POLITEHNICA University of Bucharest (**UPB**)
Faculty of Engineering and Management of Technological Systems (**IMST**)
Study Programme: Industrial Engineering (**IE**)
Form of study: Licence (Bachelor)

COURSE SPECIFICATION

Course title:	Modelling and simulation	***Semester:***	4
Course code:	UPB.06.D.04.A.006	***Credits (ECTS):***	4

Course structure	Lecture	Seminar	Laboratory	Project	Total hours
Number of hours per week	2	-	2	-	4
Number of hours per semester	28	-	28	-	56

Lecturer	Lecture	Seminar / Laboratory / Project
Name, academic degree	Dan Mihai Constantinescu, Prof.	Ştefan Sorohan, Prof.
Contact (email, location)	dan.constantinescu@upb.ro, CA013	stefan.sorohan@upb.ro, CA113

Course description:

This course introduces the students to computation for simulation concepts by surveying its paradigms and methodologies as well as important and related disciplines. Topics discussed in the course include: system analysis and classification, abstract and simulation models, continuous, discrete, and combined models, heterogeneous models. It also covers pseudorandom number generation, optimization, discrete element and network methods, and continuous simulation.
The course is presented in the classic way. There is also electronic format (pdf, ppt) files of the courses. It emphasizes some aspects of the content, and the bibliography is used for theoretical completing and applications.
The Monte Carlo, continuous, and discrete event simulations are introduced as a foundation. Probability and Statistics, Modeling and Visualization are also introduced with particular attention to their importance as related to computation for simulation.Topics such as verification and validation, distributed simulations, and interoperability are among the methodologies.The course content is: Introduction to modelling and simulation; System analysis, classification of systems; System theory basics, its relation to simulation; Model classification: conceptual, abstract, and simulation models; Heterogeneous models; Methodology of model building; Simulation systems and languages; means for model and experiment description; Principles of simulation system design; Models of queuing systems; Discrete simulation models; Model time and simulation of experiment control; Continuous systems modelling; Overview of numerical methods used for continuous simulation; Combined simulation; The role of simulation in digital systems design; Special model classes; models of heterogeneous systems; Checking model validity and verification of models; Analysis of simulation results; System Dynamics: system thinking; Basic concepts and software tools; Simulation results visualization; Interactive simulation, virtual reality; Overview of commonly used simulation systems; Design and control of simulation experiments; Model optimization.

Seminar / Laboratory / Project description:

The applications (labs) activities pass of on half of groups in the computer laboratory rooms for the beginning simple software and commercial codes at the end of course. All programs are described in an electronic format and are available for students. Usually the first problem of each chapter is presented by the professor, the next ones are proposed and each student must solve them. The results are then discussed in common.

Intended learning outcomes:
At the completion of this course student will be able to: 1. distinguish among the different simulation paradigms; 2. understand how other disciplines relate to Modeling and Simulation; 3. demonstrate general knowledge of the methodologies used in Computation for Simulation. Within these three main course objectives, the student will be able to: • describe the difference between Continuous and Discrete Event Simulations; • understand how to use Visualization to display state of simulations and their results; • understand the use of Computation for Simulation in the study of systems; • create simulations with either custom or simulation software.

Assessment method:	% of the final grade	Minimal requirements for award of credits
Written exam	40	20
Report / project	-	-
Homework	30	15
Laboratory	30	15
Other	-	-

References:	
Compulsory References **1.** Hector Guerrero, Excel Data Analysis: Modeling and Simulation, ISBN-10: 3642108342 | ISBN-13: 978-3642108341, 2010. **2.** Modelling and Simulation, Edited by Giuseppe Petrone and GiulianoCammarata, ISBN 978-3-902613-25-7, 2008. **Optional References** **3.** Principles of Modeling and Simulation: A Multidisciplinary Approach, Edited by John A. Sokolowski and Catherine M. Banks, ISBN-10: 0470289430 | ISBN-13: 978-0470289433, 2009. **4.**Robert L. Woods,Kent L. Lawrence, Modeling and Simulation of Dynamic Systems, ISBN-10: 0133373797 | ISBN-13: 978-0133373790, 1997.	
Prerequisites:	***Co-requisites*** ***(courses to be taken in parallel as a condition for enrolment):***
Engineering Mathematics I, II, Priciples of Programming I, II, Mechanics and Materials I, II, Design and Manufacturing I	-
Additional relevant information:	
Requirements for 5 grade. Basics on: *a.* Definitions of basic computational tools for simulation; *b.* When to apply these techniques; *c.* Terminology & Components; *d.* Discrete vs. Continuous time; *e.*Manage time and maintain the discipline required to meet the lab requirements; *f.* Complete all laboratories and prove minimum knowledge. Requirements for 10 grade. Be able to prove understanding of: *a.* Types of Simulations with Respect to Output Analysis; *b.* Stochastic Nature of Output Data; *c.* Measures of Performance of Computation for Simulation Verification and Validation of Simulation Models; *d.* Model Building, Verification, and Validation; *e.* Verification of Simulation Models; f. Calibration and Validation of Models.	

Date:14.07.2016
Prof.Dan Mihai Constantinescu: