# COURSE SYLLABUS
# Research Activity III
UP.02.DAP.1.O.21.23-AP

## 1. Program information

| | | |
|---|---|---|
| 1.1 | Higher education institution | National University of Science and Technology POLITEHNICA Bucharest |
| 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

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Name of discipline | | | | | Road Vehicle Dynamics | | | | | |
| 2.2 | Instructor of the lecture activities | | | | | - | | | | | |
| 2.3 | Instructor of the lab activities | | | | | TABACU Ștefan | | | | | |
| 2.4 | Year of the studies | I | 2.5 | Semester | I | 2.6 | Type of evaluation | E | 2.7 | The discipline regime | O |

## 3. Estimated total time

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Number of hours per week | 12 | 3.2 | lecture | - | 3.3 | project | 12 |
| 3.4 | Total hours of the Course syllabus | 168 | 3.5 | lecture | - | 3.6 | project | 168 |

| **Distribution of the time allocated to the individual study** | **hours** |
|---|---|
| Study by handbook, course support, bibliography and notes | 50 |
| Additional documentation in the library, on specialized electronic platforms and in the field | 50 |
| Preparation of seminars / laboratories, topics, reports, portfolios, essays | 60 |
| Tutorial | 8 |
| Examinations | 7 |
| Other activities ..... | |

| | | |
|---|---|---|
| 3.7 | Total hours of individual study | 175 |
| **3.8** | **Total hours per semester[2]** | 343 |
| **3.9** | **Number of credits allocated to the discipline** | 7 |

## 4. Prerequisites (where applicable)

| | | |
|---|---|---|
| 4.1 | Curriculum | Not applicable |
| 4.2 | Skills | Mathematics, Mechanics, Internal Combustion Engines, Road Vehicle Dynamics |

## 5. Conditions (where applicable)

| | | |
|---|---|---|
| 5.1 | for the lecture | Classroom equipped with board, video projector, projection screen, computer |
| 5.2 | for the lab | Board, computer, lab equipments |

## 6. Specific skills acquired

| | |
|---|---|
| Professional skills | C3. calibration of different vehicle subsystems for energy optimization purposes (1 p.)<br>C4. research with the purpose of validating the prototypes resulting from the activities of conception, design, modeling, and numerical simulation (1 p.)<br>C5. Documentation (1 p.)<br>C6. Communication (1 p.) |
| transversal skills | CT1. project management (1 p.)<br>CT2. responsible execution of professional tasks under autonomous conditions (1 p)<br>CT3 carrying out activities exploiting the ideas of teamwork and continuous improvement of one's own activity (1 p.) |

## 7. Course goal(s)

| | |
|---|---|
| 7.1 The main goal of the discipline | The general objective of the discipline is to improve the knowledge in the field of computer aided numerical simulation. |
| 7.2 Specific goal(s) | Understand the need for computer simulation;<br>Definition of the problem;<br>Select the proper numerical simulation tool;<br>Development of the numerical model;<br>Solving the numerical model;<br>Validation of the numerical model; |

## 8. Contents

| | **8.1. Project** | **No. hours** | **Teaching methods** | **Remarks Resources used** |
|---|---|---|---|---|
| 1 | Introduction to computer simulation. | 12 | *- Lecture*<br>*- Exposure with support material*<br>*- Explication*<br>*- Description and exemplification*<br>*- The heuristic conversation*<br>*- Debate*<br>*- State the problem*<br>*-Exercise* | *board, sketches, tables, graphs, sheets, photos, models, video projector, computer, internet* |
| 2 | Methods for the numerical simulation. | 12 | | |
| 3 | Understanding material characterization for numerical modelling | 12 | | |
| 4 | Understanding FE, SPH, and DEM methods | 12 | | |
| 5 | Modeling of the mechanical systems for computer simulation | 24 | | |
| 6 | Solving, post-processing, and validation of the numerical models | 12 | | |
| 7 | Modeling of the fluid-structures interaction | 24 | | |
| 8 | Solving, post-processing, and validation of the numerical models | 12 | | |
| 9 | Numerical modeling in vehicle dynamics | 24 | | |
| 10 | Miscellaneous | 24 | | |
| | **TOTAL HOURS** | **168** | | |

**Minimal bibliography:**


1. Milliken, W., Milliken, D, Race car vehicle dynamics, SAE Inc, 1995;
2. Hans Pacejka, Tire and Vehicle Dynamics, Elsevier, 2012;
3. Happian-Smith, J., An Itroduction to the Modern Vehicle Design, SAE International, 2002;
4. Ammar, M.; Haleem, A.; Javaid, M.; Bahl, S.; Garg, S.B.; Shamoon, A.; Garg, J. Significant Applications of Smart Materials and Internet of Things (IoT) in the Automotive Industry. Mater Today Proc 2022, 68, 1542–1549, doi:10.1016/j.matpr.2022.07.180;
5. Chang, K.-H. Rapid Prototyping. e-Design 2015, 743–786, doi:10.1016/B978-0-12-382038-9.00014-4;
6. Haleem, A.; Javaid, M. Additive Manufacturing Applications in Industry 4.0: A Review. Journal of Industrial Integration and Management 2019, 04, 1930001, doi:10.1142/s2424862219300011;
7. Hallquist, J. LS-DYNA® Theory Manual; 2006; ISBN 9254492507;
8. Körgesaar, M. The Effect of Low Stress Triaxialities and Deformation Paths on Ductile Fracture Simulations of Large Shell Structures. Marine Structures 2019, 63, 45–64, doi:10.1016/j.marstruc.2018.08.004;
9. Ren, X.; Das, R.; Tran, P.; Ngo, T.D.; Xie, Y.M. Auxetic Metamaterials and Structures: A Review. Smart Mater Struct 2018, 27;
10. Santos, J.; Gouveia, R.M.; Silva, F.J.G. Designing a New Sustainable Approach to the Change for Lightweight Materials in Structural Components Used in Truck Industry. J Clean Prod 2017, 164, 115–123, doi:10.1016/j.jclepro.2017.06.174;
11. Sartal, A.; Bellas, R.; Mej, A.M.; Garc Ia-Collado, A. Sustainable Manufacturing-Review Article The Sustainable Manufacturing Concept, Evolution and Opportunities within Industry 4.0: A Literature Review. Advances in Mechanical Engineering 2020, 12, 1–17, doi:10.1177/1687814020925232;
12. Savolainen, J.; Collan, M. How Additive Manufacturing Technology Changes Business Models? – Review of Literature. Addit Manuf 2020, 32;
13. Suhaib Kamran, S.; Haleem, A.; Bahl, S.; Javaid, M.; Prakash, C.; Budhhi, D. Artificial Intelligence and Advanced Materials in Automotive Industry: Potential Applications and Perspectives. Mater Today Proc 2022, 62, 4207–4214, doi:10.1016/j.matpr.2022.04.727;
14. Tabacu, S.; Ducu, C. Numerical Investigations of 3D Printed Structures under Compressive Loads Using Damage and Fracture Criterion: Experiments, Parameter Identification, and Validation. Extreme Mech Lett 2020, 39, doi:10.1016/j.eml.2020.100775.


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

*The skills acquired in this discipline allow the graduates to work in the field of simulation for automotive engineering: design, calibration, test, and homologation of thermal engines and automobile structures. Being a specialized discipline, its purpose is to train students, especially for engineering centers (design, research, development).*

## 10. Evaluation

| Activity type | 10.1 Evaluation Criteria | 10.2 Evaluation methods | 10.3 Percentage of the final grade |
|---|---|---|---|
| 10.4 Activity | Final evaluation | Oral exam | 20% |
| 10.5 Project | Involvement in activity throughout the semester | Questions / answers. Individual discussions | 30% |
| 10.6. Work for home | Correct resolution. Quality of presentation | Oral presentation. Individual discussions | 50% |
| 10.6 Minimum standard of performance | - Determining the type of numerical model.<br>- Determining the type of numerical simulation.<br>- Evaluation of the performance of a numerical model. | | |

Titular de curs
Prof.univ.dr.ing. **Ştefan TABACU**

Date (of filling)
20.09.2023

Date (of approval)
29.09.2023

Head of department (DAT)
Lect.PhD.Eng. **Helene SUSTER**