Syllabus for SM212P
Differential Equations
Spring Semester 2010-2011

text: *Differential Equations with Boundary-Value Problems* , 7th ed., by Dennis G. Zill and Michael R. Cullen

	SECTION I - Intro to ODEs (1st Order)	
1	1.1 Introduction to ODEs	p10: 1,2,13,19,27,29
2	1.2 Initial value problems; 2.2 Separable DEs	p17: 13,17,25,26; p50: 7,17,23,25
3	2.1 Qualitative: direction fields	p41: 1, 3, 19, 20, 33
4	2.3 1st Order Linear DEs	p60: 3,5,10,23,27,28
5	2.6 Numerical: Euler's method	p79: 1, 4 [h = 0.1 only]; 5 [use excel, compare to exact solution]
6	3.1 Modeling with 1st order linear equations (mixing, cooling)	p90: 13, 19, 23, 25
7	Review	
	SECTION II - Linearity and Second Order ODEs	
8	4.1 Higher order linear DE s: Existence and uniqueness	p128: 3,5,7,9,10
9	4.1 Higher order linear DE s: Linear independence	p128: 15,18,23,25
10	4.3 Linear homogeneous constant coefficients DE's: real roots	p138: 3, 6, 15, 24, 32, 35, 49
11	4.3 Linear homogeneous constant coefficients DE's: complex roots	p138: 9, 11, 23, 29, 43-48
12	5.1.1 Undamped mass-spring systems	p194: 1,2,3,5
13	5.1.1 Undamped mass-spring systems	p194: 9,11
14	5.1.2 Damped mass-spring systems	p194: 17,19,21,23,25,35
15	Review	
16	Test 1	
17	4.1, 4.4 Non-homogeneous DE (theory, undetermined coefficients)	p129: 31, 35; p148: 3, 6,29,31
18	4.4 Non-homogeneous DE (multiplication rule)	p148: 12,15,30,33
19	5.1.3 Mass-spring systems with external force	p194: 31, 35, 37, 38
20	5.1.4 Series electrical circuits	p194: 45, 49, 57, 58
21	Review	
	SECTION III - The Laplace Transform	
22	7.1 Laplace transform	p261: 2, 7, 10, 11, 20, 23, 27, 29
23	7.2.1 Inverse Laplace transform	p269: 1, 5, 10, 11, 15, 25
24	7.2.2 Solving DE's using Laplace transform	p269: 31, 34, 35, 38
25	7.3.1 First translation theorem	p278: 3, 14, 15, 21, 23, 29
26	7.3.2 Unit step functions	p278: 37, 39, 43, 48, 61, 82(b,c)
27	7.3.2. Unit step functions in a DE	p278: 63, 66, 69
28	Review	
29	7.5 Dirac delta function	p295: 3, 5, 10
30	Handout: Convolution	*all*
31	Review	
32	Test 2	

SECTION IV - Matrices and 1st Order Systems		
33	3.3 Modeling with systems (mixing, radioactive series)	p110: 1, 5, 8
34	3.3, 9.4 Euler's method for systems and higher order DEs	p357: 1, 2; p111: 10 (*Use Euler: h=0.2*)
35	Appendix II.1 Matrices	pApp-18: 1, 4, 11, 13, 15, 25
36	Appendix II.2 Solving linear systems by row reduction	pApp-18: 31, 33, 39
37	Appendix II.2 Matrix inverse by row reduction	pApp-18: 41, 42, 43
38	Appendix II.3 Eigenvalues	pApp-18: 47, 49, 55
39	Review	
40	8.1 Systems of differential equations	p310: 3, 7, 11, 14, 17, 25
41	8.2.1 Systems of DE with distinct real eigenvalues	p324: 1, 5, 13, 17♪, 49(a)♪
42	Handout: The Lanchester Equations	*all*
43	8.2.3 Systems of DE with complex eigenvalues	p324: 36, 37, 38, 47♪
44	8.1, 8.3.2 Nonhomogeneous systems and variation of parameters	p310: 21, 26; p332: 11, 15, 31
45	3.3, 7.6 Electrical networks	p110: 12; p299: 15, 17
46	Review	
47	Test 3	
SECTION V - PDEs and Fourier Synthesis		
48	12.1 Intro to PDEs (Separation of Variables)	p436: 1, 3, 6, 11
49	11.1 Orthogonal Functions	p402: 1, 2, 5, 9, 11, 18
50	11.2 Fourier Series	p407: 1, 3, 9
51	11.2 Convergence of Fourier Series	p407: 5♫, 11♫, 17
52	11.3 Sine and Cosine Series	p414: 1, 2, 3, 13, 14, 25♫, 34♫
53	12.3 Heat Equation (Dirichlet)	p445: 1 (*Use L=2*), 2 (*Use L=1*)
54	12.3 Heat Equation (Neumann)	p445: 3, 4
55	Review	
56	Review	
57	Test 4	
58	Review	
59	Review	

Footnotes:

♪ For these problems, Prof. John Polking has a nice application (pplane) for drawing phase portraits:
http://math.rice.edu/~dfield/dfpp.html

♫ For these problems, also graph (carefully, over several periods) the function to which each series converges.

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