

Summary of analytical review of educational programs in CMSE field in EU and PC universities

As a result of the review and analysis of the CMSE curricula, InMotion Partners have identified needs for the development of improved Syllabi, that will be included in the updated Curricula for the engineers in the universities of the partner countries. New syllabi for bachelors and masters (shown in Table 1) will be developed and included in curricula in the areas of training of engineers in fields related to CMSE.

The requirements for the curriculum being developed are determined: the optimal number of hours devoted to the individual work of students (IW), the number of contact hours - lectures, practices, laboratory works (CH), the number of ECTS counted for each developed program of the discipline. In addition, professional competencies which must be acquired by students in the course of studying special disciplines have been formalized. The need for the new textbooks is also determined and listed in the Table 1.

Table 1. The list of the new Syllabi to be included in the Curricula for Engineers.

| University | Syllabus | Level | IW | CH | CP/ ECTS | Name of the program/ Specialization | New textbook/ guidelines/responsible |
|------------|--|----------|----|----|-------------|---|---|
| SPbPU | The basis of mathematical modeling | Bachelor | 72 | 72 | 4 | Name of the program: 02.03.02 Fundamental Informatics and information technologies Specialization: 02.03.02_02 Computer Science | Mathematical Models (Textbook, SPbPU) |
| SPbPU | Technologies of computer modeling | Master | 72 | 72 | 4 | Name of the program: 02.04.02 Fundamental Informatics and information technologies Specialization: 02.04.02_02 Design of information systems | Technologies of component modeling (Textbook, SPbPU) |
| SPbPU | Computer modeling of complex dynamical systems | Master | 72 | 72 | 4 | Name of the program: 02.04.02 Fundamental Informatics and information technologies Specialization: 02.04.02_02 Design of information systems | Modeling and Simulation in Engineering using Modelica (Textbook, UNED) |



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|------|---|----------|-----|----|---|--|--|
| SMTU | Modeling and Simulation of Dynamic Systems | Bachelor | 108 | 36 | 4 | Name of the program: 01.03.04.A Applied Mathematics. Specialization: 01.03.04.A.01.16.D Computer and Mathematical Modeling in Science and Technology | Modeling and Simulation of Dynamic Systems / WSM (Textbook, SMTU) |
| SMTU | Modeling and Simulation in Engineering using Modelica | Master | 108 | 36 | 4 | Name of the program: 01.04.04.A Applied Mathematics. Specialization: 01.04.04.A.01.16.D Computer and Mathematical Modeling in Science and Technology | Modeling and Simulation in Engineering using Modelica (Textbook, UNED) |
| SMTU | Modeling and Simulation in Engineering using RMD | Bachelor | 108 | 36 | 4 | Name of the program: 01.03.04.A Applied Mathematics. Specialization: 01.03.04.A.01.16.D Computer and Mathematical Modeling in Science and Technology | Mathematical Models (Textbook, SPbPU) |
| NSTU | Simulation fundamentals | Bachelor | 47 | 61 | 3 | 09.03.03 Applied Informatics; Specialization: Mobile and internet technologies | Fundamentals of event-continuous systems simulation theory (Textbook, NSTU) Instrumental simulation of hybrid systems / ISMA (Guidelines for Lab works, NSTU) |
| NSTU | Modeling and Simulation in Engineering using Modelica | Bachelor | 47 | 61 | 3 | 09.03.01 Computer Science and Computer Engineering; Specialization: 1) Software for computer systems and networks or 2) Network Information Technologies 09.03.03 Applied Informatics; Specialization: Mobile and internet technologies | Modeling and Simulation in Engineering using Modelica (Textbook, UNED) |
| NSTU | Modeling and simulation of hybrid systems | Master | 46 | 26 | 2 | 09.04.01 Computer Science and Computer Engineering; Specialization: Computer modeling of systems | Control oriented modelling and simulation: methods and tools (Textbook, UL) Domain-specific models and libraries for solving engineering |



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|-------|--|----------|----|----|---|---|---|
| | | | | | | | problems in instrumental environments / ISMA, Matlab (Guidelines for Lab works, NSTU) |
| UniKL | Mathematical Modeling of Complex Dynamical Systems | Bachelor | 52 | 68 | 5 | Name of the program: Bachelor of Engineering Technology in Naval Architecture and Shipbuilding. Specialization: Basic Mathematical Modeling for Complex Dynamic Systems. | To be recommended by InMotion Project. |
| UniKL | Applied Marine Hydrodynamics | Bachelor | 92 | 68 | 6 | Name of the program: Bachelor of Engineering Technology in Naval Architecture and Shipbuilding. Specialization: Computer and Mathematical Modeling for Marine Hydrodynamics. | To be recommended by InMotion Project. |
| UTP | Rotating Machine Stability | Bachelor | 52 | 72 | 3 | Name of the program: Bachelor of Engineering (Mechanical Engineering) | Control Systems Engineering (Textbook) |
| UTM | Robotics | Bachelor | 78 | 42 | 5 | Name of the program: Bachelor of Engineering (Mechanical Engineering) | <i>To be recommended by InMotion Project</i> |
| UTM | Ship and Offshore Structure Modeling & Simulation | Master | 78 | 42 | 5 | Name of the program: Master of Sciences (Ship and Offshore Engineering) | <i>To be recommended by InMotion Project</i> |

The comparative analysis of the differences in the existing curricula of doctoral students at EU universities and partner countries universities results in the decision to improved curricula for doctoral students in CMSE field and develop improved individual plans for them.

We decided to develop the methodological guidelines, which will contribute to the improvement of the scientific and educational process in the field of training doctoral students who actively use CMS methods and packages for special engineering applications. See Table 2.

Table 2. The list of guidelines for doctoral students in CMSE field.

| Developer | Guidelines |
|-----------------|--|
| UniHB/SMTU | eScience approach and structured programs for the third educational level |
| SPbPU | Visual environments for modelling and simulation. Developer's approach. Doctoral level (методические указания) |
| SMTU/SPbPU/NSTU | The guidelines on the structure of the individual plans in terms of targets and training time |
| NSTU | Comparative study of simulation tools (Recommendations on holding workshops for Doctoral students) |

The work on the guidelines will contribute to the improvement of the following Syllabi. See Table3.

Table 3. The List of doctoral Syllabi

| University | Syllabus | IW | CH | CP/ ECTS | Speciality |
|------------|--|-----|----|-------------|---|
| SPbPU | Visual environments for modelling and simulation | 72 | 72 | 4 | 05.13.18. Mathematical modeling, numerical methods and complexes of programs |
| SMTU | Computer modeling for marine engineering applications | 108 | 36 | 4 | 05.13.18. Mathematical modeling, numerical methods and complexes of programs |
| NSTU | Comparative study of simulation tools | 193 | 23 | 6 | 05.13.11. Mathematical and software of computers, complexes and computer networks |
| NSTU | Introduction to the theory of formal languages and compilers | 193 | 23 | 6 | 05.13.11. Mathematical and software of computers, complexes and computer networks |