COURSE SYLLABUS
Numerical Methods for Automotive Engineering

UP.02.DAP.1.O.21.01

1. Program information

1.1	Higher education institution	National University of Science and Tehnology Polytechnic Bucharest, Pitesti University Center
1.2	Faculty	Mechanics and Technology
1.3	Department	Automobiles and Transport
1.4	Field of studies	Automotive Engineering
1.5	Level of education	Master
1.6	Program / Qualification	Automotive Engineering for Sustainable Mobility

2. Discipline information

2.1	Name of discipline					**Advanced Mathematics for Automotive Engineering**					
2.2	Instructor of the lecture activities					Lect. PhD Petre STAN					
2.3	Instructor of the seminar activities					Lect. PhD Petre STAN					
2.4	Year of the studies	I	2.5	Semester	I	2.6	Type of evaluation	E	2.7	The discipline regime	O, DAP

3. Estimated total time

3.1	Number of hours per week	2	3.2	Lecture	1	3.3	Seminar	1
3.4	Total hours of the academic syllabus	28	3.5	Lecture	14	3.6	Seminar	14

Distribution of the time allocated to the individual study	ore
Study by handbook, course support, bibliography and notes	40
Additional documentation in the library, on specialized electronic platforms and in the field	25
Preparation of seminars / laboratories, topics, reports, portfolios, essays	30
Tutorial	17
Examinations	10
Other activities ...	

3.7	Total hours of individual study	122
3.8	**Total hours per semester**	**150**
3.9	**Number of credits allocated to the disciplines**	**4**

4. Prerequisites (where applicable)

4.1	Curriculum	Not applicable
4.2	Skills	Mathematical Analysis, algebra, Vector Calculation, Numerical Methods

5. Conditions (where applicable)

5.1	For the lecture	Classroom equipped with board, video projector, projective screen, computer, equipment and software for on-line activities
5.2	For the seminar	Classroom equipped with board, video projector, projective screen, computer, equipment and software for on-line activities

6. Specific skills acquired

Professional skills	C2- numerical modeling and simulation of the various components, sub-assemblies and assemblies of the car, in the context of minimizing the number of physical prototypes C4- experimental research with the aim of validating prototypes resulting from conception, design, modeling and numerical simulation documenting and exploiting the information
Transversal skills	CT2 - the responsible execution of professional tasks under conditions of autonomy CT3 - carrying out activities exploiting the ideas of teamwork and continuous improvement of one's own activity

7. Course goal(s)

7.1 The main goal of the discipline	- providing students with specific work methods and techniques for the design, development and validation of products in the field of automotive engineering (e.g. documentation and professional communication, modeling, simulation, manufacturing, calibration, optimization, project management, etc.); - developing the ideas of autonomy and teamwork, at the level of students, by establishing a pedagogy based on projects, assumed by teams and by individual responsibility; - the development of the skills necessary to carry out fundamental and applied research works, with the aim of creating technologies, products that ensure sustainable (sustainable)

	mobility; - the training of specialists for the scientific research activity in the field of automobile engineering, in accordance with the national and European framework of qualifications and with the current needs of the relevant industry; - the development of highly qualified human resources for the scientific doctorate activity; - sharing good practices in teaching, learning and research through the development of national and international partnerships.
7.2 Specific goals	The transmission of knowledge and the formation of the skills necessary to acquire the following skills, - innovative conception and design with the aim of creating products, technologies that ensure sustainable (sustainable) mobility, - numerical modeling and simulation of the various components, sub-assemblies and assemblies of the car, in the context of minimizing the number of physical prototypes, - calibration of the various subsystems of the car for the purpose of energy optimizations, - experimental research with the aim of validating prototypes resulting from conception, design, modeling and numerical simulation activities, - documenting and exploiting the information, - the responsible execution of professional tasks under conditions of autonomy, - carrying out activities exploiting the ideas of teamwork and continuous improvement of one's own activity.

8. Contents

8.1. Lecture		No. hours	Teaching methods	Remarks Resources used
1	Approximation and interpolation of functions – Lagrange, Newton, Chebyshev, Fourier and Hermite methods. Spline functions. Uniform approximations; methods of best approximation **(onsite)**	4	Lecture Exposure with support material Explication Description and exemplification Heuristic conversation Debate State of the problem Exercises	**(onsite)** Board Sketches Tables Video projector Computer
2	Integration of system ordinary differential equations **(online)**	4		**(online)** Computer, tablet
3	Integration of partial differential equations **(online)**	2		
4	Numerical methods for nonsmooth mechanics **(online)**	2		
5	Elements of optimization theory **(onsite)**	2		**(onsite)** Board Sketches Tables Video projector Computer
Minimal bibliography (selected chapters of) 1. P. Stan, M. Stan, Applied mathematics in mechanics, Pitesti University Publishing House, page 412, ISBN 978-606-560-498-8, 2016 2. Stănescu, N.-D., Numerical methods, Pitesti, 2022. 3. Pandrea, N., Stănescu, N.-D., Dynamics of the Rigid Solid with General Constraints by a Multibody Approach, John Wiley & Sons, Chichester, Great Britain, 2016. 4. Pandrea, N., Popa, D., Stănescu, N.-D., Classical and Modern Approaches in the Theory of Mechanisms, John Wiley & Sons, Chichester, Great Britain, 2017. 7. Tabacu Ș., Baba, V., Diaconescu, V., Sandu, A., Numerical analysis of mechanical systems, Pitești University Publishing House, 2020. 8. S. Eugeniu Zaharia, A. Bogoi, Numerical methods for solving engineering problems, Politehnica University of Bucharest, Letras Publishing House, 2020				
8.2. Applications: Seminar		No. hours	Teaching methods	Remarks Resources used
1	Approximation and interpolation of functions – Lagrange, Newton, Chebyshev, Fourier and Hermite methods. Spline functions. Uniform approximations; methods of best approximation	4	Lecture Exposure with support material Explication Description and exemplification Heuristic conversation Debate State of the problem Exercises	**(onsite)** Board Sketches Tables Video projector Computer
2	Integration of system ordinary differential equations	4		
3	Integration of partial differential equations	2		**(online)** Computer, tablet
4	Numerical methods for nonsmooth mechanics	2		
5	Elements of optimization theory	2		**(onsite)** Board Sketches Tables Video projector Computer
Minimal bibliography (selected chapters of) 1. Pandrea, N., Stănescu, N.-D., Dynamics of the Rigid Solid with General Constraints by a Multibody Approach, John Wiley & Sons, Chichester, UK, 2016.				

2. Stan P., Mathematics and numerical methods applied in mechanics, Publishing House of the University of Pitesti, 2016
3. Pandrea, N., Popa, D., Stănescu, N.-D., Classical and Modern Approaches in the Theory of Mechanisms, John Wiley & Sons, Chichester, UK, 2017.
4. Stănescu, N.-D., Numerical methods, Pitesti, 2022.
5. S. Eugeniu Zaharia, A. Bogoi, Numerical methods for solving engineering problems, Politehnica University of Bucharest, Letras Publishing House, 2020

8.3. Homework

Problems from the different topics taught at courses

3.Corroboration of the contents of the discipline with the expectations of the epistemic community representatives, professional associations and employers in the field related to the program

In order to update and enrich the content of the disciplines, the staff participated at the following activities:
- working meetings with specialists in the field and employers (Automobile Dacia, RTR, EuroAPS, Johnson Controls, Componente Auto);
- change of good practices with colleagues from other universities (Bucureşti, Timişoara, Iaşi, Cluj-Napoca, Braşov, Ploieşti);
- workshops with the participation of specialists in the field.

4. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	Verification test	Written test – solving of some problems	10 %
	Final evaluation	Written test – solving of some problems	50 %
10.5 Seminar	Solving of problems	Written test	20 %
	Homework	Portofolio	20 %
10.6 Minimum standard of performance	Obtaining of minimum 1.0 points at homework, minimum 1.0 points at seminar, minimum 0.5 point at the verification test, minimum 2.5 points at the final evaluation and the sum of points is equal at least to 5.0 points		

Date (of filling)
28.09.2023

Instructor (lecture),
Lect. PhD Petre STAN

Instructor (seminar),
Lect. PhD Petre STAN

Date (of approval)
29.09.2023

Head of department (DAT)
Lect. PhD Eng. Helene BĂDĂRĂU ȘUSTER