DOCTORAL STUDIES COURSE UNIT DESCRIPTION

<table>
<thead>
<tr>
<th>Subject</th>
<th>Scientific Field</th>
<th>Faculty</th>
<th>Center/Institute/Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction of laser radiation with matter</td>
<td>Physics N 002</td>
<td>Faculty of physics</td>
<td>Laser Research Center <strong>Department</strong></td>
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<tr>
<td></td>
<td></td>
<td>Center for Physical Sciences and Technology</td>
<td>for Laser Technics</td>
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</tbody>
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Student’s workload | Credits | Student’s workload | Credits
Lectures          |          | Consultations      | 1,5
Individual study  | 6        | Seminars           | 1,5

Course annotation


**Laser ablation with nanosecond pulses.** Ablation mechanisms. Thermal, photomechanical and photochemical ablation. Ablation threshold and rate. Material damage during ablation.


radiation absorption. Laser damage to transparent materials.

**Volume modification of transparent media by ultrashort pulses.** Refractive index modifications. Formation of nanogratings. Void formation. Etching of modified areas. Physical mechanisms explaining modifications.

**Complex beams in transparent media processing.** Stealth dicing method. Bessel beam utilization schemes and advantages. Airy beam applications.

**Petawatt power laser systems.** Principles of petawatt power laser systems development. European Extreme Light Infrastructure (ELI). New possibilities in studying the interactions between radiation and matter with a petawatt laser system. Generation of high harmonics by illuminating hard surfaces with high intensity ultrashort pulses.


**Thermonuclear reactions initiated by powerful laser pulses.** Schemes used. Initiation mechanisms.

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**List of literature**


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**List of additional literature**


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**Subject presentation and method of payoff**

There are no lectures on the subject. Doctoral students have to learn from the textbooks themselves. Part of this course is taught in the 1st semester at Vilnius University Physics Faculty in the Laser Technology program for master's students, so sometimes doctoral students from other universities or other programs choose to listen to part of those lectures together with current master's students. The subject section includes consultations, the topics of which are offered by the doctoral students who have chosen the course.
The exam consists of two parts. The first is the preparation of a paper that reviews a certain topic of the interaction between laser radiation and matter, which is important for the preparation of a doctoral dissertation. Its volume is > 40,000 signs. Efforts are made to select the topic of the paper in such a way that its material is useful for the review of the dissertation and the work carried out in it. The content of the paper is first offered to the doctoral student together with his/her research supervisor, and then coordinated with the consulting lecturers. After agreeing on the content of the paper, the doctoral student prepares the paper and forwards it to the consulting lecturers, who are included in the examination commission. Then a time is set when the presentation of the paper takes place and the doctoral student has to prepare the presentation which takes ~ 20 minutes. The presentation is presented to at least 3 members of the examination commission. After the presentation, the questions of the commission members are answered. The paper and its presentation with the answer to the questions can be evaluated with a maximum of 5 points.

The second part of the exam is the written answers to 3 questions. To do this, are given 1.5 hours. Typically, a list of 10-15 generalized questions is compiled, based on the topics in the stock, from which those 3 questions are selected. Once the doctoral students have written the answers, they are scanned and forwarded to all members of the examination board, who must evaluate them. Written answers to 3 questions can be evaluated with a maximum of 5 points.

The evaluation of each member of the examination commission, both for the paper and its presentation, as well as for the answers to the given questions, is averaged and the final summary evaluation with a maximum value of 10 points is recorded accordingly.

<table>
<thead>
<tr>
<th>Consulting teachers</th>
<th>Scientific degree</th>
<th>Pedagogical name</th>
<th>Main scientific works published in a scientific field in last 5 year period</th>
</tr>
</thead>
</table>
| Vytautas Jukna (vytautas.jukna @ff.vu.lt) | Dr. | Assoc. Prof. | 1. E. Kažukauskas, S. Butkus, P. Tokarski, V. Jukna, M. Barkauskas, V. Sirutkaaitis, Micromachining of transparent biocompatible polymers applied in medicine using bursts of femtosecond laser pulses, Micromachines 11 (12), 1093 (2020)  
3. S. Butkus, V. Jukna, D. Paipulas, M. Barkauskas, V. Sirutkaaitis, Micromachining of Invar Foils with GHz, MHz and kHz Femtosecond Burst Modes, Micromachines 11 733 (2020)  
| Gediminas | Dr. | | 1. K. A. Drogowska-Horna, I. Mirza, A. |
| Andrius Melninkaitis (andrius.melninkaitis@ff.vu.lt) | Dr. Doc.  
4. Tomas Tolenis, Lina Grinevičiūtė, Rytis Buzelis, Linas Smalakys, Egidijus Pupka, Simas Melnikas, Algirdas Selskis, Ramutis Drazdys, and Andrius Melninkaitis, "Sculptured anti-
| Mindaugas Gedvilas  

| Valdas Sirutkaitis  
3. J. Skruibis, O. Balachninaite, S. Butkus, V. Vaičaitis, V. Sirutkaitis, Multiple-pulse Laser-induced breakdown spectroscopy for monitoring |


Certified during Doctoral Committee session 30/03/2021, protocol No. 120000-KT-39

Committee Chairman prof. S. Juršėnas