Mathematics 4: Differential Equations (AESB2110)

The transport of materials through porous media, the propagation of waves, radioactive decay and many, many more physical processes, when described mathematically, boil down to one or more differential equations (DE's, for short). In the standard book by Boyce & DiPrima several types of 'standard' equations, and also systems of equations are considered, for which 'receipts' to come to the solutions exist. In addition, especially for systems of DE's, global properties are analyzed. An important question: is/are solution(s) bounded? (In a physical context: is a model stable?) In chapter 8 some principles of numerical solutions are described, i.e. approximations to the exact solution. This important subject – most differential equations 'from reality' cannot be solved exactly/explicitly – will be part of a next step in your mathematics education: Numerical Mathematics.

The course also comprises a second part of linear algebra, determinants and eigenvalues/vectors, which subjects are applied directly in the solution of systems of linear DE's.

In the classroom
There are four sessions per week, Mo 3/4, Tu 3/4, Th 3/4, Th 5/6.
Three of these are used for lectures, the first session on Thursday will be used for exercises, and will be given by Marleen Keijzer.
On the next pages you find a week-to-week schedule for the first eight weeks. If necessary I will use one or two of the lectures scheduled for week 9.

BOOKS

Boyce & DiPrima: *Elementary Differential Equations and Boundary Value Problems*, 9th/10th edition, international student version, J. Wiley and Sons, 2010/2013

David Lay: *Linear Algebra and its Applications*, 4th ed., Pearson 2012

Week 1 - Basic Differential Equations + Laplace Transform

Mo	B&D 2.1/2.2(/2.3)/3.1	Exercises:	2.1	13, 15
			2.2	2, 3, 6
			3.1	2, 7, 15
Tu	B&D 3.3 – 3.6	Exercises:	3.3	7, 11, 17
			3.4	1, 9, 11
			3.5	1, 3, 7, 13
			3.6	1, 7, 11
Th	B&dP. 6.1, 6.2	Exercises:	6.2	1, 3, 9, 11, 13, 15, 21, 23

Week 2 - Laplace Transform + Linear Algebra

Mo	B&dP. 6.3, 6.4	Exercises:	6.3	5, 7, 8, 11, 13, 14, 17, 21
			6.4	1, 10, 11
Tu	B&dP. 6.5,6.6	Exercises:	6.5	1, 3, 7, 15
			6.6	5, 7, 9, 13
Th	Lay 3.1	Exercises:	3.1	1, 3, 9, 13, 19, 21, 23, 37
	(+ recap)			

Week 3 - Some more Linear Algebra

Mo	Lay 3.2/3.3	Exercises:	3.2	3, 9, 11, 17, 19, 21, 25, 29
			3.3	1, 5, 7
Tu	Lay 5.1/5.2	Exercises:	5.1	1, 3, 5, 7, 11, 15, 17, 19, 20, 21, 27, 31
			5.2	1, 5, 9, 11, 15
Th	Lay 5.2/5.3	Exercises:	5.2	18, 19, 21, 23, 27
			5.3	1, 5, 7, 15, 21, 25, 27, 29, 31

Week 4 - Some last Linear Algebra + Systems of Linear Diff. Eqns

Mo	Lay 5.5	Exercises:	5.5	1, 5, 7, 11, 13, 21, 23 – 25
	B&dP. 7.1		7.1	2, 3, 4
Tu	B&dP. 7.4/7.5	Exercises:	7.4	2
			7.5	1, 3, 5, 8, 15, 16, 24, 25
Th	B&dP. 7.6/7.8	Exercises:	7.6	1 – 6, 9, 10
			7.8	1 – 6, 12, 14

Week 5 - Systems of Differential Equations

Mo	B&dP. 7.7	Exercises:	7.7	1, 3, 4, 6, 11, 12
	7.9	Exercises:	7.9	1 – 6
Tu	B&dP. 9.1	Exercises:	9.1	1 – 6
Th	B&dP. 9.2	Exercises:	9.2	3, 4

Week 6 - Systems of ODEs; start Partial Diff. Eq's

Mo	B&dP. 9.3	Exercises:	9.3	1−6,9,13,17,18
Tu	B&dP. 9.4	Exercises:	9.4	2−5
	9.5	Exercises:	9.5	1,3,5,13
Th	first order PDE's			

Week 7 - Partial Differential Equations; Fourier Series

Mo	B&dP. 10.2	Exercises:	10.2	1−6,13−18
	10.3	Exercises:	10.3	1−
Tu	B&dP. 10.4	Exercises:	10.4	1−6,15,16
	10.1		10.1	1−6,14−16
Th	B&dP. 10.5	Exercises:	10.5	3, 7−12
	10.6	Exercises:	10.6	1,3,4

Week 8 - Heat, Wave & Laplace Equation

Mo	B&dP. 10.7	Exercises:	10.7	1−8,10
Tu	B&dP. 10.8	Exercises:	10.8	1,2,3,8
Th	catchin' up	or old exam		