

## FISA DISCIPLINEI Syllabus

### 1. Information about the program

|                                    |  |
|------------------------------------|--|
| 1.1. University                    | West University of Timisoara   |
| 1.2. Faculty                       | PHYSICS  |
| 1.3. Department                    | PHYSICS  |
| 1.4. Study direction               | PHYSICS  |
| 1.5. Study cycle                   | MASTER   |
| 1.6. Study program / qualification | PHYSICS AND TECHNOLOGY OF ADVANCED MATERIALS / according to COR: Analyst - 251201; Research assistant in physics - 211103; Physicist - 211101; Teacher - 233002; |

### 2. Subject matter information

|  |                                 |               |   |                      |   |                   |             |
|--|---------------------------------|---------------|---|----------------------|---|-------------------|-------------|
| 2.1. Subject matter                                      | Defects in crystals             |               |   |                      |   |                   |             |
| 2.2. Subject teacher                                     | Conf. dr. Marius Ștef           |               |   |                      |   |                   |             |
| 2.3. Subject applications teacher (seminar / laboratory) | Asist. cercet. dr. Gabriel Bușe |               |   |                      |   |                   |             |
| 2.4. Study year  | 2                               | 2.5. Semester | 3 | 2.6. Assessment type | E | 2.7. Subject type | Op-PTAM2304 |

### 3. Study time distribution

|  |    |                      |    |                         |              |
|--|----|----------------------|----|-------------------------|--------------|
| 3.1. Nr. of hours/week   | 3  | In which: 3.2 course | 2  | 3.3. seminar/laboratory | 1            |
| 3.4. Total hours in educational plan   | 42 | In which: 3.5 course | 28 | 3.6. seminar/laboratory | 14           |
| <b>Time distribution:</b>  |    |                      |    |                         | <b>hours</b> |
| Study after lecture notes, bibliography or notes                               |    |                      |    |                         | 20           |
| Additional documentation in the library, electronic specialty platforms/ field |    |                      |    |                         | 14           |
| Seminar / laboratory preparations, homework, portfolio and essays              |    |                      |    |                         | 14           |
| Tutoring   |    |                      |    |                         | 8            |
| Exams  |    |                      |    |                         | 14           |
| Other activities...  |    |                      |    |                         | -            |
| 3.7. Total number of personal study hour                                       |    |                      |    |                         | 84           |
| 3.8. Total number of hours in semester   |    |                      |    |                         | 42           |
| 3.9. Number of credits   |    |                      |    |                         | 6            |

### 4. Preconditions (where appropriate)

|                  |   |
|------------------|---|
| 4.1. curriculum  | <ul style="list-style-type: none"> <li>Complements of solid state physics and statistical physics</li> <li>Fizica solidului si a semiconductorilor</li> </ul> |
| 4.2. Competences | <ul style="list-style-type: none"> <li></li> </ul>  |

### 5. Conditions (where appropriate)

|                     |  |
|---------------------|--|
| 5.3 for course      | <ul style="list-style-type: none"> <li>• laptop</li> <li>• projector</li> </ul>                                |
| 5.4 for seminar/lab | <ul style="list-style-type: none"> <li>• laptop</li> <li>• projector</li> <li>• experimental set-up</li> </ul> |

### 6. Specific skills gained

|                          |  |
|--------------------------|--|
| Professional competences | <ul style="list-style-type: none"> <li>• Capacity of analyze and synthesize (adaptability to new situation, realization of synthesis and comparisons, correlations and propinquity).</li> <li>• Basic knowledge (thermodynamics of crystallization)</li> <li>• Basic knowledge necessary to profess (presentation, dialog)</li> <li>• Knowledge of foreign languages (English)</li> <li>• Theoretical understanding (of evolution of basic concepts in physics of crystallization)</li> <li>• Deep understanding (of basic notions, of physical parameters)</li> <li>• Experimental skills (the understanding of experiments)</li> <li>• Computational skills (PC uses for research, data acquisition)</li> <li>• Culture in Physics domain</li> <li>• Bibliography investigation</li> <li>• Learning skills</li> <li>• Skills for team working</li> <li>• The capacity to transfer the acquired knowledge in practical applications</li> <li>• Capacity to plan and organize experimental or theoretical applications</li> <li>• Capacity of solving characteristic problems for real physical systems.</li> <li>• Capacity of critical evaluations and auto evaluation.</li> <li>• Capacity of communication inside a group</li> </ul> |
| Transversal competences  | <ul style="list-style-type: none"> <li>• Effective use of information sources, communication resources and training assistance (Internet portals, specialized software, data bases, online courses, etc..) both in romanian and in a foreign language (english).</li> </ul>  |

### 7. Course Objectives

|                         |   |
|-------------------------|---|
| 7.1 Main Objective      | <ul style="list-style-type: none"> <li>• OG: Students to identify the specific concepts and phenomena ia a given context and to apply these knowledge in the analysis and interpretation of experimental data.</li> </ul> |
| 7.2 Specific objectives | <p>O.c1: Students to define the specific notions of this discipline and to describe the phenomena</p> <p>O.ap2: Students to use correct laboratory equipment to perform</p>   |

|  |  |
|--|--|
|  | <p>measurements.</p> <p>O.ap3: Students to process experimental data using software packages and correctly interpret the experimental results.</p> <p>O.ap5: Students to develop their organizational capacity</p> <p>O.at6: Students to develop their spirit of teamwork.</p> <p>O.at7: Students to appreciate and cultivate a scientific environment based on values and quality</p> |
|--|--|

## 8. Table of content

| 8.1. Lecture  | Teaching methods  | Remarks, details   |
|---|---|--|
| 1. Introduction. Classification of defects in crystals. (2 hr.)   | Exposure, introductory conversation, heuristic conversation, illustration using analogies | The lecture will be interactive, conducting learning being facilitated by engaging students in conversation episodes - to catching the attention, for updating of some knowledge acquired at university courses and systematization / fixing the new knowledge (OG and O.c1).<br><br>Students will develop their ability in of analysis and synthesis,<br><br>Students will use correctly the the terminology in physics in writing and oral communication.<br><br>Students will become familiar with a scientific environment based on values and quality (O.at7) |
| 2. Types of point defects   |   |  |
| 3. Thermodynamics of crystallization processes. Gibbs-Thomson equation. Wulf theorem. Crystal shapes. (2 hr.)   |   |  |
| 4. Homogeneous and heterogeneous nucleation (2 hr.)   |   |  |
| 5. Crystallization of multicomponent materials (2 hr.)  |   |  |
| 6. Phase diagrams. Segregation (2 hr.)  |   |  |
| 7. Impurities centers. (2 hr.)  |   |  |
| 8. Dislocations (2 hr.)   |   |  |
| 9. Crystal growth models. Jackson model (2 hr.)   |   |  |
| 10 Crystallization interface stability. (2 hr.)   |   |  |
| 11. Color centers (2 hr.)   |   |  |
| 12. F color centers (2 hr.)   |   |  |
| 13. F <sub>A</sub> color centers. (2 hr.)   |   |  |
| 14. Laser color centers. (2 hr.)  |   |  |
| <b>Recommended literature</b>   |   |  |
| 1. I. Nicoară, <i>Defecte de structură în cristale</i> , Ed. Mirton, Timișoara, 2003<br>2. M. Ștef, I. Nicoară, <i>Caracterizarea defectelor de structură cristalină</i> , Ed. Marineasa, Timișoara, 2009<br>3. S. Amelinckx, <i>The direct observations of dislocations</i> , Acad. Press, N.Y. 1964<br>4. A.A.Kaminskii, <i>Laser Crystals, Their Physics and Properties</i> , Springer-Verlag, Barlin, 1981<br>5. I.Nicoară, D.Nicoară, <i>Cristale artificiale</i> , Ed.Mirton, Timișoara, 1999<br>6. Y. Quere, <i>Physics of materials</i> , Gordon and Breach Science Publishers, 1998.<br>7. W. Fowler, <i>Physics of color centers</i> , Acad. Press, 19688. B. Henderson, R. Bartram, "Crystal-Field Engineering of Solid-State Laser Materials", Cambridge University Press, 2000 |   |  |
| 8.2. Seminar / Laboratory   | Teaching methods  | Remarks, details   |
| 1. Crystalline structures. (2 hr)   | Demonstrative   | Students will form / practice /  |

|   |  |  |
|---|--|--|
| 2. Point defects in various crystals. (2 hr)  | experiments in order to illustrate the phenomena or processes, verification of laws and assumptions. It will call on analogies and algorithms. | develop:<br><ul style="list-style-type: none"> <li>• Ability to handle the laboratory equipment in order to perform measurements, to process data and to analyse the experimental results (O.ap2).</li> <li>• teamwork spirit (O.at6).</li> <li>• Ability to organize and to investigate (O.ap5).</li> </ul> <p>Students will use appropriate statistical and numerical methods for analysis of physical processes (O.ap3). Experimental data and graphs will be done using Excel, Origin and MathCad.</p> |
| 3. Direct observation of the dislocations. (2 hr)   |  |  |
| 4. Determination of dislocation's density in crystals. (2 hr)   |  |  |
| 5. Electrolytic coloration of the crystals. (2 hr)  |  |  |
| 6. Optical characterization of F centers. (2 hr)  |  |  |
| 7. Impurities in CaF <sub>2</sub> crystals; modeling of crystal field symmetry. (2 hr)                            |  |  |
| <b>Recommended literature</b>   |  |  |
| 1. M. Ștef, I. Nicoară, <i>Caracterizarea defectelor de structură cristalină</i> , Ed. Marineasa, Timișoara, 2009 |  |  |
| 2. I. Nicoară, <i>Defecte de structură în cristale</i> , Ed. Mirton, Timișoara, 2003                              |  |  |
| 3. S. Amelinckx, <i>The direct observations of dislocations</i> , Acad. Press, N.Y. 1964                          |  |  |

## 9. Relation between subject content and the expectations of employers

|   |
|---|
| • |
|---|

## 10. Assesment

| Activity   | 10.1 Assesment criteria                | 10.2 Assesment method | 10.3 Percent in final mark |
|--|--|-----------------------|----------------------------|
| <b>10.4 Lecture.</b><br>will take place online using the GoogleMeet and Moodle application - WUT e-learning platform - <a href="https://elearning.e-uvt.ro/">https://elearning.e-uvt.ro/</a> | answers at exams (final evaluation)    | oral                  | 50%                        |
| <b>10.5. Seminar/labs</b><br>will take place face to face  | final answers at laboratory activities | oral                  | 25%                        |
|  | tests along the laboratories           | oral                  | 25%                        |
| <b>10.6 Minimum performance standards</b>  |  |                       |                            |
| • correct formulation of the proposed subject without demonstrations   |  |                       |                            |

Completion date:

September 21<sup>st</sup> 2021

Subject teacher's signature:

Conf. univ. dr. Marius STEF

Subject applications teacher's  
signature:

Asist. cercet. dr. Gabriel BUSE

Department Director' Signature:  
Conf. univ. dr. Nicoleta ȘTEFU