

SYLLABUS 2019/2020

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|---------------------------------------|--|--------------|---|
| Level of study | Master's Course | | |
| Course title in Ukraine | Оптичні явища у напівпровідниках та діелектриках | | |
| Course title in English | Optical phenomena in semiconductors and dielectrics | | |
| Course code | | ECTS credits | 6 |
| Lecturer(s) | Prof. Vasiliy Moiseyenko Email address: fttkaf@i.ua ; | | |
| Course objectives (learning outcomes) | The aim of this course to understand the physical nature of basic processes which are responsible for optical phenomena in semiconductors and dielectrics. | | |

Prerequisites:

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|-------------------|---|
| Knowledge | Knowledge of mathematics and physics on the level of bachelor of physics or applied physics |
| Skills | Mathematical and physical skills on the level of bachelor of physics or applied physics |
| Courses completed | The bachelor of physics or applied physics |

Learning effects:

| | Learning effects of the course | Relation of the learning effects to the specialization |
|-----------|--|--|
| Knowledge | W01 A student understands foundations of band theory of the solid state. W02 A student knows optical constants and relations between them. W03 A student comprehends mechanisms of absorption and emission of the light. W04 A student knows optical properties of semiconductors and dielectrics, which are widely used in engineering | K_W01 – K_W10 |
| Skills | U01 A student is able to measure and analyze optical spectra of semiconductors and dielectrics. U02 A student is be able to determine the type of electronic transitions responsible for the fundamental absorption of the light, to evaluate the participation of excitons and phonons in optical processes, to consider the presence of impurities. U03 A student is able to count optical constants of semiconductors and dielectrics U04 A student can determine some parameters of semiconductor materials by optical methods. | K_U01 – K_U07 |

| | Learning effects of the course | Relation of the learning effects to the specialization |
|--|--|--|
| | K01. A student has the creativity and the ability to conceptual thinking. K02 A student is able to present and justify the personal point of view. K03 A student is able to use the information technologies for the communication with the scientific community. K04 A student is aimed to expand personal knowledge and skills. K05 A student has the legal erudition. K06 A student concerned about the environmental safety of physical experiment. | K_K01 – K_K06 |

Course organization:

| Form of classes | Lecture (W) | Group-exercises | | | | | | | |
|-----------------|-----------------------------|-----------------|-----------------|---------|-------------|-------------|------|--|--|
| | | A (large group) | K (small group) | L (Lab) | S (Seminar) | P (Project) | Exam | | |
| Contact hours | 34 | | 34 | | | | 1 | | |
| Semester | 1 | | | | | | | | |
| Language | English, Ukrainian, Russian | | | | | | | | |

Teaching methods:

Classes will be performed in tutorial system on a weekly basis using multimedia presentation and internet in a form of the lectures open for discussion and questions.
 In-class exercises are designed to probe knowledge developed through this process, with emphasis on how well students have understood the underlying mathematical and physical ideas.
 The students will prepare one individual presentation.

Assessment methods:

| | E – learning | Didactic games | Classes in schools | Field classes | Laboratory tasks | Individual project | Group project | Discussion participation | Student's presentation | written assignment (essay) | Oral exam | Written exam | Test |
|-----|--------------|----------------|--------------------|---------------|------------------|--------------------|---------------|--------------------------|------------------------|----------------------------|-----------|--------------|------|
| W01 | | | | | | x | | x | | | x | | x |
| W02 | | | | | | x | | x | | | x | | x |
| W03 | | | | | | x | | x | | | x | | x |
| W04 | | | | | | x | | x | x | | x | | x |
| U01 | | | | | | | x | x | | | x | | x |
| U02 | | | | | | | x | x | | | x | | x |

| | | | | | | | | | | | | | |
|-----|--|--|--|--|--|---|---|---|---|--|---|--|---|
| U03 | | | | | | | x | x | | | x | | x |
| U04 | | | | | | | x | x | | | x | | x |
| K01 | | | | | | x | | x | x | | x | | x |
| K02 | | | | | | | x | x | | | x | | x |
| K03 | | | | | | | x | x | x | | x | | x |
| K04 | | | | | | x | x | x | | | x | | x |
| K05 | | | | | | | | | | | x | | x |
| K06 | | | | | | | | | | | x | | x |

Assessment criteria:

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| Grades | <p>The grading scale will be as follows:</p> <p>90 – 100 % - A including A- excellent (eq. in Ukraine: відмінно (very good))</p> <p>82–89 % : B including B – very good (eq. in Ukraine: добре (good))</p> <p>74–81 %: C including C – good (eq. in Ukraine: добре (good))</p> <p>64–73 %: D including D – satisfactory (eq. in Ukraine: задовільно (satisfactory))</p> <p>60–63 %: E including E – acceptable (eq. in Ukraine: задовільно (satisfactory))</p> <p>< 59 %: F failed (eq. in Ukraine: незадовільно (unsatisfactory))</p> |
| Criteria | <p>A. A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4. A student can work without any assistances, his/her knowledge's are creative and easily applied to decision of specific problem.</p> <p>B. A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4, yet needs a little help when decision of specific problem.</p> <p>C. A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4, however needs a help when decision of specific problem.</p> <p>D. A student knows the most of terms and concepts mentioned in W1-W4, U1- U4 and K1-K4 and has difficulty in decision of specific problem.</p> <p>E. A student knows only several terms and concepts mentioned in W1-W4, U1- U4 and K1-K4 and can solve only a simple problem.</p> <p>F. A student does not know most of terms and concepts mentioned in W1-W4, he/she did not reach the satisfactory level of knowledge this course.</p> |

Course content (topic list):

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| Topics | <p>W1. Optical constants and relations between them.</p> <p>W2. The structure of energy bands in crystals of semiconductors and dielectrics</p> <p>W3. Fundamental optical absorption in semiconductors .</p> <p>W4. The effect of external factors on the optical absorption in the crystals</p> <p>W5. Exciton and impurity absorption of the light.</p> <p>W6. The absorption of light by free charge carriers. Lattice absorption of the light.</p> <p>W7. Monomolecular, metastable and recombination luminescence</p> <p>W8. Photoelectric phenomena in crystals of semiconductors and dielectrics</p> |
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Literature:

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| Compulsory reading | 1. Панков, Ж. Оптические процессы в полупроводниках[Текст]/ Ж. Панков - М.:Мир.-1973.-456 с. 2. Шалимова, К.В. Физика полупроводников[Текст]/ К.В.Шалимова - М.: Энергия,1976.-416 с. 3. Перлин, Е.Ю. Физика твердого тела. Оптика полупроводников, диэлектриков, металлов [Текст]/ Е.Ю.Перлин, Т.А.Вартанян, А.П.Федоров С-Пб: СПбГУ ИТМО.- 2008 .-218 с. |
| Recommended reading | 5. Павлов, Л.П. Методы измерения параметров полупроводниковых материалов[Текст]/ Л.П.Павлов - М.: Высшая школа, 1987.-240 с. |

Estimation of the total working time of students:

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|---|--|-----|
| Contact hours | Lectures | 68 |
| | Seminars | |
| | Other (consultation, meetings) | 26 |
| Students' work hours (without the lecturer) | Reading books and preparation for the lectures | 26 |
| | Preparation to the seminar | |
| | Preparation of an individual presentation | 15 |
| | Preparation to the test | 15 |
| Total works' hours | | 150 |
| ECTS credits 1 ECTS = 25 h | | 6 |