FIȘA DISCIPLINEI / SYLLABUS

1. Program information

1.1 University	WEST UNIVERSITY OF TIMIȘOARA
1.2 Faculty	PHYSICS
1.3 Department	PHYSICS
1.4 Study direction	PHYSICS
1.5 Study cycle	MASTER
1.6 Study program / Qualification	ADVANCED RESEARCH METHODS IN PHYSICS according to COR: physicist (211101), physics researcher (211102), research assistant in physics (211103), researcher in physics-chemistry (211104), research assistant in physics-chemistry (211105), researcher in technological physics (211106), research assistant in technological physics (211107)

2. Subject matter information

2.1 Subject title				Crystal Growth Methods			ARMP1201
2.2 Course teacher				C.S.III Dr. Gabriel Raoul BUȘE			
2.3 Seminar teacher				C.S.III Dr. Gabriel Raoul BUȘE			
2.4 Study year	1	2.5 Semester	2	2.6 Assessment type	E	2.7 Subject type	DS/DOP

3. Study time distribution (hours per semester of didactical activities)

3.1 Number of hours per week	3	of which: 3.2 course	2	3.3 seminar/lab	1
3.4 Number of hours per semester	42	of which: 3.5 course	28	3.6 seminar/lab	14
Distribution of allotted time:					hrs.
Study using lecture notes, bibliography or notes					22
Additional documentation in the library, electronic specialty platforms/ field					22
Seminar / laboratory preparations, homework, portfolio and essays					21
Tutoring					6
Exams					4
Other activities					8

3.7 Total no. hrs. of individual study	83
3.8 Total no. hrs. per semester	125
3.9 No. of credits	5

4. Preconditions

4.1 of curriculum	• Complements of Atom and Molecule Physics • Complements of Solid-State Physics
4.2 of skills	• scientific communication (presentation, dialogue) in English language

5. Conditions

5.1 for course	• expositions are frontal, dialogue is conducted within collective group discussions; • students must make use of the institutional (@e-uvt) address in electronic communication and, if requested to do so, use online educational platforms (Google Meet). Specifically, the platform used for the dissemination of support materials is Google Classroom; • laptop + projector, notebooks.
5.2 for seminar/lab	• tasks are assigned either individually of in group, under the supervision of the instructor; • students must make use of the institutional (@e-uvt) address in electronic communication and, if requested to do so, use online educational platforms (Google Meet). Specifically, the platform used for the dissemination of support materials is Google Classroom; • laptop + projector, notebooks, experimental installations.

6. Subject objectives – Expected learning outcomes of the instruction, which contribute to the completion and promotion of the subject

Knowledge	• Familiarization with the main techniques for crystal growth and the physical phenomena behind them • Basic theoretical knowledge of the general problematics and methods of crystal growth • Knowledge related to the culture and history of the topic
Abilities	• Capacity of solving characteristic problems for real physical systems and model building by idealization of real systems • Development of skills and experimental abilities in operating specific device and crystal growth installations • Capacity to analyze and synthesize (adaptability to new situation, realization of synthesis and comparisons, correlations)
Responsibility and autonomy	• Development of critical evaluations and auto-evaluation • Capacity of communication inside a group • Concern for a continuous improvement of process quality

7. Contents

8.1 Course	Teaching methods	Observations
1. Phase transformation. Solidification	exposition	2 hours [1] p.67
2. Crystal growth process		2 hours [1] p.171
3. Crystal growth methods (from solutions, from melt, etc.)		2 hours [4], [1] p.419
4. Verneuil method		2 hours [4]
5. Czochralski method		2 hours [6] p.49
6. Bridgman method. General consideration		2 hours [6] p.6
7. Bridgman method. System without isolation		2 hours [1] p.117, p.125
8. Bridgman method. System with isolation		2 hours [1] p.131
9. Bulk crystal growth (HEM, GSM methods)		2 hours [6] p.78
10. Shaped crystal growth. Stepanov method		2 hours [6] p.19
11. Shaped crystal growth. EFG method		2 hours [6] p.20
12. Growth stability for EFG method		2 hours [6] p.24
13. Shaped crystal growth. LHPG and NCS methods		2 hours [4]
14. Melting zone method		2 hours [6] p.70

Bibliography:

[1] I. Nicoară – Tehnologia materialelor cristaline, Tipografia Univ. de Vest, 1998.
[2] W. Kurz, D. Fischer – Fundamentals of solidification, Trans Tech Publications, 1985.
[3] Y.A. Tatarchenko – Shaped Crystal Growth, Kluwer Academic Publishers, 1993.
[4] D.T.J. Hurle (editor) – Handbook of crystal growth, Elsevier, 1993.
[5] J. Villain, A. Pimpinelli – Physique de la croissance cristalline, Alea Saclez, 1995.
[6] D. Vizman, I. Nicoară – Curs de tehnologia materialelor cristaline, Ed. Eurobit, 2008.

8.2 Seminar / lab	Teaching methods	Observations
1. Crystal growth	exposition, dialogue	1 hour [1] p.11
2. Temperature. Thermocouple. Pyrometer	exposition, experiment	2 hours [1] p.77
3. Thermocouple gauges		1 hour, notes
4. Determination of temperature gradient for Zn crystal growth by Bridgman method	exposition, experiment/ simulation	2 hours [1]
5. Growth of Zn crystals by Bridgman method		2 hours [1]
6. Growth of BaF_2 crystals by Bridgman method		2 hours [1]
7. Growth of CaF_2 crystals by EFG method		1 hour [1]
8. Growth of sapphire crystals by EFG method		2 hours [1]
9. Growth stability for EFG method		1 hour [1]

Additional Bibliography:

[7] I. Nicoară, D. Nicoară – Cristale artificiale, Editura Mirton, 1999.

8. Corroboration of the contents with the expectation of the epistemic community, professional associations and representative employers from the program's corresponding domain

The students gain skills useful for jobs in research or industry, specifically relating to crystal growth processes, metallurgy, study of growth processes, operation and physical engineering of crystal growth installations.

9. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Percent in final mark
10.4 Course	knowledge of the theoretical notions	final evaluation (written)	35%
	homework, reports, essays, translations	in the course of the semester	15%
10.5 Seminar / lab	final answers at seminar activities	in the course of the semester (orally)	10%
	10 tests during the seminars	in the course of the semester (written)	35%
	activity during seminars	in the course of the semester	5%
10.6 Minimum performance standards			
Fulfillment of 50% of the abovementioned criteria.			

Completion date:
25.01.2025

Course instructor,
C.S.III Dr. Gabriel Raoul BUȘE

Date of approval in the department:

Department head,
Conf. Dr. Nicoleta ȘTEFU