Code	VI.4.
Course Title (English)	Mathematics III - statistics
Course Title (Polish)	Matematyka III – statystyka i badania operacyjne
Credits	4 ECTS

Language of instruction **English**

Compulsory for Profile: Computer Modelling and Simulation (CMS), Intelligent Energy (IE), Biotechnology for Environmental Protection (BI), Bussines and Technology (BT)

Type of studies BSc studies

Unit running the programme Institute of Mathemtics (Instytut Matematyki), Institute of Thermal Machinery (Instytut Maszyn Cieplnych)

***Course coordinator** and academic teachers* **Andrzej Grzybowski, Dr (Subject Coordinator and Lecturer)**, Stanisław Drobniak (Lecturer)**,** Prof., Maciej Marek, Dr (Responsible for Tutorials)

Form of classes and number of hours

Semester	Lec.	Tut.	Lab.	Proj.	Sem.	Credit points
3	30	15	-	-	-	4

Learning outcomes Students who successfully complete the Probability and Statistics course *should* be able to:
Define, interpret and use basic terms from probability theory and statistics.
Perform standard analysis of random variables.
Understand main methods and tools of modern statistics.
Calculate and interpret basic statistics.
Apply probability and statistical techniques to solve typical practical problems arising in fields such as engineering, business, and physical sciences

The Fourier Analysis course objectives are to enable students to use Fourier Analysis in various applications including vibration analysis, economy and ecology phenomena. The basic concepts are followed by idea of Fourier series, Fourier Integral, Fourier Transform and Inverse Fourier Transform, both in real and complex spaces. This is followed by introduction to correlation analysis, which finally makes students familiar with basic ideas and tools of spectral analysis.

Prerequisites Basic knowledge of differential and integration calculus, fundamental properties of vectors (representation of vectors using rectangular components, vector multiplication), basics of complex variable calculus, programme of Mathematics I and II.

Course description LECTURE

PROBABILITY AS A MEASURE, Basic concepts - events, sample spaces, probability

distribution. Fundamental probability laws and rules. Examples (2h).

RANDOM VARIABLES, Random variables of discrete and continuous type. Cumulative distribution functions, density functions. Fundamental characteristics of a probability distribution: expected value (mean) , median, variance, standard deviation, quantiles. (3h).

PROBABILITY DISTRIBUTION CLASSES, Important classes of distributions as model for random phenomena (*binominal, Poisson, normal, exponential*). The sampling distributions of means and sums. Sampling distributions related to normal distribution (*Student t-distribution).* (2h)

INTRODUCTION TO STATISTICS. Descriptive Statistics vs. Statistical Inference - basic concepts and elements. Most important statistics. Point estimation. Properties of point estimators. Interval estimation. (3h).

STATISTICAL TESTS OF HYPOTHESIS., Properties of statistical test. Choosing the null and alternative hypotheses. Tests about population mean (2h).

FOURIER SERIES AND TRANSFORM, Introductory concepts, series convergence, Fourier series and Fourier coefficients, Fourier analysis in time domain – interpretation, Fourier Integral, Fourier Transform and Inverse, Fourier Transform in real and complex calculus, sample application in mechanical and environmental engineering and in economy (3 hours)

TUTORIALS:

FOURIER SERIES AND FOURIER COEFFICIENTS – calculations for sample functions (2 hour).
FOURIER TRANSFORM – calculations for sample functions (2 hours).
Autocorrelation, cross-correlation – calculations for various signals. Correlation coefficient (1 hour).
INTRODUCTION TO PROBABILITY THEORY. Discussion of fundamental concepts (sample space, events). Conditional probability. Operations on events (2 hours). Total probability. Bayes rule (2 hours).
RANDOM VARIABLES. Probability distribution. Probability density function. Classical probability distributions – binomial, Poisson, normal. Expected value, variance, standard deviation (2 hours).
STATISTICAL INFERENCE. Point and interval estimation. Confidence interval. Statistical tests of hypotheses (2 hours).
INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS (PDE).
Classification of PDE's. Application of PDE's to modelling of physical phenomena (heat transfer, wave propagation etc.)
(2 hours).

LABORATORY
Not applicable

PROJECT
Not applicable

SEMINAR

Not applicable

Form of assessment Assignment (lecture and tutorials, overall grade)

Basic reference materials

1. R.E. Scheaffer, L.J, Young, Introduction to probability and its applications, Brooks/Cole, Boston, 2010,
2. W. Mendenhall, T. Sincich, Statistics for Engineering and Computer Sciences, Collier McMillian Publishers, New Jersey, 1988.
3. Probability I – Lecture Notes
4. Probability II – Lecture Notes
5. Probability III – Lecture Notes
6. Statistical Inference I – Lecture Notes
7. Statistical Inference II – Lecture Notes
8. MIII - Probability ver 2010.pdf – Extended Lecture Notes
9. MIII - Statistics ver 2010.pdf - Extended Lecture Notes
10. D.E. Newland, An Introduction to Random Vibrations, Spectral and Wavelet Analysis, Longman
11. Fourier Analysis Part I – Lecture Notes
12. Fourier Analysis Part II – Lecture Notes
13. Fourier Analysis Part III – Lecture Notes
14. Handouts for tutorial classes.

Other reference materials

For Polish-speaking students:

1. Krysicki W, Bartos J, Dyczka W, Królikowska K., Wasilewski M., Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, cz. I i II, PWN, Warszawa 2005.
2. Plucińska A., Pluciński E., Probabilistyka, WNT, Warszawa 2000.
3. Cz. Cempel, Wibroakustyka Stosowana, PWN, 1989
4. Analiza Sygnałów – Materiały wykładowe http://www.imc.pcz.czest.pl/instytut/pl/3/3.8/3.8.html

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Average student workload per week (teaching hours + individ.)	6 teaching hours + 3 hours of individual work
Remarks:	
Updated on: 04.04.2012	