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| 1. Course title: Analysis 2 lecture | | | | | |
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| 2. Code: | | 3. Type (lecture, practice etc.): lecture | | | |
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| 4. Contact hours: 3 hoursper week | | 5. Number of credits (ECTS): 3 | | | |
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| 6. Preliminary conditions (max. 3): Analysis 1 lecture+ seminar | | | | | |
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| 7. Announced:fall semester, spring semester, both | | | | | |
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| 8. Limit for participants: 40 | | | | | |
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| 10. Responsible teacher (faculty, institute and department):  Margit Pap PhD (Faculty of Science, Institute of Mathematics and Informatics, Department of Mathematics) | | | | | |
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| 11. Teacher(s) and percentage: | | Dr. Margit Pap | | 100 % | |
| Dr. Tímea Eisner | | 100 % | |
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| 12. Language:English | | | | | |
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| 13. Course objectives and/or learning outcomes:  **Objectives**: The lecture intends to introduce students to the basic notions of Mathematical Analysis 2: concepts of **function limits, differentiability, continuity**. The course helps the development of problem solving skills.  Learning outcomes: students completing the course will have *knowledge* on basic concepts and theorems of Mathematical Analysis. They will be *able* to apply the properties of these concepts. They will have a *competence* of evaluating readings in Analysis 2. Their positive *attitude* towards methods calculating limits will increase significantly. | | | | | |
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| 14. Course outline   1. Notion of open sets, integer function, analytic function, examples. Representing functions by power series. Definition of some elementary functions applying power functions (exp, sin cos, sinh, cosh) Properties of elementary functions. Cauchy formulas. Condensation points of real sets. 2. Closed sets. Closure of sets. **Limits of functions.** Uniqueness of limits. Limits at finite points, limits at infinity. Finite and infinite limits. One-sided limits. Connection with the limits of sequences. Operations and limits. 3. Theorem on monotonicity of limits. Monotone functions. Limits of monotone functions. Highlighted limits: limits of polynomials, rational functions, analytic functions. 4. **Continuity**. Continuity of monotone and convex functions. Operations and continuity. Some continuous function classes (power functions, polynomials, rational functions. The continuity of sum of power series: exp, sin, cos, sinh, cosh) Definition and classification of discontinuities. Definition of singularity. 5. Continuity on closed intervals. Definition of compact sets. Theorem on the continuity on compact sets. Properties of continuous functions: Theorem of Weierstrass, theorem on the uniformly continuity. 6. Continuity of inverse functions. Theorem of Bolzano and a corollary. Proof of . Properties of the function. Its connection with power function. 7. Powers with real exponents. Exponential and logarithmic functions. Power functions with real exponents. Notion of inner point. **Differentiability.** Definition and basic properties. Geometric meaning of derivatives. Differentiability and continuity. One-sided derivatives. Derivatives of constant functions, that of power functions with positive integer exponent. 8. Linearization formula. Rules of differentiation. (Sum, product, quotient, composition) Derivative of power function, derivative of sum of power series. Consequences: derivative of exp, sin, cos, sinh, cosh. Derivative of inverse functions. Corollaries: derivatives of logarithmic functions, derivative of power functions with real exponent. Logarithmic differentiation, derivative of functions of form.  1. Local monotonicity, extremes. Connection of local monotonicity and the derivative. Mean value theorems of differential calculus (Rolle, Lagrange, Cauchy). Connection of monotonicity on intervals and derivatives. Theorem of Darboux. 2. The function cosine has a unique zero on (0,2). The. The notion of periodic functions. Period of functions sine, cosine. The functions tangent, cotangent. Properties. Inverse trigonometric functions: definitions, properties and their derivatives. 3. **Applications of differentiability.** l’Hospital rule. Higher derivatives. Leibniz rule. Higher derivatives of a power series. Taylor polynomials, Taylor formula. 4. Maximum and minimum values of functions. The first and higher order derivative test for extrema. Convexity and concavity. The second and higher order derivative test for convexity and concavity. Inflection points. Sufficient criteria of the existence of inflection points.   Local extremes. Sufficient criteria of the existence of extremes. Finding extremes - examples. Asymptotes: definition and classification. Differentiable functions. Complete investigation of a function (identify the domain, the intersections of the functions with both the *x*-axis and *y*-axis, classify the critical points and determine the intervals of increase/decrease, find the inflection points and determine the intervals of convexity/concavity, evaluate the limits at those congestion points of the domain which are not domain points, sketch the graph of the function.) | | | | | |
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| 15. Mid-semester works  Attending lectures is compulsory. | | | | | |
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| 16. Course requirements and grading  Written exam is based on lectures, accessible electronic sources and lecture materials.  There is a written preliminary exam. Preliminary exam grades:  0–55% fail  56–70% acceptable  71–80% average  81–90% good  91–100% excellent  After successful preliminary exam there is an oral exam in 3 topics. The final grade is obtained from the arithmetic mean of the 4 grades, but only in case when all parts hit the acceptable measure. | | | | | |
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| 17. List of readings  Rudin, Walter. Principles of mathematical analysis. Vol. 3. New York: McGraw-Hill, 1964.  Stewart, James. Calculus: early transcendentals. Cengage Learning, 2015.  Stroyan, K. D. "A brief introduction to infinitesimal calculus." University of Iowa (2004).  Lang, Serge. Undergraduate analysis. Springer Science & Business Media, 2013. | | | | | |
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| 18. Recommended texts, further readings  Joel R. Hass, Christopher D. Heil, Maurice D. Weir. Thomas' Calculus, 14th Edition. | | | | | |
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| **Date** | 14 May, 2017 | **Prepared by** |  | | |
| **Dr. Margit PAP** responsible teacher | | |
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| **Endorsed by** | | |  | | |
| Dr. László TÓTH program supervisor | | |