STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Applied matematics		**1010102111010346018**
Field of study	Profile of study (general academic, practical)	Year /Semester
Civil Engineering Second-cycle Studies	**(brak)**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Structural Engineering	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**full-time**	
No. of hours		No. of credits
Lecture: **30** Classes: **15** Laboratory: **-** Project/seminars: **-**		**3**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
(brak)	**(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)
the sciences		**3 100%**
Mathematical sciences		**3 100%**

Responsible for subject / lecturer:

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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 (from first degree studies).
2	**Skills**	Capability to find derivatives, integrals, analyze the function of real variable, solve ordinary differential equations, apply matrix calculus.
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 the understanding of 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 particle solutions of partial differential equations of first and second order, finding Fourier series and Fourier transforms of a given function, solving boundary problems and boundary-initial problems of partial differentiable equations by applying Fourier transforms and Fourier series, understanding basic notions of calculus of variations (minimum of functional, extremizing function, the Euler-Lagrange equation)

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, particle solution of partial differential equation, the equation of characteristisc, the canonical form of second order equation, examples in phisics - [K_W01+++]
3. give the form of integral functional in calculus of variation, the form of Euler-Lagrange equation - [K_W01+++]
4. explain the notion of Fourier series, Fourier transform, explain the algorithm of solving partial differential equations by Fourier transform (Fourier series) - [K_W01+++]
5. 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 particle 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 extremizing function by solving Euler-Lagrange equation (degenerated cases), give basic examples of calculus of variations - [K_U13+++, K_U14++, K_U06+]

4. find the Fourier series of a given function in simple cases - [K_U13+++, K_U14++, K_U06+]

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++]

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

Actualization 2017/2018

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 and Fourier transforms

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. Fourier integral of a function f absolutely integrable on R

5. Sine, cosine and complex Fourier transform

6. Fundamental properties of Fourier transform useful in applications

7. Applications of Fourier series and Fourier transforms to differential equations, algorithm of finding solution of differential equations by Fourier transforms

IV. Calculus of variations

1. Several examples which lead to variational problems defined by integral functional

2. The necessary condition for minimizing problem - the Euler-Lagrange equation

3. Analogies between the extremum of a real valued function on a real line and the extremum of a functional.

4. Finding of an extremizing function in several classical problems.

The applied methods of education:

-lectures

1. lecture led in interactive way with questions formulating to group,

2. the students' activity is taken into account during the final evaluation (the preparation of historical reports connected with the mathematicians' related to material),

3. in track of lecture initiating the discussion,

4. theory presented with connections of current knowledge from previous lectures.

-classes

1. solving on board example tasks,

2. detailed the reviewing by leader the solutions of tasks of practice and the discussions over comments,

3. the students' activity is taken into account during the final evaluation.

Basic bibliography:

1. R. Leitner i J. Zacharski, Zarys matematyki wyższej dla studentów cz. 3, Wydawnictwo Naukowo-Techniczne , Warszawa, 1998

2. R. Leitner, Zarys matematyki wyższej dla studentów cz. 2, Wydawnictwo Naukowo-Techniczne , Warszawa, 1998

3. W. Krysicki i L. Włodarski, Analiza matematyczna w zadaniach cz.2, Państwowe Wydawnictwo Naukowe, Warszawa, 1974

4. T. Trajdos, Matematyka dla inżynierów, Wydawnictwo Naukowo-Techniczne, Warszawa, 1974

5. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1 Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2003

6. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2 Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław, 2005

7. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1 Przykłady i zadania , Oficyna Wydawnicza GiS, Wrocław, 2003

8. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 2 Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław, 2005

9. I. M. Gelfand i S.W. Fomin, Rachunek wariacyjny, Państwowe Wydawnictwo Naukowe, Warszawa, 1972

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. M. Itskov, Tensor Algebra and Tensor Analysis for Engineers with Applications to Continuum Mechanics, Springer-Verlag, Berlin Heidelberg New York, 2007.
4. D. J. Hartfiel, Elementary Linear Algebra, PWS Publishers (a division of Wadsworth) Inc., Boston 1987.
5. G. E. Mase, Theory and Problems of Continuum Mechanics, McGraw-Hill Company Inc., 1970.
6. G. T. Mase and G. E. Mase, Continuum Mechanics for Engeneers, CRC Press LLC, London New York Washington 1999.
7. Tyn Myint-U, Partial Differential Equations of Mathematical Physics, American Elesevier Publishing Co.,Inc., 1973.
8. H. F. Wienberger, A First Course in Partial Differential Equations, John Wiley&Sons Inc., 1965.
9. S. Vent, W. Bishop, Elementary Linear Algebra, second edition, PWS Publishers, Boston-USA, 1985.

Result of average student's workload

Activity	Time (working hours)
1. Active participation in meetings (lectures and classes)	45
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)	10
5. Preparing to the tests and exam	15

Student's workload

Source of workload	hours	ECTS
Total workload	85	3
Contact hours	50	2
Practical activities	35	1