**SYLLABUS**

1. **Information about the program**

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| **1.1** Higher education institution |  UNIVERSITATEA POLITEHNICA TIMISOARA  |
| **1.2** Faculty[[1]](#footnote-1) / Department[[2]](#footnote-2) |  CONSTRUCTII/ CMMC / CMMC+CCI |
| **1.3** Field of study (name/code[[3]](#footnote-3)) |  INGINERIE CIVILA/ 10  |
| **1.4** Study cycle | Master  |
| **1.5** Study program (name/code/qualification) |  ADVANCED DESIGN OF BUILDINGS – PROIECTAREA AVANSATA A CLADIRILOR/ 10/ Master  |

1. **Information about discipline**

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| **2.1** Name of discipline/The educational classe[[4]](#footnote-4) | Computational Modelling of Structures / DA  |
| **2.2** Coordinator (holder) of course activities | Conf. dr. ing. Adrian DOGARIU |
| **2.3** Coordinator (holder) of applied activities[[5]](#footnote-5) | As. dr. ing. Viorel TODEA |
| **2.4** Year of study[[6]](#footnote-6) | 1 | **2.5** Semester | 1 | **2.6** Type of evaluation | E | **2.7** Regime of discipline[[7]](#footnote-7) | DI |

1. **Total estimated time** (direct activities (fully assisted), partially assisted activities and unassisted activities[[8]](#footnote-8))

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| **3.1** Number of hours fully assisted/week | 4 ,of which:  | course | 2 | seminar/laboratory/project | 2 |
| **3.1\*** Total number of hours fully assisted/sem. | 56 ,of which:  | course | 28 | seminar/laboratory/project | 28 |
| **3.2** Number of on-line hours fully assisted/sem | 24 ,of which:  | course | 16 | seminar/laboratory/project | 8 |
| **3.3** Number of hours partially assisted/week | 0 ,of which:  | project, research | 0 | training | 0 | hours designing M.A. dissertation | 0 |
| **3.3\*** Number of hours partially assisted/ semester | 0 ,of which:  | project of research | 0 | training | 0 | hours designing M.A. dissertation | 0 |
| **3.4** Number of hours of unassisted activities/ week | 6.71 ,of which:  | Additional documentation in the library, on specialized electronic platforms, and on the field | 1 |
| Study using a manual, course materials, bibliography and lecture notes | 2 |
| Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays | 3.71 |
| **3.4\*** Total number of hours of unasssited asctivities/ semester | 94 ,of which:  | Additional documentation in the library, on specialized electronic platforms, and on the field | 14 |
| Study using a manual, course materials, bibliography and lecture notes | 28 |
| Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays | 52 |
| **3.5 Total hrs./week**[[9]](#footnote-9) | 10.71 |
| **3.5\* Total hrs./semester** | 150 |
| **3.6 No. of credits** | 6 |

**4. Prerequisites** (where applicable)

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| **4.1** Curriculum | * Not the case
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| **4.2** Competencies | * Not the case
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**5. Conditions** (where applicable)

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| **5.1** of the course | * Medium capacity classroom/small amphitheater, video projector
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| **5.2** to conduct practical activities | * Medium capacity classroom, video projector, computer-pool
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**6. Specific competencies** acquired through this discipline

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| Specific competencies | * Upon completion of this course, students will be able to:
* Apply fundamental principles of structural mechanics to computational modeling
* Utilize ABAQUS and SAP software tools for structural analysis design and research
* Conduct comprehensive structural analyses, including static, dynamic, and nonlinear analyses
* Evaluate the performance of structural systems under different loading conditions
* Optimize structural designs for efficiency, safety, and cost-effectiveness
* Interpret and verify and validate the results of structural analysis
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| Professional competencies ascribed to the specific competencies | * provide construction counseling; draw sketches; utilize CAD software; draft technical reports; apply numerical computing skills; supervise personnel; adapts existing projects to new circumstances; evaluates the integrated design of buildings; manage data in the field of research; conducts scientific research; prepares scientific reports; applies the principles of ethics and scientific integrity in research activities;
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| Transversal competencies ascribed to the specific competencies | * oversee quality control; apply scientific, technological, and engineering knowledge; work in teams; train others;
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**7. Objectives of the discipline** (based on the grid of specific competemcies acquired)

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| **7.1** The general objective of the discipline | * This course continues the classes of Mechanics of Materials, Structural Analysis and Finite Element analysis and introduces computer-based methods for the analysis of solid, structural. The main objective of this course is to give students the principles of computational modeling and analysis of structures, with a detailed description of each step of the method. Together with the practical works intend to teach to students in using finite element software (SAP2000 and ABAQUS©), for linear and nonlinear analyses. Applications include finite element analyses, modelling of problems, and interpretation of numerical results. At the end of this course, it is expected that students will be able to model and solve complex steel and reinforced concrete civil engineering structures
 |
| **7.2** Specific objectives | * This course is designed to provide civil engineers with a comprehensive understanding of computational modeling techniques as applied to structural analysis and design. Students will learn to use advanced software tools to analyze complex structural systems, evaluate their performance under various loading conditions, and optimize their design for efficiency and safety.
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**8. Content**

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| **8.1** Course | Number of hours | Of which online | Teaching methods |
| Introduction to Structural Modeling in Civil Engineering.Basic Concepts of Finite Element Analysis (FEA). Introduction to structural analysis software. Fundamental equations of elasticity theory. Overview of elasticity theory. 2D stress and strain state in cartesian and polar coordinate systems. Applications and scope of elasticity theory. | 1 | Max 60% | Presentation on the blackboard, with video projector, conversations, explanations, examples |
| Geometric Modeling and Discretization.Creating geometric models of structures using CAD software. Discretization techniques for structural analysis. Types of finite elements and their applications. | 1 |   |
| Material PropertiesLinear and nonlinear constitutive models. Isotropic and anisotropic materials | 4 |   |
| Fundamental Theory of Plasticity. Plasticity criteria: (i) Plasticity under unidimensional stress states. (ii) Yield criteria under bidimensional and tridimensional stress states. (iii) Deformations in the plastic regime. Testing and characterization of materials. | 1 |   |
| Structural Analysis: Static Analysis: Formulation of equilibrium equations. Methods for solving linear systems. Dynamic Analysis: Modal and frequency analysis. Time-history analysis and response spectrum analysis.Nonlinear Analyses: Material and geometric nonlinearity. Techniques for solving nonlinear problems. Analysis of structures with large P-d displacements.Seismic Analysis: Seismic loading and modeling in compliance with EN 1993-1-8 design codes. Stability Analysis: Stability of structures. Bifurcation. Limitation. Divercence Linear and nonlinear stability analysis. Design considerations for stability using advanced numerical methods.Other analysis: Fatique analisys, Impact analysis, Progresive Collapse Analysis, Thermal Analysis, Coupled multiphysics analysis, Soil-Structure Interaction (SSI) Analysis | 8 |   |
| Optimization Techniques for Structural Systems: Shape optimization. | 1 |   |
| Advanced Topics in FEA: Constraint formulation. Adaptive discretization and control of discretization error. Contact formulation. Parallel computation for large-scale problems. Coupling structural analysis with analyses from other physical domains. | 2 |   |
| Case Studies and Applications: Examples of structural analysis and design. Application of modeling in various civil engineering projects. Validation and verification. Documentation of all FE analyses in compliance with prEN 1993-1-14. Practical demonstration using ABAQUS software. | 5 |   |
| Recap of Key Concepts and Techniques: Final project presentations by students.  | 1 |   |
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|  | Bibliography[[10]](#footnote-10) CSI – SAP2000 – Integrated Software for Structural Analysis and Design – Computers and Structures, Berkeley, California;ABAQUS (2014) Analysis User’s Manual, Version 6.14. Dassault Systems Simulia, Inc.;FprEN 1993-1-14:2025 Eurocode 3 — Design of steel structures — Part 1-14: Design assisted by finite element analysisTimoshenko and Goodier, Theory of Elasticity, McGraw-Hill, 2006J. Lubliner: Plasticity theory. University of California at Berkeley. 2006O.C. Zienkiewicz and R. Taylor: The Finite Element Method. Volume 1: Basis. Ed Butterworth-Heinemann, 2000C. Pacoste, V. Stoian, D. Dubină: Metode moderne în mecanica structurilor. Ed. Ştiintifică şi Enciclopedică. 1988. |
| **8.2** Applied activities[[11]](#footnote-11) | Number of hours | Of which online | Teaching methods |
| Introduction: Presentation of structural analysis software. Description of modeling stages.  | 2 | Max 35% | Presentation on the blackboard, with video projector, on the computer, conversations, explanations, examples |
| Multi-story Steel Structure with Two Planes of Symmetry: Description of the SAP model. Calculation scheme. - Linear analysis. Plastic analysis. First-order and second-order analysis. Modal analysis. Buckling analysis. Incremental nonlinear static analysis – Pushover. Linear dynamic analysis. Nonlinear dynamic calculation – Time-history.  | 8 |   |
| Analysis of a Structure with Reinforced Concrete Shear Walls: Description of the SAP model | 6 |   |
| Stress and Deformability Analysis of a Reinforced Concrete Beam: Description of the ABAQUS model | 2 |   |
| Soil-Foundation Interaction: Modeling the contact between soil and concrete foundation. Determination of stress and deformability (settlements) in the foundation soil. Structural response influenced by soil flexibility. | 2 |   |   |
| Modeling a Welded Steel Connection: Consideration of imperfections. Determination of the joint's capacity | 4 |   |   |
|   |   |   |   |
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|   |   |   |   |
|  | Bibliography[[12]](#footnote-12) Romanian seismic design code – Part I – General rules for buildings – P100-1/2013;EN 1990 (2004), Eurocode 0: Basis of structural design, European Committee for Standardization;EN 1991-1-1 (2004), Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings, European Committee for Standardization;EN 1992-1-1 (2004), Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings, European Committee for Standardization;EN 1993-1-1 (2004), Eurocode 3: Design of steel structures - Part 1- 1: General rules and rules for buildings, European Committee for Standardization;CSI – SAP2000 – Integrated Software for Structural Analysis and Design – Computers and Structures, Berkeley, California;ABAQUS (2014) Analysis User’s Manual, Version 6.14. Dassault Systems Simulia, Inc.; |

**9. Coroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program**

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| * Students will learn to use advanced software tools to analyze complex structural systems, evaluate their performance under various loading conditions, and optimize their design for efficiency and safety
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**10. Evaluation**

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| Type of activity | **10.1** Evaluation criteria[[13]](#footnote-13) | **10.2** Evaluation methods | **10.3** Share of the final grade |
| **10.4** Course |  2 theoretical topics  | Written examination  | 25 %  |
| **10.5** Applied activities  | **S:** one application with the use of the FE program | Application on computer  | 75 %  |
|  | **L:**   |   |   |
|  | **P:**   |   |   |
|  | **Pr:**   |   |   |
|  | **Tc-R[[14]](#footnote-14):**  |   |   |
| **10.6** Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified[[15]](#footnote-15) |
| * The final mark must accumulate a minimum score of 5 points out of 10 possible
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| **Date of completion** | **Course coordinator****(signature)** | **Coordinator of applied activities****(signature)** |
| 23.11.2024 |   |   |

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| **Head of Department** **(signature)**  | **Date of approval in the Faculty Council [[16]](#footnote-16)** | **Dean****(signature)** |
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1. The name of the faculty which manages the educational curriculum to which the discipline belongs [↑](#footnote-ref-1)
2. The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs. [↑](#footnote-ref-2)
3. The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated. [↑](#footnote-ref-3)
4. The educational classes of disciplines are: thoroughgoing study discipline (DA), advanced knowledge discipline (DCAV), synthesis discipline (DS) or complementary discipline (DC). [↑](#footnote-ref-4)
5. The applied activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr). [↑](#footnote-ref-5)
6. The year of study to which the discipline is provided in the curriculum . [↑](#footnote-ref-6)
7. Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT or optional discipline (DO). [↑](#footnote-ref-7)
8. Within UPT, the number of hours from 3.1\*, 3.2\*,…,3.9\* are obtained by multipling by 14 (weeks) the number of hours from 3.1, 3.2,…, 3.9. [↑](#footnote-ref-8)
9. The total number of hours/week is obtained by summing up the number of hours from 3.1, 3.4 şi 3.8. [↑](#footnote-ref-9)
10. At least one title must belong to the department staff teaching the discipline, and at least one title must refer to a relevant work for the discipline, a national and international work that can be found in the UPT Library. [↑](#footnote-ref-10)
11. The types of applied activities are those mentioned in 5. If the discipline containes more types of applied activities then they are marked, consecutively, in the table below. The type of activity will be marked distinctively under the form: „Seminar:”, „Laboratory:”, „Project:” and/or „Practice/Training:”. [↑](#footnote-ref-11)
12. At least one title must belong to the staff teaching the discipline. [↑](#footnote-ref-12)
13. The Syllabus must contain the evaluation method of the discipline, specifying the criteria, the metods and the forms of evaluation, as well as mentioning the share attached to these within the final mark. The evaluation criteria must correspond to all activities stipulated in the curriculum (course, seminar, laboratory, project), as well as to the methods of continuous assessment (homework, essays etc.) [↑](#footnote-ref-13)
14. Tc-R= Homework-Reports [↑](#footnote-ref-14)
15. For this point turn to “Ghid de completare a Fișei disciplinei” found at: <http://www.upt.ro/img/files/2018-2019/calitate/Ghid_de_completare_fisa_disciplinei.pdf> [↑](#footnote-ref-15)
16. The approval is preceeded by discussing the study program’s board’s point of view with redgards to the syllabus. [↑](#footnote-ref-16)