POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics [S1Mech1>MAT2]

Course

Field of study Mechatronics	**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 (e.g. online)** 0
Tutorials 30	**Projects/seminars** 0	

Number of credit points

5,00

Coordinators	**Lecturers**
	dr Leszek Wittenbeck leszek.wittenbeck@put.poznan.pl

Prerequisites

Student possesses mathematical knowledge at basic level from secondary school. Student has logical reasoning skills

Course objective

The acquirement of knowledge and computational skills in single variable differential and integral calculus, linear algebra, analytical geometry and complex numbers 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 complex numbers, linear algebra, analytical geometry and single variable differential and integral calculus.
2. Student has a systematized knowledge in the field of mathematics, useful in formulating and solving complex problems in the area of mechatronics.

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 mechatronic 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 mechatronics, 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:

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

COMPLEX NUMBERS
  Modulus, argument, principal argument
  Form: geometric, rectangular, polar (complex plane)
  Square root of complex number
  Quadratic equation on complex domain
  Derivation polar form from rectangular form
  de Moivre"s formula
  formula for the n-th root of complex number
  formula for multiplication and division of two complex numbers that are in polar form
  Euler"s formula for complex numbers
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)
ELEMENTS OF ANALITYCAL GEOMETRY IN 3D
  Coordinates of a vector
  Length of a vector
  Vector calculus (addiction, multiplication vector by scalar, dot product, cross product, mixed product)
  Definition of a dot product of two vectors
  Definition of a cross product of two vectors
  Parallel and perpendicular vectors
  Formula for an area of the parallelogram/triangle spanned by two nonparallel vectors
  Formula for an area of the parallelepiped/tetrahedron spanned by three nonplanar vectors
  Angle between two vectors
SEQUENCES
  Definition of a sequence
  Monotonicity of a sequence
  Definition of a limit of a sequence
  Properties of limits of convergent sequences
  Squeeze theorem
  Definition and properties of Euler's number
  Indeterminate symbols
FUNCTION OF A SINGLE VARIABLE
  Definition of function, injection, surjection
  Explicit, implicit and parametric relations
  Definition of an one-to-one function, a monotonic function, an inverse function, a composite function
  Trigonometric functions, inverse trigonometric functions, hyperbolic functions, inverse hyperbolic functions
  Definition of limit of a function
  Definition of continuity of a function
  Asymptote of a function
  L"Hospital"s rule
  Definition of a derivative of a function and its geometric interpretation
  Properties of derivation of functions
  Formulas for derivatives of sums, products, differences and quotients
  Definition of exact differential and its geometric interpretation
  Inverse function theorem
  Derivative of a parametrically defined function
  Logarithmic derivative
  Higher order derivative
  Chain rule
  Mean value theorem
  Extreme values of functions (necessary and sufficient conditions)
  Monotonicity of a function
  Inflection points (necessary and sufficient conditions)
  Concavity and convexity of a function
INDEFINITE INTEGRAL
  Definition of indefinite integral and anti-derivative
  Properties of indefinite integrals
  Integration by substitution
  Integration by parts
DEFINITE INTEGRAL
  Definition of definite integral
  Properties of definite integral
  Integration by substitution
  Integration by parts
  Geometric interpretation of definite integral
  Definition of region with repect to x axis
  Definition of region with respect to y axis
  Application of definite integral:

o area of a region
o arc length
o area of surface of revolution
o volume of surface of revolution
IMPROPER INTEGRAL
  first type (infinite interval)
  second type (discontinuous integrand)

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 1 (Definicje, twierdzenia, wzory), GiS, Wrocław
 2011.
3. M. Gewert, Z. Skoczylas, Analiza matematyczna 1 (Przykłady i zadania), GiS, Wrocław 2011.
4. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Definicje, twierdzenia, wzory), GiS,
 Wrocław 2007.
5. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Przykłady i zadania), GiS, Wrocław
 2007.
Additional
1. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, T.1, T.2, PWN, Warszawa 2011.
2. M. Grzesiak, Liczby zespolone i algebra liniowa, Wydawnictwo PP, Poznań 1999.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	65	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	85	3,50