Opole University of Technology
Faculty of Mechanical Engineering

Course Description Card

Field of study	Mechanical Engineering
Profile of Education	General Academic
Level of study	First Cycle Studies
Specialization	
Form of Study	Full-Time Studies
Semester	Third

Course Title	Differential and integral calculus	Basic Science (Y/N)	N
Nazwa przedmiotu	Rachunek różniczkowy i całkowy		

ECTS points						Mode of complete the course	Course code
Total	3	Cont.	1.5	Pract.	0	Course credit	A.1.3

USOS Course code	DAIC(3)

Preliminary requirements of the course	Name of course		Mathematics I, Linear Algebra with Analytic Geometry
	Knowledge	1	Some experience with mathematical language and proofs, mathematical logic, theory of sets.
		2	Fundamental knowledge of differential calculus of single variable real functions.
		3	Fundamental knowledge of integral calculus of single variable real functions.
	Skills	1	The ability to abstractional thinking.
		2	The ability to construct proofs of simple theorems.
		3	The ability to formulate problems in the mathematical language.
		4	English (min B1 level)
	Social Competence	1	The ability to co-work in a group.
		2	Understanding of need for self-education.
		3	Student's responsibility for his own work.

Course Goals Providing the background for more advanced mathematical and technical courses.

Course Programme

The course format	Hours/sem. (h)		Lecturer (title/academic degree, surname and name)
	Workload	Contact	
Lecture	30	15	dr inż. Ścięgosz Hanna
Calculation class	30	15	dr inż. Ścięgosz Hanna
Laboratory class			
Project			
Seminar			

Course Content

Lecture	Execution method	Lecture in audytorium.

Item	Content of Course	Hours
1	Applications of the definite integral, the length of a curve, the lateral area and the volume of surfaces of revolution.	2
2	Definition of the improper integral, tests for convergence.	1
3	Basic properties of n-dimensional Euclidean space.	1
4	The partial derivatives, the gradient, the total differential, the directional derivative, a tangent plane and a normal line.	1
5	Applications of the total differential for an approximation and an estimation of errors.	1
6	Higher order partial derivatives and differentials, the Hessian matrix.	1
7	Differential calculus for vector valued functions, Jacobian matrix, the differential operator del, definitions of the divergence, the curl and the Laplace operator.	1
8	Extrema of multivariable functions and their applications. Examples of optimization issues.	2

9	Definitions of the ordinary differential equation and IVP , theorems of existence and uniqueness of the solution of ODE.	1
10	The first order ordinary differential equations - equations with separable variables and linear equations.	2
11	The n-th order linear differential equations with constant coefficients - homogeneous and nonhomogeneous.	2

Student's own study (h)	15	Contact hours per semester	15

Calculation class	Execution method	Group tutorial.

Item	Content of Course	Hours
1	The definite integral - a repetition of calculation methods.	1
2	Solving geometric problems using definite integrals. Calculation of the length of a curve, the lateral area and the volume of surfaces of revolution.	2
3	Finding domains and drawing contours, level curves and traces of graphs of functions of two variables, characteristics of sets in the 2D space. Visualization using Desmos and GeoGebra graphic software.	2
4	Exercises in calculation of partial derivatives and their application to the determination of the tangent plane and the normal line.	2
5	Finding the extremes of the functions of two and three variables. Solving optimization problems. Visualization of successive approximations using GeoGebra software.	2
6	Solving the first-order ordinary differential equations.	2
7	Solving the n-th order linear differential equations with constant coefficients - homogeneous and nonhomogeneous using the method of undeterminated coefficients and the method of variation of constants.	2
8	Written test.	2

Student's own study (h)	15	Contact hours per semester	15

Learning outcomes for the course - after completing the training cycle			The reference to the learning outcomes	Form of course (LE, C, LA, P, S)	Methods of verification of learning outcomes
Knowledge	1	A student has knowledge with regard to applications of integral calculus of functions of single variable.	ME_K1_W01	W C	C E G P
	2	A student has knowledge with regard to differential calculus of multivariable functions.	ME_K1_W01	W C	C E G P
	3	A student knows the methods of solving of fundamental ordinary differential equations.	ME_K1_W01	W C	C E G P
	4	A student knows English terminology used in mathematics.	ME_K1_W15	W C	A C E J
Skills	1	A student is able to apply integral calculus of functions of single variable to solve certain geometrical and physical issues.	ME_K1_U05	W C	C E G P
	2	A student is able to apply differential calculus of multivariable functions to solve certain optimization issues.	ME_K1_U05	W C	C E G P
	3	A student is able to solve simple differential equations and apply them to describe dynamic systems.	ME_K1_U05	W C	C E G P
	4	A student is able to describe the above problems in English.	ME_K1_U03	W C	A C E J
Social Competence	1	A student understands need of continuous improvement in the range of applying of modern mathematics methods used in technology.	ME_K1_K01	W	P R
	2	A student more effectively cooperates and works in a group of co-workers.	ME_K1_K04	C	I P

Methods of verification of learning outcomes:

A-written exam, B-oral exam, C-written assessment, D-oral assessment, E-based on partial marks of oral answers, F-based on partial marks of written answers, G-term paper, H-assessment from reports, I-assessment from realization of exercises, J-assessment from preparations for exercises, K-assessment from the project implementation, L-assessment of the written implementation of the project, M-assessment of defense of project, N-assessment of form of presentation, O-assessment of content of presentation, P-observation of students' activity, R-observation of the regularity.

Teaching methods:

Auditory lectures and group tutorials with using geometric software Desmos and GeoGebra.

Form of assessment:

Written tests and an exam.

Basic references:

1. B. Sikora, E. Łobos, A First Course in Calculus, Wydawnictwo Politechniki Śląskiej, 2007.
2. B. Sikora, E. Łobos, Advanced Calculus, Wydawnictwo Politechniki Śląskiej, 2009.
3. E. Zakon, Mathematical Analysis I, The Trillia Group, 2004;
4. B. S. Schroder, Mathematical Analysis: A Concise Introduction, JohnWiley&Sons,2008.

Additional references:

1. N. Piskunov, Differential and Integral Calculus, CBS Publishers & Distributors, 1996.
2. E. Mahmudov, Single Variable Differential and Integral Calculus, Springer, Berlin 2012.
3. K. Azad, Calculus. Better Explaned, Ingram International 2015.
4. R.A. Adams, Calculus. A Complete Course, Pearson Edition (US), 2006.

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