DOCTORAL STUDIES COURSE UNIT DESCRIPTION

Name of subject	Scientific Field	Faculty	Center/Institute/ Department
Semiconductor Photonics (8 ECTS credits)	Physics N 002	Faculty of Physics	Institute of Photonics and Nanotechnology
Student's workload	Hours	Student's workload	Hours
Lectures	20	Consultations	20
Individual study	160	Seminars	

Course annotation
Phenomena in semiconductors under strong excitation. Dynamics of high-density exciton systems. Biexcitons. Electron-hole plasma. Stimulated emission. Optical bistabilities. Techniques for studying high excitation phenomena in semiconductors. Semiconductor lasers. Gain and generation spectra of the laser diodes. Single-mode laser diodes. Vertical cavity surface emitting and optically pumped lasers. Semiconductor optical amplifiers, optical modulators and switches. Integrated optoelectronics. Solid-state lighting. Modern light sources. Human vision. Photometry and colorimetry. Generation of light in light-emitting diodes (LEDs). Escaping of light form crystals. High-brightness LEDs. Efficiency droop in LEDs. Light source based on photonic crystal.
List of literature
1. G. A. Reider, Photonics: an introduction, Springer, 2016. 2. C.F.Klingshirn, Semiconductor optics, Springer, 1997. 3. P.Bhattacharaya, Semiconductor optoelectronic devices, Prentice Hall, 1997. 4. W.W.Chow, S.W.Koch, Semiconductror-laser fundamentals: physics of the gain materials, Springer, 1999. 5. J.D.Joannopoulos, R.D.Meade, J.N.Winn, Photonic Crystals: molding the flow of light, Princeton University Press, 1995. 6. A. Žukauskas, M. S. Shur, R. Gaska, Introduction to solid state lighting, John Wiley & Sons, 2002. 7. A. Žukauskas, Puslaidininkiniai šviestukai (Progretus, Vilnius, 2008), 231 p. 8. E. F. Schubert, Light-Emitting Diodes, Cambridge University Press; 2 edition, 2006. 9. V. K. Khanna, Fundamentals of Solid-State Lighting, CRC Press, 2014.

Consulting teachers	Scientific degree	Pedagogical name	Main scientific works published in a scientific field in last 5 year period
Ramūnas Aleksiejūnas	dr.	prof. assoc.	[1] R. Aleksiejūnas, K. Nomeika, O. Kravcov, S. Nargelas, L. Kuritzky, C. Lynsky, S. Nakamura, C. Weisbuch, and J.S. Speck, Phys. Rev. Applied **14**, 054043 (2020). [2] P. Ščajev, R. Aleksiejūnas, P. Baronas, D. Litvinas, M. Kolenda, C. Qin, T. Fujihara, T. Matsushima, C. Adachi, and S. Juršėnas, J. Phys. Chem. C **123**, 19275 (2019). [3] P. Ščajev, R. Aleksiejūnas, S. Terakawa, C. Qin, T. Fujihara, T. Matsushima, C. Adachi,

			and S. Juršėnas, J. Phys. Chem. C **123**, 14914 (2019). [4] Ž. Podlipskas, J. Jurkevičius, A. Kadys, M. Kolenda, V. Kovalevskij, D. Dobrovolskas, R. Aleksiejūnas, and G. Tamulaitis, Journal of Alloys and Compounds **789**, 48 (2019). [5] R. Norkus, R. Aleksiejunas, A. Kadys, M. Kolenda, G. Tamulaitis, and A. Krotkus, Sci Rep **9**, 7077 (2019). [6] P. Ščajev, C. Qin, R. Aleksiejūnas, P. Baronas, S. Miasojedovas, T. Fujihara, T. Matsushima, C. Adachi, and S. Juršėnas, J. Phys. Chem. Lett. **9**, 3167 (2018). [7] R. Aleksiejunas, Z. Podlipskas, S. Nargelas, A. Kadys, M. Kolenda, K. Nomeika, J. Mickevicius, and G. Tamulaitis, Sci Rep **8**, 4621 (2018). [8] P. Ščajev, R. Aleksiejūnas, S. Miasojedovas, S. Nargelas, M. Inoue, C. Qin, T. Matsushima, C. Adachi, and S. Juršėnas, J. Phys. Chem. C **121**, 21600 (2017). 1.
Ignas Nevinskas	dr.		1. Nevinskas, Ignas; Butkutė, Renata; Stanionytė, Sandra; Bičiūnas, Andrius; Geižutis, Andrejus; Krotkus, Arūnas, THz pulse emission from InAs-based epitaxial structures grown on InP substrates, Semiconductor science and technology. ISSN 0268-1242. Vol. 31, iss.11 (2016), p. art. no. 115021. 2. Nevinskas, Ignas; Vizbaras, K.; Trinkūnas, A.; Butkutė, Renata; Krotkus, Arūnas. Terahertz pulse generation from (111)-cut InSb and InAs crystals when illuminated by 1.55-μm femtosecond laser pulses. Optics letters. ISSN 0146-9592. 2017, Vol. 42, iss.13, p. 2615-2618. 3. Ikamas, Kęstutis; Nevinskas, Ignas; Krotkus, Arūnas; Lisauskas, Alvydas. Silicon field effect transistor as the nonlinear detector for terahertz autocorellators . Sensors. Basel : MDPI AG. eISSN 1424-8220. 2018, vol. 18, iss. 11, art. no. 3735, p. 1-11. 4. Ponseca, S. Carlito A. Arlauskas, H. Yu, F. Wang, I. Nevinskas, E. Dūda, V. Vaičaitis, J. Eriksson, J. Bergqvist, X.K. Liu, M. Kemerink, A. Krotkus, O. Inganas, F. Gao, Pulsed terahertz emission from solution-processed lead iodide perovskite films,

			ACS Photonics. ISSN 2330-4022. 2019, vol. 6, p. 1175-1181. Q1 5. R. Norkus, I. Nevinskas, and A. Krotkus, "THz emission from a bulk GaSe crystal excited by above bandgap photons," J. Appl. Phys., vol. 128, pp. 225701-5, 2020. 6. I. Nevinskas, R. Norkus, A. Geižutis, L. Kulyuk, A. Miku, K. Suschkevich, and A. Krotkus, "THz pulse emission from photoexcited bulk crystals of transition metal dichalcogenides," J. Phys. D: Appl. Phys., vol. 54, pp. 115105-12, 2021. 7. R Adomavičius, I Nevinskas, J Treu, X Xu, G Koblmüller and A Krotkus, "Pulsed THz emission from wurtzite phase catalyst-free InAs nanowires", J. Phys. D: Appl. Phys. 53 19LT01, 2020.
Pranciškus Vitta	dr.	prof. assoc.	1. A. Petrulis, L. Petkevičius, P. Vitta, R. Vaicekauskas And A. Žukauskas "Exploring Preferred Correlated Color Temperature in Outdoor Environments Using a Smart Solid-State Light Engine, " Leukos, 14 pp 95-106, 2018. 2. I. Reklaitis, L. Krencius, T. Malinauskas, S. Yu. Karpov, H. J. Lugauer, I. Pietzonka, M. Strassburg, P. Vitta, R. Tomassiunas „Time of carrier escape and recombination coefficients in InGaN quantum-well active regions of blue, cyan, and green light-emitting diodes," Semicond. Sci. Technol. 34(1), art. No. 015007, 2019. 3. I. Buchovec, A. Gricajeva, L. Kalediene, and P. Vitta "Antimicrobial Photoinactivation Approach Based on Natural Agents for Control of Bacteria Biofilms in Spacecraft" Int. J. Molec. Sci. 21(18), Art. No 6932, 2020. 4. J. Grigorjevaite, E. Egle, J. Paterek, S. Saitzek, A. Zabiliute-Karaliune, P. Vitta, D. Enseling, T. Juestel, and A. Katelnikovas "Luminescence and luminescence quenching of K2Bi(PO4)(MoO4):Sm3+ phosphors for horticultural and general lighting applications," Materials Advances 1(5), pp. 1427-1438, 2020. 5. G. Inkrataite, A. Zabiliute-Karaliune, J. Aglinskaite, P. Vitta, K. Kristinaityte, A. Marsalka, and R. Skaudzius "Study of YAG : Ce and Polymer Composite Properties for Application in LED

			Devices," Chempluschem 85(7), pp.1504-1510, 2020.
Certified during Doctoral Committee session 02/02/2022, protocol No. (7.17 E) 15600-KT-32			
Committee Chairman prof. S. Juršėnas			