COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics [S1MiTPM1>MAT2]

Course

Field of study
Materials and technologies for automotive industry

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

6,00

Coordinators

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Lecturers

Prerequisites

Student possesses knowledge of selected mathematic fields, including complex numbers and single variable differential and integral calculus. Student has logical reasoning skills.

Course objective

The acquirement of knowledge and computational skills in linear algebra, multiple variables differential and integral calculus and differential equations that are necessary to handle engineering problems.

Course-related learning outcomes

Knowledge:
1. Student has extended and in-depth knowledge of selected mathematic fields, including linear algebra, multiple variables differential and integral calculus and differential equations.
2. Student has a systematized knowledge in the field of mathematics, useful in formulating and solving complex problems in the area of materials and technologies for automotive industry.

Skills:
1. Student is able to obtain information from literature, databases and other properly selected sources,

including information in English; is able to combine the obtained information, to interpret and critically assess it, to draw conclusions and to formulate opinions and provide exhaustive justifications for them.
2. Student is able to use the known methods and mathematical models - and, if necessary, modify them - for the analysis and design of components of automotive systems.
3. Student is able to develop, evaluate and use existing analytical, simulational and experimental methods to solve complex engineering tasks in the field of materials and technologies for automotive industry, including non-typical tasks that contain a research component.
4. Student has the ability to learn independently, mainly in order to improve professional skills; is able to identify areas of detailed technical knowledge necessary to implement a specific engineering task and acquire them independently as well as present them.

Social competences:
1. Student understands the need of lifelong learning.
2. Student is able to cooperate and work in a team, and take different roles in it.
3. Student is able to define priorities which serve the implementation of a task assigned by him-/herself or by others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
• assessment of knowledge and skills at the written exam checking knowledge of concepts and the ability to solve short practical tasks
• passing threshold: 50% of points; exam issues, on the basis of which questions are prepared, will be published on the eKursy platform.
Tutorials:
• assessment of knowledge and skills at the short written tests (at the beginning of tutorial); the date of test will be announced with at least a one-week in advance
• passing threshold: 50% of points

Programme content

Functional series
Linear algebra
Differential calculus of functions of two variables
Multiple integrals
Ordinary differential equations

Course topics

INFINITE SERIES
• Definition of power series. Convergence of power series
• Taylor series
• Fourier series
LINEAR ALGEBRA
• Definition of a cartesian product
• Definition of a matrix
• Matrix calculus (addition, multiplication matrix by scalar, multiplication matrix by matrix, transpose of matrix)
• Definition of a determinant
• Methods for calculation of a determinant:
o Sarrus' rule
o Laplace expansion
• Definition of an inverse matrix
• Finding an inverse of a matrix (from definition, Gaussian elimination)
• Definition of a rank of a matrix
• Properties of a rank of a matrix
• Cramer’s rule
• Kronecker-Capelli theorem
• Homogeneous system of linear equations

• Gaussian elimination
• Eigenproblem (eigenvalues and eigenvectors)
FUNCTION OF A SEVERAL VARIABLES
• Definition of a partial derivative
• Definition of an exact differential
• Schwarz's theorem
• Extreme values, critical point (necessary and sufficient conditions)
• Geometric interpretation of two variables function
• Conditional extrema (optional)
• Lagrange multipliers (optional)
MULTIPLE INTEGRAL
• Definition of normal domain
• Definition of double integral and its geometric interpretation
• Evaluating double integral as iterated integral
• Changing the order of integration in double integral
• Polar coordinates in double integral + Jacobian
• Cylindrical and spherical coordinates in triple integral +Jacobian
• Application of the double integral: (the area of the region bounded by the curves, the first and the second moments, the mass and the center of mass, the parallel axis theorem)
• Application of the triple integral: (the volume of solids, the first and the second moments, the mass and the center of mass)
FIRST-ORDER ORDINARY DIFFERENTIAL EQUATIONS
• Definition of the first order differential equations
• General solution, particular solution
• Initial value problem
• Separable differential equations
• Linear differential equations
• Exact differential equations, integrating factor
SECOND-ORDER ORDINARY DIFFERENTIAL EQUATIONS
• Linear differential equations with constant coefficients
• Wronskian, linear independence of particular solutions
• Nonhonogenous linear differential equations with constant coefficient (method: undetermined coefficient, method of variation of parameters)
SYSTEMS OF FIRST-ORDER ORDINARY DIFFERENTIAL EQUATIONS (optional)
• Definition, matrix form
• Fundamental set of solutions
• Solution of systems of honogeneous first-order differential equations

Teaching methods

Lectures:
• lecture is conducted in an interactive way with formulating questions for a group of students or for selected students
• student activity during classes is taken into account when the final grade is considered
Tutorials:
• sample tasks are solved on the blackboard
• detailed discussion of solved tasks

Bibliography

Basic:
1. W. Żakowski, Matematyka, T.1 i T.2, WNT, Warszawa 2003.
2. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Definicje, twierdzenia, wzory), GiS, Wrocław 2007.
3. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Przykłady i zadania), GiS, Wrocław 2007.
4. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 (Definicje, twierdzenia, wzory), GiS, Wrocław 2011.
5. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 (Przykłady i zadania), GiS, Wrocław 2011.
6. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne (Definicje, twierdzenia, wzory), GiS, Wrocław 2011.
7. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne (Przykłady i zadania), GiS, Wrocław 2011.

Additional:
1. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, T.1, T.2, PWN, Warszawa 2011.
2. I. Foltyńska, Z. Ratajczak, Z. Szafrański, Matematyka dla studentów uczelni technicznych, cz1., cz.2, Wydawnictwo PP, Poznań 2004.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	62	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	88	3,00