Mathematics EP2 (BMETE90AX34)

Lecturer: Dr. Peter Moson (www.math.bme.hu, +3614632690, +36309329626)

Detailed summary of the lectures:

Lecture 1. (February 7, 2018).
Complex numbers (definition, addition, multiplication – algebraic, polar, exponential forms). Solution of equations $z^4-1=0$, $z^4-2z^2+1=0$.
Ordinary differential equations of the first order (repetition) and of the second order.
Linear ordinary differential equations of the second order with constant coefficients. General solution of the homogeneous equation.
Examples: gravity / $my''=mg$, harmonic oscillator / $y''+y=0$.
Homework. Find the general solution for the following differential equations $y''+2y'+2y=0$, $y''-y'=0$, $y''-2y'+y=0$.

Lecture 2. (February 14, 2018).
Linear ordinary differential equations of the second order with constant coefficients. Theorem of structure. General solution of the nonhomogeneous equation. Solution of initial value problems. and the solution of the initial value problem.
Examples: gravity / $y''=g$, harmonic oscillator / $y''+y=e^{-x}+\sin 2x+\cos x$.
Homework. Find the general solution of the following differential equations $y''+y'-2y=1+2\sin x\cos x+2\cosh x-2x^2$,. $y''+y'=1$, $y(0)=1$, $y'(0)=0$.

Lecture 3. (February 21, 2018).
2nd order ODEs reducible to ordinary differential equations of the first order (linear, separable). Example: $y''-y'=1$, $y(0)=0$, $y'(0)=0$ (by 2 method: reducible, linear with constant coefficients). Checking the solution. Graph of the solution.
2 dimensional linear systems with constant coefficients. Matrices. Eigenvalues, eigenvectors. General solution.
Homework. Solve the equation $y''=\frac{y'}{x}+x\sin x$.

Lecture 4. (February 28, 2018).
2 dimensional linear systems with constant coefficients. General solution, phase portraits (in case of real eigenvalues – saddle, node, complex eigenvalues – focus, center).
Example: $\dot{x}=-2x+ay,\ \dot{y}=x-2y,\quad a=1,9\quad a=-1.$
Homework. Find the general solution, sketch the phase portrait of the system of differential equations $\dot{x}=-3x+2y,\ \dot{y}=ax-3y,\quad a=-2,2,8$.

Lecture 5. (March 7, 2018).
Solution of Test 1 (2017-03-08).

Lecture 6. (March 14, 2018. 8:15. K. building 255.).
Test 1.

Lecture 7. (March 21, 2018.). *Limited number of students because of Architecture Week.*
Results of Test 1.

Lecture 8. (March 28, 2018).
Functions of 2 real variables. Graph, level curves, partial, directional derivatives. Tangent plane.
Homework: Thomas. Chapter 14, §1, Exercises 7, 9. Chapter 14, §3, Exercises 7, 9, 43. Chapter 14, §6, Exercises 9, 11.

Lecture 9. (April 11, 2018).
Local, global extrema of functions of 2 real variables.
Examples for local extremum $f(x,y)=x^2+y^2$, x^2-y^2, $x^3-6xy+y^3$.
Examples for global extremum (on compact sets). $f(x,y) = x^2 + y^2 - 2x$ on $x^2 + y^2 \le 4$.
Investigation on the boundary by its parametrization.
Homework: Thomas. Chapter 14, §7, Exercise 25, 31, 41.

Lecture 10. (April 18, 2018).
Double integral (Cartesian coordinates). Examples: (i)Volume of a pyramid calculated by 2 methods (elementary, integration). f(x,y)= 1-x-y, D: 0<x<1, 0<y<1-x. (ii) (by 2 methods): $\iint_D 2xydxdy$, $D = \{(x,y) \mid 0 \le x \le 1, x^2 \le y \le x\}$.
Substitution in double integrals. Polar coordinates. Example: $\iint_D (x^2 + y^2)dxdy$, $D = \{(x,y), x^2 + y^2 \le 1\}$
Homework. Thomas. 15.1. 1, 5, 21, 31. 15. 3. 1, 7.

Lecture 11. (April 25, 2018).
Application of double integrals (volume, mass, center of gravity, moment of inertia).
Conditional extremum.
Example for global extremum (on compact sets). $f(x,y) = x^2 + y^2 - 2x$ on $0 \le x \le 2$, $x-2 \le y \le -x+2$.

Lecture 12. (May 2, 2018).
Sample Test 2.

Lecture 13. (May 9, 2018).
Test 2.

Lecture 13. (May 16, 2018).
Retake (Test 1, Test 2).

Last retake (for extra fee) ***May 22, 2018.***

(2 hours/2 credits)

Literature:

Thomas' Calculus by Thomas, G.B. et al. Several editions, e.g. Addison-Wesley, 2005. (ISBN0321185587)

Grading system:
There will be 2 mid-term tests. The mark will be calculated: 2*50% from the tests. The planned dates of the midterm tests: March 14, May 9, 2018.
For the *signature* the minimal score of the midterm tests is 15-15%. Make Up Test1 or Test2 May 16, 2018. The last possibility to obtain the mark will be in the week right after the semester (for extra fee): May 22, 2018.
Final marks (sum of midterm tests): 0-39 fail (1), 40-54 pass (2), 55-69 satisfactory (3), 70-84 good (4), 85- (excellent (5).

Good Luck, Have a Nice Semester!