# STUDY MODULE DESCRIPTION FORM

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|---|---|---|
| Name of the module/subject<br>**Mathematics** | | Code<br>**1010112111010343698** |
| Field of study<br>**Civil Engineering** | Profile of study<br>(general academic, practical)<br>**(brak)** | Year /Semester<br>**1 / 1** |
| Elective path/specialty<br>**-** | Subject offered in:<br>**English** | Course (compulsory, elective)<br>**obligatory** |
| Cycle of study:<br>**Second-cycle studies** | Form of study (full-time,part-time)<br>**full-time** | |
| No. of hours<br>Lecture: **30** Classes: **30** Laboratory: **-** Project/seminars: **-** | | No. of credits<br>**4** |
| Status of the course in the study program (Basic, major, other)<br>**(brak)** | (university-wide, from another field)<br>**(brak)** | |
| Education areas and fields of science and art<br>**technical sciences**<br>**Technical sciences** | | ECTS distribution (number and %)<br>**100 4%**<br>**100 4%** |

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## Prerequisites in terms of knowledge, skills and social competencies:

| | | |
|---|---|---|
| 1 | **Knowledge** | Basic knowledge with range of differential and integral calculus, ordinary differential equations, linear algebra and analytical geometry, probability theory (from first degree studies). |
| 2 | **Skills** | Capability to find derivatives, integrals, analyze the function of real variable, solve ordinary differential equations, apply matrix calculus. Capability to determine basic probabilities and to verify independence of random events. |
| 3 | **Social competencies** | Understanding of need of competences broadening, readiness to undertaking of co-operation. |

## Assumptions and objectives of the course:

-the main aim is to understand basic notions of the theory in order to apply them to solving technics problems, making use of tensor calculus to solving eigenvalue problems, finding general and particular solutions of partial differential equations of first and second order, finding Fourier series of a given function, solving partial differentiable equations by applying Fourier series, application of basic statistical methods to technical problems

## Study outcomes and reference to the educational results for a field of study

### Knowledge:

1. explain notion of linear operator (tensor), the notion of eigenvalues and eigenvectors of linear operators - [K_W01+++]
2. explain the notion of general, particular solution of partial differential equation, the equation of characteristisc, the canonical form of second order equation, examples in phisics - [K_W01+++]
3. explain the notion of Fourier series, explain the algorithm of solving partial differential equations byFourier series - [K_W01+++]
4. formulate the rules of the construction of confidence intervals - [K_W01]
5. formulate the procedure of hypothesis testing - [K_W01]
6. understand the meaning of mathematics and its applications for development of engeneering branches and civilization - [K_W01+++]

### Skills:

1. solve the eigenvalue problem of linear operator given by a matrix (tensor), find the set of principle directions. - [K_U13+++, K_U14++, K_U06+]
2. find the general and particular solution of linear partial differential equation of first order and of partial differential equation of second order with constant coeffiecients - [K_U13+++, K_U14++, K_U06+]
3. find the Fourier series of a given function in simple cases - [K_U13+++, K_U14++, K_U06+]
4. determine the distribution of random variable - [K_U13]
5. conclude about unknown parameters of population from confidence intervals - [K_U13]
6. test hypothesis about unknown population parameters - [K_U13]

## Social competencies:

1. can think and behave in good mathematical manner in the area of tensor calculus, partial differential equations, Fourier series and Fourier transform and calculus of variation - [K_K01+, K_K06++]
2. can conclude from the experiment, takes care about the reliability of experiment results and inference, can detect possible manipulation of statistical inference - [K_K01, K_K02]

## Assessment methods of study outcomes

The lecture:

-written exam concerning mainly the theoretic part of the subject.

Classes :

evaluation of written tests and the direct activity during the classes (solving problems and preparing reports)

-continuous evaluation during each meeting - taking into account the activity in discussion and in cooperation concerning practical exercises.

Getting extra points related with activity, in partucular:

-presenting reports concerning applications of theory in different branches or putting the theory in history of mathematics

-notes concerning the improvement of basic materials;

-active participation in consultations.

## Course description

I. Tensor calculus

1. Background of elementary linear algebra
2. Linear space (linear dependence and independence of vectors, a basis of a linear space)
3. Basic products of vectors.
4. Linear operators (Tensors as linear operators)
5. Transformations of a coordinate system
6. Eigenvalue problem

II. Partial differential equations

1. Basic notions
2. The boundary and initial conditions
3. Linear partial differential equations of first order
4. Partial differential equations of second order (canonical form, the most known examples, conversion to the canonical form)

III. Fourier series

1. Separating of variables as justification for the theory of Fourier series
2. Approximating the function by a trigonometric series.
3. Fourier series of a given function, Fourier sine (cosine) series, Fourier series expansion in the interval [-l,l], Fourier series in a complex form
4. Applications of Fourier series to differential equations, algorithm of finding solution of differential equations by Fourier series.

IV. Elements of statistical inference

1. Random variables (discrete and continuous, standard probability distributions)
2. Poin and interval estimation
3. Hypothesis testing

## Basic bibliography:

1. D. J. Hartfiel, Elementary Linear Algebra, PWS Publishers (a division of Wadsworth) Inc., Boston 1987.
2. M. Itskov, Tensor Algebra and Tensor Analysis for Engineers with Applications to Continuum Mechanics, Springer-Verlag, Berlin Heidelberg New York, 2007.
3. G. E. Mase, Theory and Problems of Continuum Mechanics, McGraw-Hill Company Inc., 1970.
4. G. T. Mase and G. E. Mase, Continuum Mechanics for Engeneers, CRC Press LLC, London New York Washington 1999.
5. Tyn Myint-U, Partial Differential Equations of Mathematical Physics, American Elesevier Publishing Co.,Inc., 1973.
6. H. F. Wienberger, A First Course in Partial Differential Equations, John Wiley&Sons Inc., 1965.
7. T. Trajdos, Matematyka dla inżynierów, Wydawnictwo Naukowo-Techniczne, Warszawa, 1974
8. R. Leitner i J. Zacharski, Zarys matematyki wyższej, Wydawnictwo Naukowo-Techniczne , Warszawa, 1998
9. W. Krysicki i L. Włodarski, Analiza matematyczna w zadaniach, Państwowe Wydawnictwo Naukowe, Warszawa, 1974
10. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1 Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2003
11. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2 Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2005
12. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1 Przykłady i zadania , Oficyna Wydawnicza GiS, Wrocław, 2003
13. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2 Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2005
14. S. Vent, W. Bishop, Elementary Linear Algebra, second edition, PWS Publishers, Boston-USA, 1985.
15. W. Krysicki, J. Bartos, W. Dyczka, K. Królikowska i M. Wasilewski, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, wydanie 8. PWN Warszawa, 2012
16. D. Bobrowski i K. Maćkowiak-Łybacka, Wybrane metody wnioskowania statystycznego., Wyd. PP, Poznań, 2004
17. S. M. Ross, Introductory Statistics, Elsevier, 2010

## Additional bibliography:

1. D. L. Powers, Elementary Differential Equations with Boundary Value Problems, PWS Publishers (a division of Wadsworth) Inc., Boston 1985.
2. E. W. Swokowski, Calculus with analytic geometry, PWS Publishers (a division of Wadsworth) Inc., Boston 1983.
3. L. L.. Lapin, Probability and Statistics for Modern Engineering, Wadsworth, Inc., 1983

## Result of average student's workload

| Activity | Time (working hours) |
|---|---|
| 1. Active participation in meetings (lectures and classes) | 60 |
| 2. Active participation in consultations with posing questions | 5 |
| 3. Solving exercises designed for independent work | 10 |
| 4. Independent studying theoretical questions (notions, algorithms, theorems, proofs) | 5 |
| 5. Preparing to the tests and exam | 20 |

## Student's workload

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 100 | 4 |
| Contact hours | 65 | 3 |
| Practical activities | 35 | 1 |