



### COURSE UNIT (MODULE) DESCRIPTION

| Course unit (module) title                   | Code |
|----------------------------------------------|------|
| Optoelectronic devices in telecommunications |      |

| Lecturer(s)                                  | Department(s) where the course unit (module) is delivered                    |
|----------------------------------------------|------------------------------------------------------------------------------|
| <b>Coordinator:</b> dr. Sandra Pralgauskaitė | Institute of applied electrodynamics and telecommunications, Physics Faculty |
| <b>Other(s):</b>                             |                                                                              |

| Study cycle | Type of the course unit (module) |
|-------------|----------------------------------|
| The second  | Compulsory                       |

| Mode of delivery | Period when the course unit (module) is delivered | Language(s) of instruction |
|------------------|---------------------------------------------------|----------------------------|
| Face-to-face     | The second (spring) semester                      | Lithuanian                 |

| Requirements for students                                                                           |                                          |
|-----------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>Prerequisites:</b><br>Common knowledge of physics and basics of solid state physics are required | <b>Additional requirements (if any):</b> |

| Course (module) volume in credits | Total student's workload | Contact hours | Self-study hours |
|-----------------------------------|--------------------------|---------------|------------------|
| 5                                 | 140                      | 48            | 92               |

| Purpose of the course unit (module): programme competences to be developed                                                                                                                                                                                                                                                                                                                                                             |                                                                                                             |                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| The purpose of the course is to provide knowledge about the structure, operation and characteristics of the optoelectronic devices employed in telecommunication systems, physical processes that take place in these devices, to develop a competence to assess by yourself the characteristics of optoelectronic devices, their quality, to critically estimate the suitability of devices for use in optical communication systems. |                                                                                                             |                                                         |
| Learning outcomes of the course unit (module)                                                                                                                                                                                                                                                                                                                                                                                          | Teaching and learning methods                                                                               | Assessment methods                                      |
| Understanding of structure and operation principals of the optoelectronic devices used in optical communication systems. Understanding of relations between device structure and operation characteristics.                                                                                                                                                                                                                            | Problem-based learning, research-based learning (information search, preparation of a report).              | Test, seminar presentation                              |
| Knowledge of the factors that determine optoelectronic devices' quality and reliability and competence to assess their quality and lifetime.                                                                                                                                                                                                                                                                                           | Problem-based learning, research-based learning (information search, preparation of a report).              | Test, seminar presentation                              |
| Competence to assess characteristics of optoelectronic devices and to use them in optical communication systems.                                                                                                                                                                                                                                                                                                                       | Problem-based learning, research-based learning (information search, preparation of a project), discussion. | Test, project presentation, participation in discussion |

| 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. Basics of optoelectronics                                                                                                                                                                                                      | 4             |           | 1         |           |                 |                           | 5             | 2                                     | Read the literature on the topic, prepare for the tests, search information and prepare presentation for seminar on the selected topic.                            |
| 2. Transmitters of optical communication systems                                                                                                                                                                                  | 6             |           | 3         |           |                 |                           | 9             | 18                                    |                                                                                                                                                                    |
| 3. Receivers of optical communication systems                                                                                                                                                                                     | 6             |           | 3         |           |                 |                           | 9             | 18                                    |                                                                                                                                                                    |
| 4. Optical cable                                                                                                                                                                                                                  | 4             |           | 2         |           |                 |                           | 6             | 12                                    |                                                                                                                                                                    |
| 5. Other components of optical communication system: optical modulators, optical amplifiers and regenerators, wavelength division multiplexers and demultiplexers, couplers, driving circuits of transmitters and receivers, etc. | 4             |           | 3         |           |                 |                           | 7             | 15                                    |                                                                                                                                                                    |
| 6. Quality and reliability problems of optoelectronic devices, their solutions                                                                                                                                                    | 4             |           | 2         |           |                 |                           | 6             | 12                                    | Read the literature on the topic, prepare for the test, search information and prepare a project, prepare a presentation of the project, prepare for a discussion. |
| 7. Optical communication networks and application of optoelectronic devices                                                                                                                                                       | 4             |           | 2         |           |                 |                           | 6             | 15                                    |                                                                                                                                                                    |
| <b>Total</b>                                                                                                                                                                                                                      | <b>32</b>     |           | <b>16</b> |           |                 |                           | <b>48</b>     | <b>92</b>                             |                                                                                                                                                                    |

| Assessment strategy        | Weight, % | Deadline            | Assessment criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|-----------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test No. 1                 | 16.7      | During the semester | <b>K1:</b><br>Test of 10 closed questions. Assessment: 1 point is awarded for every correct answer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test No. 2                 | 16.7      | During the semester | <b>K2:</b><br>Test of 10 closed questions. Assessment: 1 point is awarded for every correct answer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test No. 3                 | 16.6      | During the semester | <b>K3:</b><br>Test of 5 open questions. Assessment: 2 points are awarded for every full and correct answer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Seminar presentation No. 1 | 15        | During the semester | <b>S1:</b><br>Seminar presentation on the selected topic. Assessment:<br>1.5 point: the topic is disclosed in detail, presentation is based on scientific articles, presentation is fluent, visual means are informative;<br>1.0 point: the topic is disclosed in detail, presentation is based on scientific articles, but there are shortcomings in the quality of the presentation; or the topic is disclosed in detail, presentation is fluent, visual means are informative, but the presentation is not based on the scientific articles;<br>0.5 point: the topic is disclosed incompletely, presentation is not based on the scientific articles, there are shortcomings in the quality of the presentation;<br>0 point: presentation is not prepared. |
| Seminar presentation No. 2 | 15        | During the semester | <b>S2:</b><br>Seminar presentation on the selected topic. Assessment:<br>1.5 point: the topic is disclosed in detail, presentation is based on scientific articles, presentation is fluent, visual means are                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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|                                                                             |    |                            | <p>informative;</p> <p>1.0 point: the topic is disclosed in detail, presentation is based on scientific articles, but there are shortcomings in the quality of the presentation; or the topic is disclosed in detail, presentation is fluent, visual means are informative, but the presentation is not based on the scientific articles;</p> <p>0.5 point: the topic is disclosed incompletely, presentation is not based on the scientific articles, there are shortcomings in the quality of the presentation;</p> <p>0 point: presentation is not prepared.</p>                                                                                                                                                                                                                                                                    |
| Project (description in written, presentation, participation in discussion) | 20 | By the end of the semester | <p><b>P:</b></p> <p>The project of the optical communication system: written description, presentation of the project during the seminar, participation in the discussion. The assessment consists of:</p> <p>P1: the project is prepared taking into account the tasks of the chosen communication system, the appropriate elements of the system are selected (up to 0.5 point);</p> <p>P2: the quality of the project description is evaluated according to the VU Physics Faculty requirements for the written works (up to 0.5 point);</p> <p>P3: the quality of presentation: fluent and focused speech, informative visual means, focusing on the audience (up to 0.5 point);</p> <p>P4: reasoned answer to questions, active participation in the discussion (up to 0.5 point).</p> <p><math>P = P1 + P2 + P3 + P4</math>.</p> |
| Exam (instead of tests)                                                     | 50 | During the exam session    | <p><b>E:</b></p> <p>3 open questions. Assessment:</p> <p>5 points – excellent knowledge, ability to analyse and summarize the knowledge gained during the course;</p> <p>4 points – good knowledge, course material is mastered, minor mistakes can be present;</p> <p>3 points – average knowledge, mistakes are present, not able to analyse and summarize the knowledge gained during the course;</p> <p>2 points – knowledge and skills are below average, a fundamental errors are made;</p> <p>1 point – knowledge and skills meet the minimum requirements, mastering only part of the course material;</p> <p>0 points – knowledge and skills do not meet the minimum requirements.</p>                                                                                                                                        |
| Final (cumulative) score                                                    |    |                            | <p><math>= K1 \cdot 5:30 + K2 \cdot 5:30 + K3 \cdot 5:30 + S1 + S2 + P</math> (in the case the tests were written)</p> <p>or</p> <p><math>= E + S1 + S2 + P</math> (in the case the exam was taken).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| Author                    | Year of publication | Title                                                                   | Issue of a periodical or volume of a publication | Publishing place and house or web link |
|---------------------------|---------------------|-------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------|
| <b>Compulsary reading</b> |                     |                                                                         |                                                  |                                        |
| S. Pralgauskaitė          | 2010                | Otoelektronikos įtaisai telekomunikacijų sistemose                      |                                                  | Vilnius, VU leidykla                   |
| <b>Optional reading</b>   |                     |                                                                         |                                                  |                                        |
| C. Hamaguchi              | 2017                | Basic Semiconductor Physics                                             |                                                  | Springer International Publishing, AG  |
| M. Fukuda                 | 1998                | Optical semiconductor devices                                           |                                                  | John Wiley&Sons, New York              |
| P. K. Basu                | 2003                | Theory of optical processes in semiconductors: bulk and microstructures |                                                  | Clarendon Press                        |

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|----------------------------------------------|------|-------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ed. H. Venghaus, N. Grote                    | 2017 | Fibre Optic Communication: Key Devices                            |  | Springer International Publishing, Switzerland                                                                                                                                                                      |
| G. P. Agrawal                                | 2004 | Lightwave technology: components and devices                      |  | John Wiley&Sons, New York                                                                                                                                                                                           |
| S. Kumar, M. J. Deen                         | 2014 | Fiber Optic Communications : Fundamentals and Applications        |  | John Wiley & Sons, Incorporated;<br><a href="https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=1712884">https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=1712884</a> |
| O. Strobel                                   | 2016 | Optical and Microwave Technologies for Telecommunication Networks |  | John Wiley & Sons, Incorporated;<br><a href="https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=4457846">https://ebookcentral.proquest.com/lib/viluniv-ebooks/detail.action?docID=4457846</a> |
| G. P. Agrawal                                | 2005 | Lightwave technology: telecommunication systems                   |  | John Wiley&Sons, New York                                                                                                                                                                                           |
| Z. Fang, H. Cai, G. Chen, R. Qu              | 2017 | Single Frequency Semiconductor Lasers                             |  | Springer, Singapore                                                                                                                                                                                                 |
| Ed. T.-Y. Seong, J. Han, H. Amano, H. Morkoç | 2017 | III-Nitride Based Light Emitting Diodes and Applications          |  | Springer Nature, Singapore                                                                                                                                                                                          |
| Ed. M. Kneissl, J. Rass                      | 2016 | III-Nitride Ultraviolet Emitters                                  |  | Springer International Publishing Switzerland                                                                                                                                                                       |