Detailed course description
(SUBJECT CARD)

Course title: Mathematics
Course code:
Affiliation to a course group: common courses
Course type: core
obligatory
Field of study: Industrial and Engineering Chemistry
Level of study: first-cycle programme
Study profile: general academic
Mode of study: full-time programme
Specialty (specialisation): -
Year of study: I
Semester: II
Teaching modes and teaching hours:
lectures – 30;
tutorials – 30
Language/s of instruction: English
Number of ECTS credits *(according to the study programme)***: 6**
** – leave the appropriate option*

1. Course objectives:

   Students gain the ability to use mathematical methods to describe chemical processes by participating in the lectures and exercises. Enrichment and improvement of knowledge about advanced mathematical methods necessary in engineering practice.

2. Relating the field-specific learning outcomes to teaching modes, verification methods and assessment of student's learning outcomes:

symbol	**assumed learning outcomes** *a student who completed the course:*	**teaching modes**	**verification methods and learning outcome assessment**
Knowledge: a student knows and understands			
K1A_W19	issues of calculus, in particular derivatives and integrals of functions of one and many variables and their applications,	lecture classes	Exam Written test Oral test
K1A_W19	issues from ordinary differential equations, analytical geometry in R2 and R3	lecture classes	Exam Written test Oral test
Skills: a student can			
K1A_U33	use the mathematical methods to describe and analyse basic physical, chemical and technical issues, in particular: it can carry out calculations in vector spaces, it can use calculus in solving problems of physics and technical sciences,	lecture classes	Exam Written test Oral test
K1A_U33	apply knowledge of probability and statistics to the analysis of experimental data, and in particular be able to prepare statistical data and use basic methods of statistical conclusions.	lecture classes	Exam Written test Oral test

3. Study programme contents ensuring the learning outcomes *(according to the study programme)*:

   Calculus, in particular derivative and integrals of functions of one variable and its applications in chemical, physical and technical issues, ordinary differential equations, derivative and integrals of functions of many variables and their applications

4. Probability and statistics issues. Description of methods to determine the ECTS credits:

Type of activity	Number of hours / ECTS credits
Number of course hours regardless of a teaching mode	60/2
Student workload - preparation for exercises, consultations	30/1
Student workload - preparation for the written test	30/1
Student workload – cognition of literature	30/1
Student workload - preparation for the exam	30/1
Total hours:	**180**
Number of ECTS credits allocated for a course	**6**

Description:
* – student workload, types of activities need to be provided, e.g. preparation for the course, interpretation of results, preparation of a course report, preparation for the examination, getting familiar with the literature, preparation of a project, presentation, written work, report, etc.
** – other e.g. additional course hours

5. Summary indicators:
   - number of course hours and ECTS credits at the course with a direct participation of academic teachers or other persons teaching the course and students: 60/2
   - number of course hours and ECTS credits at the course related to the scientific activity conducted at the Silesian University of Technology in a discipline or in disciplines to which a field of study is assigned- in the case of studies with a general academic profile: 0
   - number of course hours and ECTS credits at the course shaping practical skills- in the case of practical studies: 0
   - number of course hours conducted by academic teachers employed by the Silesian University of Technology as their primary workplace: 60
6. Persons conducting particular types of courses (name, surname, academic degree or degree in arts, title of professor, business e-mail address):

   Anna Strzelewicz, dr inż., Anna.Strzelewicz@polsl.pl

7. Detailed description of teaching modes:

   1) lectures:

      - detailed programme contents:

        Ordinary differential Equations (ODEs): General Introduction: Nature and origin of differential equations. Examples from physics, chemistry and biology. General remarks on solution. Type and order. Well posedness. First order ODEs: Homogeneous equations of first order. Exact equations. Integrating factors. Linear equations. Method of variation of parameters for solving linear first order ODE. Power series solutions of nonlinear ODEs of first order. Picard's Method. Bernoulli's equations. Clairaut equations. Second order ODEs: Equations reducible to first order equations. The general solution of the homogeneous equation – Wronskian and linear independency. The linear homogeneous ODEs of second order with constant coefficients. The nonhomogeneous linear ODE with constant coefficients. Method of variation of parameters. The linear ODE with functional coefficients. Laplace and Fourier transform methods.

        Multiple integrals: Double integrals. Areas, moments and centres of mass. Double integrals in polar form. Triple integrals in rectangular coordinates. Masses and moments in three dimensions. Triple integrals in cylindrical and spherical coordinates. Substitutions in multiple integrals.

        Integration in Vector Fields: Vector and scalar fields. Line integrals. Line integrals of vector fields. Vector fields, work, circulation, and flux. Path independence, potential functions, and conservative fields. Green's theorem in the plane. Surface area and surface integrals. Parametrized surfaces. Oriented surfaces. Gradient, Divergence, and Curl. Stokes' theorem and Gauss's Law. Divergence theorem and a unified theory.

        Partial Differential Equations: The usual three operators and classes of equations: The potential operator,. the diffusion operator and the wave operator. The usual three types of problems: Boundary value problems, initial value problems and eigenvalue problems. The usual three questions: Existence, uniqueness and stability.

        The usual three types of „boundary conditions": Dirichlet boundary condition. Neumann boundary condition. Robin boundary condition. The usual three solution methods: Separation of variables. Green's function method. Variational methods. The Fourier transform. The Laplace transform.

        Elements of Probability Theory and Statistics: Combinatorial analysis. Permutations. Combinations. Probability theory. Probability of random events. Random variables and distribution. Mean value or expectation and variance. Chebyshev's inequality. The law of large numbers. Some important distributions. Limit theorems for sums of independent random variables. Statistics. Design of experiments. Regression and correlation

      - teaching methods, including distant learning:

        Lecture in the form of a tutorial on the board, additional materials uploaded to the Education Platform. Selected issues are also discussed during the lecture.

      - form and criteria for successful semester completion, including retakes, as well as the conditions for admission to the examination:

        The whole semester is divided into several thematic blocks. The partial examination takes place at the end of each thematic block.

        Student pass the partial exams if he gain at least 51%. It is possible to improve the exam twice during the examination period in January and February.

      - course organisation and rules of participation in the course, with an indication whether a student 's attendance is obligatory

        According to study regulations.

   2) Classes:

      - detailed programme contents: the same as for lectures,
      - teaching methods, including distant learning: Students solve computational examples illustrating the issues presented in the lecture. The materials concerning the classes are uploaded on the Education Platform.

- form and criteria for successful semester completion, including retakes, as well as the conditions for admission to the examination: Passing the exercises is based on the activity during the classes (for which you can get a maximum of 5%) and partial written test from each thematic block (in order to pass a given thematic block the sum of assessments from activity and test must be at least 51%). Partial written test takes place after the end of each thematic block. Improvement of the written test is possible twice and takes place in the exam session in January and February
- course organisation and rules of participation in the course, with an indication whether a student 's attendance is obligatory

  The student must actively participate in the classes. According to study regulations attendance is obligatory.

8. Description of the method to determine the final grade (rules and criteria for evaluation, as well as a calculation method for the evaluation in the case of a course which includes more than one teaching mode, including all teaching modes and all examination and credit dates including retake examinations):

   The final grade is the arithmetic mean of the grades obtained for all the thematic blocks from the lectures and classes.

9. Method and procedure for filling up arrears resulting from:

   - student's absence from the course: during office hours

   - differences in study programmes for persons changing a field of study, changing university or resuming studies at the Silesian University of Technology: during office hours

10. Prerequisites and additional requirements, taking into account the course sequence:

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11. Recommended sources and teaching aids:

    a. Bronshtein, I.N.; Semendyayev, K.A.; Musiol, G.; Muehling, H. Handbook of Mathematics, Springer - Verlag

    b. Ross L.Finney, Maurice D.Weir, Frank R.Giordano „Thomas' CALCULUS", Addison Wesley

    c. G.Doggett, B.T.Sutcliffe, "Mathematics for Chemistry", Longman .

    d. S.L.Salas, E.Hille, "Calculus – one and several variables", John Wiley

    e. K. Kuratowski, Introduction to calculus - https://archive.org/details/introductiontoca033502mbp/page/n5

    f. Khan Academy – https://www.khanacademy.org/math

12. Description of teacher's competences (e.g. publications, professional experience, certificates, trainings etc. related to the programme contents implemented as part of the course):

    Methodological and didactic competences confirmed by education in chemical sciences and Bachelor's degree from the Faculty of Mathematics and Physics of the Silesian University of Technology, as well as many years of experience in teaching mathematics. Social and IT competences confirmed by certificates of participation in training courses and workshops conducted by the University College of Social Sciences and Foreign Languages and the Centre for Remote Education within the project of the Silesian University of Technology as a Centre for Modern Education based on research and innovation and participation in the course Innovative Teacher Education of the Silesian University of Technology conducted by the University College of Social Sciences and Foreign Languages. In the years 2013 - 2015 participation in the series of workshops within the project "Mathematics Applications Centre" carried out at the Faculty of Applied Physics and Mathematics of Gdańsk University of Technology. Participation in the Conference on Applications of Mathematics in Technology, Informatics and Economics organized by the Department of Computational and Industrial Mathematics of the Institute of Mathematics of the Faculty of Applied Mathematics of the Silesian University of Technology.

13. Other information:
    none