Subject content

1. Program information

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	METODE AVANSATE DE CERCETARE IN FIZICA/ ADVANCED RESEARCH METHODS IN PHYSICS

2. Subject matter information

2.1 Subject matter				**ARMP1205** Transport phenomena			
2.2 Subject teacher				Prof.dr. Daniel Vizman			
2.3 Subject applications teacher				Lect.dr. Alexandra Popescu			
2.4 Study year	1	2.5 Semester	2	2.6 Assesment type	E	2.7 Subject type	Op

3. Study time distribution

3.1 Nr. of hours/week	4	In which: 3.2 course	2	3.3 seminar/lab	2
3.4 Total hours in educational plan	56	In which: 3.5 curs	28	3.6 seminar/lab	28
Time distribution:					**hours**
Study after lecture notes, bibliography or notes					56
Additional documentation in the library, electronic specialty platforms/ field					28
Seminar / laboratory preparations, homework, portofolio and essays					28
Tutoring					4
Exams					3
Other activities……					

3.7 Total number of personal study hour	**119**
3.8 Total number of hours in semester	**175**
3.9 Number of credits	**7**

4. Preconditions (where appropiate)

4.1 curriculum	•
4.2 skills	•

5. Conditions (where appropiate)

5.1 for course	• Molecular physics; Thermal and statistical physics
5.2 for seminar/lab	•

6. Objectives of the discipline - expected learning outcomes to the formation of which contribute to the completion and promotion of the discipline

Knowledge	• to know the advanced notions in the field of Physics, which involves a critical understanding of theories and principles • to know the working formulas for calculations with physical quantities using properly the principles and laws of physics • to know the language specific to the field
Abilities	- to deduce the working formulas for calculations with physical quantities, using appropriately the principles and laws of physics - To describe physical systems using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.) - to apply the principles and laws of physics in solving theoretical or practical problems, under conditions of qualified assistance - to use the computer and calculation programs for the numerical simulation of the physical processes - to use the computer to control some experiments or processes and to acquire data - to identify the most appropriate methods to develop new materials with well-defined properties
Responsibility and autonomy	• to critically analyze a specialized report, scientific communication with a medium degree of difficulty in the field of physics • to autonomously use information sources and resources for communication and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation

7. Table of content

7.1 Course	Teaching methods	Observations
1. Introduction. Example of complex phenomena which occur in crystal growth processes.	Exposure. Googlemeet platform	Course support in electronic format, Bibliography[1]
2. Principles of heat transfer by conduction. Differential equation of heat transfer. Boundary conditions	Exposure. Googlemeet platform	Course support in electronic format, Bibliography[1] Platforme: Google Classroom
3. Solving methods: a)Splitting the variables; b)Aproximative analytical methods: integral methods, variational method, Ritz Galerkin method c) numerical methods: finite difference and finite volume	Exposure. Googlemeet platform	Course support in electronic format, Bibliography[1,3] Platforme: Google Classroom

4. Phase transformations: melting and solidification. Boundary conditions in movement interfaces.	Exposure. Discussions.	Course support in electronic format, Bibliography[1,3] Platforme: Google Classroom
5. Convective heat transfer.	Exposure. Discussions.	Course support in electronic format, Bibliography[1,3,4] Platforme: Google Classroom
6. Equations of ideal and real fluid flow (Navier-Stokes).	Exposure. Discussions.	Course support in electronic format, Bibliography[1,3] Platforme: Google Classroom
7. Introduction in magnetohydrodynamics	Exposure. Discussions.	Course support in electronic format, Bibliography[4] Platforme: Google Classroom
8. Equation of heat transfer by convection	Exposure. Discussions.	Course support in electronic format, Bibliography[1,3] Platforme: Google Classroom
9. Radiative heat transfer. Fundamentals.	Exposure. Discussions.	Course support in electronic format, Bibliography[2]
10. Mass transfer. Molecular and convective diffusion.	Exposure. Discussions.	Course support in electronic format, Bibliography[2] Platforme: Google Classroom
11. Numerical methods	Exposure. Discussions.	Course support in electronic format, Bibliography[4] Platforme: Google Classroom
12. Simulation code Crysmas	Exposure. Discussions.	Course support in electronic format, Bibliography[1,3] Platforme: Google Classroom
13. Simulation code STHAMAS	Exposure. Discussions.	Course support in electronic format, Bibliography[4] Platforme: Google Classroom
14. Heat transfer analysis in Bridgman, Czochralski and EFG crystal growth methods.	Exposure. Discussions.	Course support in electronic format, Bibliography[4] Platforme: Google Classroom

Bibliography

1. *W.Carslaw, R.Jaeger, Heat conduction in solid,* Clarendon Press, Oxford (1986)
2. *M. Necati Ozisik, Radiative Transfer and interaction with conduction and convection, Wiley-Interscience Publication, 1972*
3. *I.Nicoara, Transfer de caldura si substanta in procesele de cristalizare din topitura, Tipografia Univ. de Vest Timisoara, 1996*
4. *Daniel Vizman, PhD thesis, 1996*
5. *R. Moreau, Magnetohydrodynamics, Kluwer Academic Publischers, London,1990*
6. *Crysmas, user manual*

7.2 Seminar / labs	**Teaching methods**	**Observations**
1. Introduction. Presentation of differential eqautions for transport phenomena.	Dialogue, Googlemeet platform	

2. Applications at the heat transfer by conduction: solving practical problems with Diriclet boundary conditions.	Dialogue, Googlemeet platform	**Students will gain skills to solve complex problems of heat transfer with practical applications, Bibliography [1,2]** Platforme: Google Classroom
3. Applications at the heat transfer by conduction: solving practical problems with convective boundary conditions.	Dialogue, Googlemeet platform	
4. Applications at the heat transfer by conduction: solving practical problems with radiative boundary conditions.	Dialogue, Googlemeet platform	
5. Solving heat conduction equation by splitting the variables method	Dialogue, Googlemeet platform	
6. Solving heat conduction equation by splitting the aproximative methods	Dialogue, Googlemeet platform	
7. General overview on Crysvun software.	Interactive method using modelling software	The students will learn practically to use a modelling software for modelling crystal growth equipment and related physical phenomena. Bibliography [3,4] Platforme: Google Classroom
8. Applications at the heat transfer simulation in a Czochralski process	Interactive method using modelling software	
9. Applications at the heat transfer simulation in a Bridgman process	Interactive method using modelling software	
10. Applications to the phase transitions	Interactive method using modelling software	

Bibliography

1. *W.Carslaw, R.Jaeger, Heat conduction in solid*, Clarendon Press, Oxford (1986)
2. *I.Nicoara, Transfer de caldura si substanta in procesele de cristalizare din topitura, Tipografia Univ. de Vest Timisoara, 1996*
3. *Crysmas, user manual*
4. *D. Vizman, B. Faina, Modelarea fenomenelor de transport, Indrumator de laborator, Editura Universitatii de Vest, 2008, Timisoara*

8. Relation between subject content and the expectations of employers

Transport phenomena gives work skills in almost all domains in which the future graduate can work. Mainly related with crystal growth processes, metalurgy, etc.

9. Assesment

Activity type	9.1 Assesment criteria	9.2 Assesment method	9.3 Percent in final mark
9.4 Course	The assimilation level of knowledge gained	Oral examination	60%
9.5 Seminar / labs	Capacity of solving specific problem	Written test	40%
9.6 Minimum performance standards			
1. Correct recognition of physical parameters in diferential equations of transport phenomena. 2. Statement of possible boundary conditions.			

3. Explanation of the difference between heat transport by conduction, convection and radiation.
4. Explanation of the difference between difusive and convective regimes of mass transport.

Data completării

15.09.2024

Semnătura titularului de curs

Prof.dr. Daniel Vizman

Semnătura directorului de departament