YMX0221 Higher Mathematics I
Autumn semester of the academic year 2017/18.

Course code: YMX0221
Course title: Higher Mathematics I
ECTS credits: 6.00
Assessment form: Examination
Language: English
Teaching semester: autumn
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Course aims: To learn main concepts related to calculus of functions of single variable and linear algebra; to acquire skills to solve related problems and to use software.

Learning outcomes in the course: Student having passed the course

- knows most important functions, their classification and graphs;

- knows main concepts related to limits and continuity;

- knows derivative and differential and is able to solve related problems;

- is able to use derivative to solve extremum problems;

- knows the concepts of indefinite and definite integrals and is able to compute simpler integrals;

- is able to solve simpler differential equations;

- knows main concepts related to vector and matrix algebra;

- has a knowledge about eigenvalues and eigenfunctions;

- is able to solve linear systems;

- knows main concepts related to complex numbers;

- is able to use software of mathematics, incl. software of vector and matrix algebra.

Description of the course

1. Function and representation of the functions; classification of the functions; inverse and composite function

2. Limit of sequence and function. Infinitesimals and limit theorems.

3. The limits $\lim\limits_{x \to 0} \dfrac{\sin x}{x}$ and $\lim\limits_{x \to \infty} \left(1 + \dfrac{1}{x}\right)^x$

4. Continuity of function. Necessary and sufficient condition for continuity. Properties of continuous function on closed interval.

5. Derivative of function, geometrical and physical concept to the derivative. Derivatives of some basic elementary functions

6. Rules of differentiation. Derivative of inverse function and composite function

7. Differential of function

8. Derivatives of higher order

9. Mean value theorems.L'Hospital's rule

10. Increase and decrease and local extrema of function

11. Convexity and concavity of function. Inflection points

12. Antiderivative and indefinite integral. Properties of indefinite integral

13. Integration by change of variable and by parts

14. Definite integral. Properties of definite integral. Evaluation of definite integral. Newton-Leibnitz formula

15. Change of variable in definite integral. Integration by parts

16. Determination of area in Cartesian coordinates. Polar coordinates. Areas enclosed by polar curves

17. Differential equations.

18. The systems of linear equations, solving these systems by elimination methods.

19. Matrices and matrix arithmetics (linear operations, multiplication, transposition), properties of matrix operations.

20. The definition and properties of determinants.

21. The inverse of a matrix, when it exists and how to find it.

22. The matrix form of a linear system, its solution.

23. Finding eigenvalues and eigenvectors.

24. Complex numbers, the definition and different forms for their representation. Operations on complex numbers: adding, subtracting, multiplying, dividing, finding exponents and roots.

Autumn semester lasts 16 weeks, followed by 3 weeks of examination session. There will be 1 academic hour lectures and 3 academic hours exercises per week. In lectures will be given theoretical material an in exercises the theory will be applied to solve problems. The semester ends with an oral examination during the examination session.

To get the credits one has to pass the examination.

Prerequisites for the examination: the student has to pass two tests on exercises. The first test takes place on 8th week and contains exercises about differential and integral calculus of functions on one variable. The second test takes place on 16th week and contains exercises about differential equations, linear algebra and complex numbers. Maximal number of points for each test is 100. To pass the test, one has to get at least 51 points. There will be two additional home tests. Students solve these without supervising using software. In the first test students have to find indefinite and evaluate definite integrals. In the second test students have to solve exercises about matrix and vector algebra. Maximal amount of points for each home test is 10.

Concepts and relations are asked on the exam. Examination consists of two parts: first - differential and integral calculus of functions of one variable. Second - differential equations, linear algebra and complex numbers. For each part a student can get at most 50 points.

An alternative possibility to pass examination is to do it by two theory tests during the semester.

The final grade of the course is computed by the sum of the points of tests and the exam or theory tests. The maximal amount of points for the subject is $100 + 100 + 10 + 10 + 50 + 50 = 320$.

Example. A student has got for the first exercises test 73 points, for second exercises test 55 points. This student has got for the first home test 10 points and he/she has not done the second home test. For the first theory test the student has got 26 points. In the examination this student writes the second theory test and gets for this 20 points.

Total amount of point for the semester is in our case 73+55+10+0+26+20=184.

The students will be graded according to the following scale.

289 ... 320 points "5" excellent

257 ... 288 points "4" very good

225 ... 256 points "3" good
193 ... 224 points "2" satisfactory
161 ... 192 points "1" poor
... 160 points "0" failed
Thus, the student in our example will be graded by "1" poor.
To get the final grade the student has to attend the examination.