<table>
<tr><td>Course code</td><td></td></tr>
<tr><td>Type and description</td><td>Background Course</td></tr>
<tr><td>ECTS credit</td><td>2</td></tr>
<tr><td>Course name</td><td>Reliability and Optimization in Civil Engineering</td></tr>
<tr><td>Course name in Polish</td><td>Niezawodność i Optymalizacja w Budownictwie</td></tr>
<tr><td>Language of instruction</td><td>English</td></tr>
<tr><td>Course level</td><td>8 PRK</td></tr>
<tr><td>Course coordinator</td><td>Marcin Kamiński</td></tr>
<tr><td>Course instructors</td><td>Marcin Kamiński</td></tr>
<tr><td>Delivery methods and course duration</td><td>
<table>
<tr><th></th><th>Lecture</th><th>Tutorials</th><th>Laboratory</th><th>Project</th><th>Seminar</th><th>Other</th><th>Total of teaching hours during semester</th></tr>
<tr><td>Contact hours</td><td>15</td><td></td><td></td><td></td><td></td><td>0</td><td>15</td></tr>
<tr><td>E-learning</td><td>Yes</td><td>No</td><td>No</td><td>No</td><td>No</td><td>No</td><td></td></tr>
<tr><td>Assessment criteria (weightage)</td><td>0,80</td><td></td><td></td><td></td><td></td><td>0,20</td><td>1,00</td></tr>
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<tr><td>Course objective</td><td>1. The main goal of this course is to present the fundamental definitions, theorems and properties in mathematical statistics, probability theory, stochastic processes and to present their significance and applications in engineering and applied sciences. Mathematical statistics with its computational implementation will be shown and discussed with special attention to its probabilistic convergence and its significance in engineering catastrophies' evidence and decision making.
2. Further, a role of stochastic processes and, particularly, time series in engineering analysis will be explained and presented jointly with a review of their basic theoretical properties and definitions.
3. The next goal is short survey on the stochastic perturbation method and its application in elementary engineering problems.
4. The final goal is to demonstrate how to perform an efficient computational implementation of all these issues using the symbolic computer program and to make a satisfactory parametric visualization of the results.</td></tr>
<tr><td>Learning outcomes</td><td>The student should be able to:
1. identify basic statistics, probabilistic moments and coefficients for the given random variable (both discrete and continuous) (W1);
2. make computational implementation of the Monte-Carlo simulation and analytical derivation of these moments and coefficients for simple engineering problems with random parameters (K1);
3. calculate basic properties of the time series with random coefficients (W1);
4. derive probabilistic moments and coefficients for some transforms of the random quantities or time series using stochastic perturbation technique (W1);
5. propose an efficient solution method to the given engineering problem with random parameters (K1);
6. discuss the differences in-between analytical, statistical and perturbation-based probabilistic characteristics (U1);
7. identify the basic sources of numerical error coming from various probabilistic computational techniques (U1).</td></tr>
<tr><td>Assessment methods</td><td>Effects W1, W4– oral examination
effects U3, K1, K2…. – presentation
Final assessment based on:
Exam - 80%, presentation – 20%.</td></tr>
<tr><td>Prerequisites</td><td>The candidate should have basic information from mathematics, computer science, and also mechanics of materials and structures to use a computer algebra program for a solution of some engineering mechanics problem.</td></tr>
<tr><td>Course content with delivery methods</td><td>This course content includes:
1. fundamental definitions, theorems and properties in probability theory - expected value, standard deviation, variance, skewness, kurtosis, coefficient of varation, probability density function (for single</td></tr>
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	and multiple variables), characteristics function and cumulative density function, correlation function and coefficient of correlation; 2. presentation of various probabilistic distributions and their basic characteristics as well as possible engineering applications; 3. fundamental definitions, theorems and properties in mathematical statistics - basic probabilistic characteristics (as above), random numbers generation and sampling (crude and stratified), statistical estimation and convergence of estimators, Central Limit Theorem and its consequencies; 4. significance and applications of statistics in engineering and applied sciences - statistical evidence of failures, experimental statistics on engineering parameters, statistical prognosis of durability for engineering structures and materials; 5. continuous and discrete, stationary and non-stationary stochastic processes, their definitions and properties, time series analysis; 6. basic principles of stochastic perturbation methods (of the first, second and general order), perturbation-based derivation of the engineering formulas including some random variables; 7. computational implementation of statistics, probability, time series and stochastic processes in symbolic computing environment; statistical and stochastic simulation as well as estimation in the computers' world; 8. a short survey on the other probabilistic methods like spectral analysis, Latin Hypercube Sampling, fuzzy sets and polynomial chaos analysis. The lectures are supported by the e-learning realized via email submission of the presentations and computer applications to the program MAPLE as well as usage of the Author's webpage connected with on-line discussion on the projects.
Basic reference materials	[1] M. Fisz, Probability Theory and Mathematical Statistics (in Polish), PSP, Warsaw, 1969. [2] M. Kamiński, The Stochastic Perturbation Method for Computational Mechanics. Wiley, Chichester, 2013. [3] K. Sobczyk, B.F. Spencer, Random Fatigue: From Data to Theory. Academic Press, Boston, 1992.
Other reference materials	[1] K. Sobczyk, Statistical Dynamics Methods (in Polish). PSP, Warsaw, 1973. [2] K. Sobczyk, Stochastic Differential Equations. With Applications to Physics and Engineering. Kluwer Academic Publishers, Dordrecht, 1990 (Polish edition also).
Average student workload outside classroom	35 h
Comments	Not applicable
Last update	05.01.2021