

**DOCTORAL (PHD) STUDIES**  
**COURSE UNIT DESCRIPTION**

| Course unit title                  | Scientific areas                | Faculty                                | Institute, department            |
|------------------------------------|---------------------------------|----------------------------------------|----------------------------------|
| Parallel and distributed computing | Informatics Engineering (T 007) | Faculty of Mathematics and Informatics | DMSTI, Global Optimization Group |
|                                    |                                 |                                        |                                  |
| Study method                       | Number of credits               | Study method                           | Number of credits                |
| Lectures                           | 1 (Spring semester)             | Consultations                          | 1                                |
| Individual works                   | 4                               | Seminars                               | 1                                |

| Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p>Solution of real-world optimization problems usually requires a lot of computational resources. Since usual computers have performance limitations, parallel computers, computer clusters, and network computing are used to solve complex problems. This course covers parallel computers architecture and computer networks; designing parallel and distributed algorithms; parallel programming tools: MPI, OpenMP, and PThreads; complexity, speedup, and efficiency of parallel algorithms; examples of parallel computing application to solve practical problems.</p> <p>Topics:</p> <ul style="list-style-type: none"> <li>• Parallel computers architecture and computer networks.</li> <li>• Designing parallel and distributed algorithms.</li> <li>• Message passing interface (MPI).</li> <li>• Shared-memory parallel computing using OpenMP.</li> <li>• Shared-memory parallel computing using POSIX Threads.</li> <li>• Parallelization skeletons.</li> <li>• Complexity, speedup, and efficiency of parallel algorithms.</li> <li>• Optimization of parallel computing.</li> <li>• Typical parallel algorithms.</li> <li>• Examples of parallel computing applications to solve practical problems.</li> </ul> <p>Practical task – create parallel algorithms related to the PhD thesis and investigate in shared and distributed memory parallel computers.</p> |
| Main literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| R. Čiegis. Lygiagretieji algoritmai. Vilnius, Technika, 2001.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| R. Čiegis. Lygiagretieji algoritmai ir tinklinės technologijos. Vilnius, Technika. 2005.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

T. Rauber, G. Rünger. Parallel Programming for Multicore and Cluster Systems. Springer, 2010.

B. Wilkinson, M. Allen. Parallel Programming. Prentice-Hall, 1999.

| Lecturer(s) (name, surname) | Science degree | Main publications                                                                                                               |
|-----------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------|
| Algirdas Lančinskas         | PhD            | <a href="http://www.elaba.mb.vu.lt/dmsti/?aut=Algirdas+Lančinskas">http://www.elaba.mb.vu.lt/dmsti/?aut=Algirdas+Lančinskas</a> |
| Viktor Medvedev             | PhD            | <a href="https://www.elaba.mb.vu.lt/dmsti/?aut=Viktor+Medvedev">https://www.elaba.mb.vu.lt/dmsti/?aut=Viktor+Medvedev</a>       |
| Julius Žilinskas            | PhD            | <a href="https://www.elaba.mb.vu.lt/dmsti/?aut=Julius+Žilinskas">https://www.elaba.mb.vu.lt/dmsti/?aut=Julius+Žilinskas</a>     |