# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics

## Course

Field of study
Electromobility

Year/Semester
1/2

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
45

Laboratory classes

Other (e.g. online)

Tutorials
30

Projects/seminars

## Number of credit points

6

## Lecturers

Responsible for the course/lecturer:
dr Leszek Wittenbeck
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Responsible for the course/lecturer:

## Prerequisites

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

## Course objective

The acquirement of knowledge and computational skills in multiple variables differentia 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 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 electrical engineering.

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 electronic 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 electrical engineering, 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 sent to students by e-mail using the university e-mail system.

**Tutorials:**

- assessment of knowledge and skills at the short written tests (at the beginning of every tutorial)
- passing threshold: 50% of points

## Programme content

**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 paralel axis theorem
- Application of the triple integral
  - The volume of solids
  - The first and the second moments
  - The mass and the center of mass

**LINE INTEGRAL**

- Definition of line integral with respect to arc length
- Definition of line integral on vector field
- Independence of a line integral of path
- Green's theorem
- Application of the line integral
  - Length of an arc
  - Area of a plane region
  - Mass and center of mass of an arc
- Physical interpretation of line integral (work)

**SURFACE INTEGRAL**

- Definition of surface integral over nonoriented surface
- Definition of surface integral over oriented surface
- Relations between integrals of different kind
  - Gauss-Ostrogradsjy divergence theorem
  - Stockes's theorem
- Application of the surface integral
  - Area of a surface
  - Mass and center of mass of a surface

**ELEMENTS OF FIELD THEORY**

- Single variable vector function
- Scalar field
- Directional derivative
- Gradient
- Vector field
- Potential functions, convervative vector field
- Divergence of vector field, solenoidal vector field
- Circulation and rotation of vector field, irrotational vector field
- Nabla operator
- Laplasian

**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**

- Definition, matrix form
- Fundamental set of solutions
- Solution of systems of honogeneous first-order differential equations

**LAPLACE TRANSFORM**

- Definition of the Laplace's transform
- General properties
- Examples of application

**INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS**

- Classification of partial differential equations
- Laplace's equation
- Heat equation
- Wave equation

## 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. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 ( Definicje, twierdzenia, wzory), GiS, Wrocław 2011.
3. M. Gewert, Z. Skoczylas, Analiza matematyczna 2 ( Przykłady i zadania), GiS, Wrocław 2011.

4. M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne ( Definicje, twierdzenia, wzory), GiS, Wrocław 2011.
5. 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 | 155 | 6,0 |
| Classes requiring direct contact with the teacher | 80 | 3,0 |
| Student's own work (literature studies, preparation for tutorials, preparation for tests and exam) | 75 | 3,0 |