Mathematics I, Plan of tutorials (preliminary) in academic year 2021/22

1) First information on the course. Survey of selected important topics from elementary mathematics. Simpler equations and inequalities. Power function, linear function, quadratic function, n–th root, exponential and logarithmic functions, trigonometric functions, domains, graphs.

2) Vectors in $\mathbb{E}_2$ and in $\mathbb{E}_3$, their geometrical interpretation. Linearly dependent and independent vectors. Dimension and basis of a vector space. Operations with matrices. Problems: 2, 8, 15, 22, 25, 42–45, 51, 53, 68, 69, 70, 79, 109, 112, 117, 124, 132, 139.

3) Rank of a matrix. Inverse matrix. Determinants. Problems with parameters. Problems: 143, 148, 149, 160, 161, 166, 168, 171, 174, 176, 177, 180, 185, 190, 200.

4) Systems of linear algebraic equations (homogeneous, inhomogeneous). Problems with parameters. Frobenius' theorem. Cramer's rule. Geometrical interpretation (relative positions of planes and straight lines). Problems: 273, 275, 278, 280, 288, 295, 324, 328, 332, 338, 348, 359, 360.

5) Eigenvalues and eigenvectors of square matrices. Problems: 236, 237, 241, 243, 245.

6) Sequences of real numbers and their limits. Elementary functions (domains, continuity, graphs, etc.) Odd, even functions. Inverse trigonometric functions. Limit of a function. Limit of a composite function. Problems: 575, 577–581, 591, 594, 596, 609, 612, 619–623, 629, 674, 675, 687, 694, 698, 718, 767, 791, 792, 796, 797, 807, 816, 839, 863–865, 902, 909, 929, 931, 932, 937, 939, 943.

7) Derivative of a function. Geometrical and physical interpretation. Equation of a tangent line and a normal line to the graph of a function. Derivative of a composite function (the chain rule). L'Hospital's rule. Problems: 837, 840, 859, 866, 869, 882, 891, 904, 960, 968, 972, 976, 979, 980, 990, 991, 993, 999, 1001, 1003, 1008, 1109, 1110, 1118, 1119, 1017-1020, 1027, 1028, 1062, 1066, 1071.

8) Intervals of monotonicity and local extremes of a function. Global extremes. Problems: 1144–1146, 1151, 1156, 1160, 1209, 1211, 1164, 1169, 1174, 1175, 1177, 1179, 1204, 1211, 1241.

9) Intervals of concavity of a function. Points of inflection. Asymptotes. Behaviour of a function. Problems: 1255, 1256, 1260, 1262, 1264, 1267, 1270, 1274, 1275, 1277, 1278, 1279, 1282, 1292, 1293, 1295, 1308, 1319, 1321.

10) Approximation of functions by Taylor's polynomials. Indefinite integrals – application of the table of basic indefinite integrals, integration by parts. Problems: 1330, 1331, 1333, 1337, 1346, 1351, 1352, 1354, 1362, 1376, 1450, 1452, 1454, 1455, 1459, 1461, 1467, 1473, 1481–1486, 1494, 1504, 1506, 1510.

11) Indefinite integrals: integration by substitution, integration of rational functions. Problems: 1514–1519, 1532–1534, 1542, 1546, 1555, 1572, 1520, 1628, 1720, 1724, 1731, 1733, 1734, 1748, 1749, 1751, 1754, 1755.

12) Integration of functions of the type $\sin^m x \cdot \cos^n x$ and irrational functions of the type $R(x, \sqrt[n]{(ax + b)/(cx + d)})$. Riemann's integral and its evaluation. Newton–Leibniz formula. Integration by parts in Riemann's integral. Problems: 1815, 1823, 1828, 1832, 1892, 1896, 1898, 1985, 1986, 1989, 1991–1993, 1996, 2000, 2002.

13) Integration by substitution in Riemann's integral. Application of Riemann's integral: area of a surface, volume of a circular body, length of a curve. Improper Riemann's integral. Problems: 2010–2012, 2015, 2–17, 2020, 2024, 2030–2032, 2036, 2038–2040, 2044, 2050, 2051, 2054, 2056–2058, 2060, 2063, 2067–2070, 2074, 2075, 2077 + further problems 1–15.

Tutorials, assessments: Tutorials are obligatory. Assessment from tutorials (written in the study record) confirms student's presence and activity at the tutorials and elaboration of homework and tests. Assessment is a necessary condition for the exam. (I.e. student can make the exam only with the assessment written in the study record.)

The assessments are written in the last semestral week, not later than one week after. Exceptions are possible only with the explicit agreement of the chair of the institute.

Basic literature:

1. [1] J.Neustupa: **Mathematics I.** Czech Technical University, Praha 2004.

2. [2] J.Neustupa, S.Kračmar: **Problems in Mathematics I.** Czech Technical University, Praha 1999.

3. [3] **Selected problems from textbook [2].** pdf file

4. [4] **Mathematics I** - some problems from exam tests in the previous years. pdf file