M009	Obligatory semester 3	**Multivariable Calculus**	L	S	E	ECTS
			3	0	2	7

Course objectives. Introduce students to multivariable calculus of real and vector functions. Basic notions and their properties, illustrated with examples, will be taught in lectures, while in exercises students will learn appropriate techniques for solving particular problems.

Course prerequisites. Differential Calculus, Integral Calculus, Linear Algebra I.

Syllabus.

1. Real multivariable functions. Space $\mathbf{R}^n$. Level curves and level surfaces. Limit and continuity.
2. Partial derivatives and differentiability of multivariable functions, gradient. Geometric interpretation: equation of tangential plane and normal on surface. Partial derivatives of higher order. Partial derivatives of implicit functions and compound functions. Directional derivative.
3. Vector functions. Differentiability of vector multivariable function, Jacobi matrix. Differentials of higher order. Rotation and divergence of vector field. Potential and solenoidal fields.
4. Applications of differential calculus of multivariable functions: mean value theorems, extremes and conditional extremes.
5. Multiple integrals. Double integral on rectangle: notion, properties, Fubini theorem. Double integral on general domains: definition, computation. Change of variables theorem, polar coordinates. Applications of double integral. Triple integral: computation, cylindrical and spherical coordinates, applications.
6. Line integral of the first and the second kind: definition, properties, computation, applications. Green theorem.
7. Surface integral of the first and the second kind: definition, properties, computation, applications. Divergence theorem. Stokes theorem.

LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	Identify and explain fundamental concepts of multivariable calculus of real and vector functions, such as continuity of function, limit, partial derivative and differential of function, as well as multiple, linear, and surface integrals.
2.	Compute partial derivatives of compound functions, implicit functions and the function defined by parametric equations.
3.	Use differential calculus for computing tangential plane and normal on surface and in optimization problems of (local) extremes of multivariable functions.
4.	Calculate areas and volumes using double and triple integrals.
5.	Compute curve and surface integrals, and use them to calculate lengths, areas and volumes.

6.	Connect concepts of calculus through fundamental theorems, such as implicit function theorem, mean value theorems, change of variable theorem, Fubini, Green, Stokes and divergence theorem.

CONNECTING LEARNING OUTCOMES, ORGANIZATION OF TEACHING PROCESS AND ASSESSMENT OF STUDENT LEARNING OUTCOMES

TEACHING PROCESS ORGANIZATION	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	SCORE	
					min	max
Lecture attendance	1	1-6	Attending lectures, discussions, teamwork and individual work on tasks	Participant lists, monitoring activities on class	0	4
Mid-term exam (preliminary exam)	3	1-6	Prepairing for written exam	Checking the correctness of solutions	25	48
Final exam	3	1-6	Revision of subject matter	Oral exam	25	48
Total	7				50	100

Teaching methods and student assessment. Lectures and exercises are mandatory. The exam consists of a written and an oral part and it can be taken after the completion of lectures and exercises. Acceptable mid-term exam scores replace the written examination.

Can the course be taught in English: Yes.

Basic literature:

1. J. Stewart, Calculus, 7th Edition, McMaster University and University of Toronto, Brooks/Cole, Cengage Learning, Belmont, 2008.
2. S. Kurepa, Matematička analiza 3: Funkcije više varijabli, Tehnička knjiga, Zagreb, 1984.

Recommended literature:

1. Š. Ungar, Matematička analiza u Rn, Golden marketing - Tehnička knjiga, Zagreb, 2005.
2. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986.
3. P. Javor, Matematička analiza 2, Element, Zagreb, 2000.
4. S. Lang, Calculus of Several Variables, Springer, New York, 1987.
5. M. Lovrić, Vector Calculus, Addison-Wesley Publ.\ Ltd., Don Mills, Ontario, 1997.