Department of Engineering Science and Mathematics, LTU

M0031M Linjär algebra och differentialekvationer

(Linear Algebra and Differential Equations)–Period 1, 2014

Contact teacher: Norbert Euler, Examiner: Lech Maligranda

35 Lectures

Literature:

1) D. C. Lay, Linear Algebra and its Applications, 4th Edition 2003

2) A. Dunkels at all, Derivator, integraler och sånt, Studentlitteratur 2000

3) N. Euler, *Elementary Ordinary Differential Equations*, Online Access will be provided.

4) A. Gilat, MATLAB: an Introduction with Applications, 4th Edition. 2008

А.	Complex	Numbers	(Dunkels))
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L1.	Definition of complex number and calculation rules (algebraic properties,	9.1-2
	conjugate number, modulus=absolute value, triangle inequality)	
L2.	Polar form of complex numbers and de Moivre formula	9.3-4
L3.	Algebraic equations (quadratic equations, polynomials and algebraic equations)	9.5-6
L4.	Equation $z^n = w$ and function e^z	9.7-8
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L5. Reserve

B. Linear Algebra (Lay)

L6.	Vector spaces and subspaces	4.1
L7.	Null spaces, column spaces, and linear transformations	4.2
L8.	Linearly independent sets. Bases	4.3
L9.	Coordinate system	4.4
L10.	The dimension of a vector space. Rank	4.5-6
L11.	Change of basis	4.7
L12.	Eigenvectors and eigenvalues. The characteristic equation	5.1-2
L13.	Diagonalization, eigenvectors and linear transformations	5.3-4
L14.	Inner product, length. Orthogonality and orthogonal sets	6.1-2
L15.	Orthogonal projections. The Gram-Schmidt process	6.3-4
L16.	Least-squares problems	6.5-6
L17.	Inner product spaces	6.7
L18.	Diagonalization of symmetric matrices	7.1
L19.	Reserve	

- L20. Reserve
- L20. Reserve

C. Differential Equations (Dunkels et al and Euler)

L22.	Introduction to differential equations	10.1-5 (Dunkels et al)
L23.	Solutions of linear equations and the Wronskian	1.1 - 1.3 (Euler)
L24.	IVP, BVP and separable 1-st order differential equations	2.1 - 2.2 (Euler)
L25.	Linear 1-st order differential equations	2.3 (Euler)
L26.	Linearizable 1-st order differential equations	2.4 (Euler)
L27.	Linear homogeneous 2-nd order differential equations	3.1 - 3.2 (Euler)
L28.	Nonhomogeneous equations: undetermined coefficients	3.3.1 (Euler)
L29.	Nonhomogeneous 2-nd order: undetermined coefficients	3.3.1 (Euler)
L30.	Nonhomogeneous 2-nd order: variation of parameters	3.3.3 (Euler)
L31.	The 2-nd order Cauchy-Euler equation	3.4 (Euler)
L32.	Linear equations: nonconstant coefficients	3.5 (Euler)
L33.	Higher-order equations: homogeneous	4.1-4.2 (Euler)
L34.	Higher-order nonhomogeneous: undetermined coefficients	4.3.1 (Euler)
L35.	Repetition	

M0031M – Exercises

Complex Numbers (Dunkels et al)

- **9.11.1:** 9.1acg, 9.2b, 9.3a, 9.4, 9.6, 9.7, 9.9, 9.11, 9.13 (9.1bd, 9.2a, 9.3b, 9.4c, 9.8, 9.12)
- **9.11.2:** 9.16abe, 9.17, 9.18, 9.20, 9.21 (9.16cf, 9.22)
- **9.11.3:** 9.25a, 9.29, 9.30acef (9.25b, 9.26, 9.30dg)
- **9.11.4:** 9.32ac, 9.33, 9.34, 9.35, 9.36, 9.37, 9.39acd, 9.41, 9.44ac, 9.45ab, 9.46, 9.50 (9.32b, 9.38, 9.39b, 9.42, 9.44b, 9.45c, 9.47, 9.48)

Linear Algebra (Lay)

- **4.1:** 1, 3, 5, 9, 12, 15, 21 (7, 10, 13, 18, 22)
- **4.2:** 1, 3, 5, 7, 9, 15, 17, 19, 21, 23, 25, 28, 31, 33 (2, 4, 8, 11, 16, 18, 22, 24, 32)
- **4.3:** 1, 3, 5, 9, 11, 13, 15, 19, 26, 31, 33 (7, 16, 23, 25, 32, 34)
- **4.4:** 1, 3, 5, 9, 10, 11, 13, 17, 21, 27, 32 (4, 7, 12, 14, 22, 31)
- **4.5:** 1, 3, 7, 11, 13, 15, 21, 23, 27 (5, 9, 16, 19, 22, 25)
- **4.6:** 1, 4, 5, 7, 8, 9, 25, 28, 29, 32 (3, 6, 11, 13, 17, 21, 27)
- **4.7:** 1, 3, 5, 7, 13 (2, 6, 8, 11, 14)
- **5.1:** 1, 3, 5, 7, 10, 13, 17, 19, 25, 26, 31 (4, 8, 14, 21, 23, 32)
- **5.2:** 1, 9, 15, 18, 20, 23, 24 (3, 11, 17, 21)
- **5.3:** 1, 3, 5, 7, 13, 19, 23, 31 (4, 9, 11, 17, 24, 25, 32)
- **5.4:** 1, 3, 5, 7, 9, 11, 15, 17, 20, 25, 29 (2, 4, 6, 10, 13, 21, 27)
- **6.1:** 1, 3, 5, 7, 11, 13, 16, 17, 22, 24, 25, 28, 31 (12, 14, 15, 23, 27, 29)
- **6.2:** 1, 5, 7, 9, 11, 13, 15, 17, 21, 26-30 (3, 10, 12, 14, 16, 20, 32)
- **6.3:** 1, 3, 7, 9, 11, 13, 15, 17, 19, 24 (2, 5, 10, 12, 14, 18)
- $6.4: \qquad 3, 4, 6, 11, 22 (2, 9, 16, 17)$

6.5:	3, 5, 9, 13,	15, 19, 20, 25	(4, 6, 11, 14, 16, 24)

6.6: 1, 3

6.7: 1, 3, 5, 9, 12, 14, 18, 21, 23, 25 (2, 4, 6, 13, 17, 22, 24, 26)

7.1: 1-6, 8, 13, 17, 19, 21, 23, 28, 30 (11, 22, 24)

Differential Equations (Euler)

- 1 a, b, c, d, h, i, j; 2; 3 a, c, f, h; 4; 5 a, c, f 1.1.1: 1.2.1: 1; 2; 3; 4 a, c, e; 5 2.2.1: 1 a, b, c, f, h, i; 2 a, c, e; 3; 4 2.3.1: 1 a, c, d, g; 2 a, c; 3 2.4.4: 1; 2 a, c, e; 3; 4; 5; 6; 7; 8 3.2.1: 1 a, c, d, e, f; 2 a, b, c, e; 3; 4 3.3.2: 1 a, c, e, f, h, j, k, m, p, r; 2 a, c, f, h; 3 a, c, f, h; 4 3.3.4: 1 a, b, c, d, e, g; 2; 3; 4; 5; 7 a, c; 8 a, c 3.4.1: 1 a, c, d, e, g; 2; 3; 4; 5 3.5.1: 1 a, b, d, f; 2; 3; 5 4.2.1: 1 a, b, d, f, h; 2 a, c, f, h; 3 a, d, f; 4; 5
- **4.3.2:** 1 a, d, e, h, l, o; 2 a, d, e; 3; 4

MATLAB Exercises

Important Note:

Hand-in deadline for your MATLAB results: 17 October 2014!

Exercises from Gilat, Edition 3:

1.10:	1, 2, 4, 5, 6, 16
2.11:	1, 4, 14
3.9:	7, 9, 18
6.13:	3

or Exercises from Gilat, Edition 4:

1.10:	1, 2, 4, 5, 6, 20
2.11:	1, 7, 29
3.9:	11, 15, 32
7.13:	2

NOTE: For the Matlab exercises from Gilat, Edition 5, please see the next page!

Exercises from Gilat, Edition 5:

1.10:1, 2, 4, 5, 6, 202.11:1, 7, 333.9:11, 15, 337.13:1