formation by Lens and Microscope	1	Kampus O-029
L6 Types of Optical Microscopes. Electron microscopes	1	Kampus O-029
L7 Fundamental Forces. Statics of the Body. Review of Forces, Torques and Equilibrium	1	Kampus O-029
L8 Mechanics of the Human Body. Implementation of Newton's Laws: Levers in the Body, Passive Walking and High Jump.	1	Kampus O-029
L9 Mechanical Properties of Tissues. Elasticity and Strength of Materials. Viscoelastic Properties of Body Tissues – Mechanical Models.	1	Kampus O-029
L10 Fluids. Hydrostatics. Surface Tension and Its Implications. Law of Laplace.	1	Kampus O-029
L11 Hydrodynamics. Bernoulli's Equation, Viscosity and Poiseuille's Law. Turbulent Flow	1	Kampus O-029
L12 Rheological Properties of Blood. Physics of the Circulatory System. Consequences of Clogged Arteries	1	Kampus O-029
L13 Ideal and Real Gases. Gas Laws. Physics of Breathing	1	Kampus O-029
L14 Basic Principles of Thermodynamics: I and II Law.	1	Kampus O-029
L15 Thermodynamics of a Biological system. Transfer of Heat.	1	Kampus O-029
L16 Transfer of Particles and Ions through Membranes. Action Potential.	1	Kampus O-029

L17 Physical Basis of Electro- and Magneto- Diagnostics (EKG, EEG, EMG).	1	Kampus O-029
L18 Dielectric Properties of Tissues. Tissues in Electric Field.	1	Kampus O-029
L19 Oscillations and Waves d Waves.	1	Kampus O-029
L20 Sound Waves: The Physics of Hearing. Intensity of Soun. Connection between Physical and Physiological Parameters of Sound.	1	Kampus O-029
L21 Therapeutic Applications of Electric Fields.	1	Kampus O-029
L22 Matter in the External Magnetic Field: A Biological System in the Electric Circuit, Magneto therapy	1	Kampus O-029
L23 Structure of Atom and Molecule: Molecular Bonds and Energy States	1	Kampus O-029
L24 Electromagnetic Waves	1	Kampus O-029
L25 Medical Use of X Rays	1	Kampus O-029
L26 Structure of the Atomic Nucleus. Nuclear Decay. Decay Rate and Half-life	1	Kampus O-029
L27 Radioactivity. Alfa, Beta and Gamma Decay.	1	Kampus O-029
L28 Interaction of Photons with Matter. Detection and Dosimetry of Ionizing Radiation.	1	Kampus O-029
L29 Application of Ultrasound in Medicine.	1	Kampus O-029
L30 Final Lecture and Preparation for Final Exam.	1	Kampus O-029

<b>VJEŽBE (TEMA)</b>	<b>Broj sati</b>	<b>Mjesto održavanja</b>
P0 Introduction to Practicals. General Laboratory Safety Procedures and Rules.	1	Kampus O-162
P1 Mechanical Waves	2	Kampus O-162
P2 Audiometry	2	Kampus O-162
P3 Surface Tension and Viscosity	2	Kampus O-162
P4 Calorimetry	2	Kampus O-162
P5 Thermal Environmental Conditions	2	Kampus O-162
P6 Index of Refraction. Spectroscopy	2	Kampus O-162
P7 Spherical Mirrors and Lenses	2	Kampus O-162
P8 Electric Circuits	2	Kampus O-162
P9 Measurement of Resistance. The Wheatstone Bridge Method	2	Kampus O-162
P10 Ionizing radiation	2	Kampus O-162
P11 Compensation	2	Kampus O-162
P12 Compensation	2	Kampus O-162

<b>SEMINARI (TEMA)</b>	<b>Broj sati</b>	<b>Mjesto održavanja</b>
S1 Calculating Measurement Errors and Estimating Measurement Accuracy	2	Kampus O-152 P08
S2 Optics	2	Kampus O-152 P06
S3 Vectors and Operations with Vectors. Graphical Representation of Measurement Results and Interpretation of Graphs. Differential Calculus.	2	Kampus O-152 P05
S4 Levers in the Human Body	2	Kampus O-152 P08

S5 Hydromechanics	2	Kampus O-152 P06
S6 Physics of Breathing	2	Kampus O-152 P09 - NASTAVA NA ENGLESKOM JEZIKU
S7 Diffusion and Osmosis. Transport of Energy and Matter through Cell Membranes	2	Kampus O-152 P07
S8 Sound. Hearing and the Ear.	2	Kampus O-152 P09 - NASTAVA NA ENGLESKOM JEZIKU
S9 Medical Use of X-Rays	2	Kampus O-152 P09 - NASTAVA NA ENGLESKOM JEZIKU
S10 Application of Radioactive Isotopes in Nuclear Medicine	2	Kampus O-152

**ISPITNI TERMINI (završni ispit):**

1.	16.06.2025.
2.	30.06.2025.
3.	14.07.2025.
4.	04.09.2025.
5.	18.09.2025.