FIŞA 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	PHYSICS AND TECHNOLOGY OF ADVANCED MATERIALS / according to COR: Analyst (251201); Research assistant in physics (211103); Physicist (211101); Teacher (233002); Education reviewer (235106)

2. Subject matter information

2.1 Subject title				Crystal Growth Methods			PTAM1202
2.2 Course teacher				Conf. Dr. Octavian Mădălin Bunoiu			
2.3 Seminar teacher				CS.III. Dr. Gabriel Raoul Buşe			
2.4 Study year	1	2.5 Semester	2	2.6 Assessment type	E	2.7 Subject type	Ob.

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

Time distribution:	hrs.
Study using lecture notes, bibliography, or notes	30
Additional documentation in the library, electronic specialty platforms/ field	34
Seminar / laboratory preparations, homework, portfolio, and essays	26
Tutoring	6
Exams	4
Other activities	8

3.7 Total no. hrs. of individual study	108
3.8 Total no. hrs. Per semester	150
3.9 No. of credits	6

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

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 Classroom/ Google Meet) • 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 Classroom/ Google Meet) • laptop + projector, notebooks, experimental installations

6. Subject objectives – Expected learning outcomes of the intruction, 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 autoevaluation • 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	exposition	2 hours [1] p.171
3. Crystal growth methods (from solutions, from melt, etc.)	exposition	2 hours [4], [1] p.419
4. Verneuil method.	exposition	2 hours [4]
5. Czochralski method.	exposition	2 hours [6] p.49
6. Bridgman method. General consideration	exposition	2 hours [6] p.6
7. Bridgman method. System without isolation	exposition	2 hours [1] p.117, 125
8. Bridgman method. System with isolation	exposition	2 hours [1] p.131
9. Bulk crystal growth (HEM, GSM methods)	exposition	2 hours [6] p.78
10. Shaped crystal growth. Stepanov method	exposition	2 hours [6] p.19
11. Shaped crystal growth. EFG method	exposition	2 hours [6] p.20
12. Growth stability for EFG method	exposition	2 hours [6] p.24
13. Shaped crystal growth. LHPG and NCS methods	exposition	2 hours [4]
14. Melting zone method	exposition	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	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 etalon	exposition, experiment	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	exposition, experiment/ simulation	2 hours [1]
6. Growth of BaF_2 crystals by Bridgman method	exposition, experiment/ simulation	2 hours [1]
7. Growth of CaF_2 crystals by EFG method	exposition, experiment/ simulation	1 hour [1]
8. Growth of sapphire crystals by EFG method	exposition, experiment/ simulation	2 hours [1]
9. Growth stability for EFG method	exposition, experiment/ simulation	1 hour [1]

Bibliography:

[1] 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 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	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:
30.01.2022

Course instructor,
Conf. Dr. Octavian Mădălin BUNOIU
[redacted]

Date of approval in the department:

Department head,
Conf. Dr. Cătălin Nicolae MARIN
[redacted]