

King Fahd University of Petroleum and Minerals
Department of Mathematical Sciences

SYLLABUS
Summer 2006(053)
(Dr. M. Sarhan)

Course #: MATH 202
Title: Elements of Differential Equations
Textbook: A First Course in Differential Equations by **D.G. Zill, 7th Edition**

| Week | Date | Sec. | Topics | Homework | (CAS) |
|------|-----------------|---------------|--|--|-----------|
| 1 | June 24-28 | 1.1 | Definition and Terminology | 4, 7, 10, 13, 16, 19, 24, 25(b), 26(a) | (49) |
| | | 1.2 | Initial-Value Problems | 2, 8, 12, 16, 18, 23 | -- |
| | | 2.1 | Solution Curves (<i>light coverage</i>) | 1, 17, 20 | (5,7) |
| | | 2.2 | Separable Variables | 8, 14, 20, 22, 23, 27, 45 | (ex 4) |
| 2 | July 01-05 | 2.3 | Linear Equations | 5, 13, 16, 18, 30, 36 | (5,9) |
| | | 2.4 | Exact Equations | 2, 5, 8, 15, 25, 27, 29, 31, 42(a), 43, 44 | -- |
| | | 2.5 | Solutions by Substitutions | 4, 6, 10, 13, 18, 21, 26, 30 | -- |
| | | 1.3 | Mathematical Models (<i>reading</i>): Growth and Decay, Newton's Law of Cooling and Mixtures | See Sec. # 3.1 | |
| | | 3.1 | Modeling with Linear Equations | 3, 8, 13, 14, 15, 19, 20 | -- |
| 3 | July 008-12 | 4.1 | Preliminary Theory: Linear Equations | | |
| | | 4.1.1 | Initial-Value and Boundary-Value Problems | 3, 10, 12, 13 | -- |
| | | 4.1.2 | Homogeneous Equations | 15, 21, 23, 28 | -- |
| | | 4.1.3 | Nonhomogeneous Equations | 33, 36, 37(b,e) | -- |
| | | 4.2 | Reduction of Order | 2, 3, 12, 14, 19 | -- |
| 4 | July 15-19 | 4.3 | Homogeneous Linear Equations with Constant Coefficients | 4, 9, 12, 15, 20, 34, 40, 51, 52 | (59) |
| | | 4.5 | Undetermined Coefficients – Annihilator Approach | 8, 13, 22, 24, 34, 41, 48, 64, 73 | -- |
| | | 4.6 | Variation of Parameters | 6, 11, 13, 24, 28 | -- |
| | | 4.7 | Cauchy-Euler Equation (<i>Both Methods</i>) | 4, 5, 10, 11, 14, 16, 19, 29, 32, 35, 37 | (42) |
| 5 | July 22-26 | 6.1 | Solutions About Ordinary Points | | |
| | | 6.1.1 | Review of Power Series | 1, 9 | -- |
| | | 6.1.2 | Power Series Solutions | 13, 16, 18, 28 | -- |
| | | 6.2 | Solutions about Singular Points [©] | 3, 10, 13, 14, 19, 20, 27 | (ex 5) |
| 6 | July29-August02 | <i>App II</i> | Matrices and Linear Systems (<i>review</i>) | 14, 15, 19, 23, 27, 29, 31, 33, 39, 43 | -- |
| | | | The Eigenvalue Problem | 47, 49, 52, 53, 55 | -- |
| | | 8.1 | Preliminary Theory | 4, 5, 8, 13, 15, 17, 23, 25 | -- |
| | | 8.2 | Homogeneous Linear Systems with Constant Coefficients | | |
| 7 | August 05-09 | 8.2.1 | Distinct Real Eigenvalues | 3, 7, 13 | (ex 2) |
| | | 8.2.2 | Repeated Eigenvalues | 19, 21, 23, 25, 27 | -- |
| | | 8.2.3 | Complex Eigenvalues | 33, 34, 36, 39, 41 | -- |
| | | 8.3 | Variation of Parameters | 1, 2, 13, 22 | (29(a,b)) |
| | | 8.4 | Matrix Exponential | 1, 5, 9, 2, 6, 4, 8 | (27(a)) |
| 8 | August 12-14 | -- | Pace Adjustment Review | | |

- For remarks about Homework Problems and CAS Assignments, see the following page.

[©] Some statements about Bessel's equation and Legendre's equation should be included in the final remarks about Series Solutions. See the introductory paragraph of Section 6.3 in page 292.

The Syllabus (Cont'd): Remarks

Homework:

- The selected homework problems indicate the levels of the breadth and the depth of coverage. To acquire proficiency on solution methods, the students are strongly urged to solve much more problems than indicated in the syllabus.
- In Sec. 8.4, problems 1, 5 and 9 refer to the same matrix. The same is true for problems 2 and 6 and problems 4 and 8. The matrix e^{At} is to be computed by the definition given in (3). The material on *Laplace Transform* in page 401 is, of course, *omitted*.

Computer Algebra Systems (CAS) [Mathematica, Matlab, Maple, ...]:

- CAS assignments are at the discretion of the instructor.
- The entire assignments may be divided into *two* parts and collected *twice* as “projects”.
- The selected assignments are *simple*. In general, nothing is required beyond typing the **commands** given in the textbook and then, for *Mathematica*, pressing **SHIFT**---**ENTER**. The students are urged to try various types of problems.
- For assignments no. 49 in Sec. 1.1 and no. 27(a) in Sec. 8.4, the following commands can be used in *Mathematica*:

(1.1) – 49:

```
Clear[y]  
y[x_]:=x Exp[5 x] Cos[2 x]  
y[x]  
Simplify [y''''[x] - ... .. 841 y[x]]
```

(8.4) – 27(a):

```
A={{4,2},{3,3}};  
c={c1,c2};  
m=MatrixExp[A t];  
sol=Expand[m.c]  
Collect[sol,{c1,c2}]/MatrixForm
```

Attendance:

- Attendance is compulsory. KFUPM policy with respect to attendance will be strictly enforced.

*****Best Wishes for a Pleasant Summer*****

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| Week | Date | Sec. | Topics | Homework | (CAS) |
|------|-------------------|---------------|--|--|------------------|
| 1 | June 24-28 | 1.1 | Definition and Terminology | 4, 7, 8, 9, 10, 13, 16, 20, 27, 28, 30 | (55) |
| | | 1.2 | Initial-Value Problems | 2, 12, 20, 22, 27 | -- |
| | | 2.1 | Solution Curves (<i>light coverage</i>) | 1, 21, 24 | (5,7) |
| | | 2.2 | Separable Variables | 8, 14, 20, 22, 23, 27, 45 | (ex 4) |
| 2 | July 01-05 | 2.3 | Linear Equations | 5, 13, 16, 18, 30, 37 | (5,9) |
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| | | 2.5 | Solutions by Substitutions | 4, 6, 10, 13, 18, 21, 26, 30 | -- |
| | | 1.3 | Mathematical Models (<i>reading</i>): Growth and Decay, Newton's Law of Cooling and Mixtures | See Sec. # 3.1 | |
| | | 3.1 | Linear Models | 3, 6, 13, 14, 15, 19, 20, 21, 23 | -- |
| 3 | July 08-12 | 4.1 | Linear Equations: Basic Theory | | |
| | | 4.1.1 | Initial-Value and Boundary-Value Problems | 3, 10, 12, 13 | -- |
| | | 4.1.2 | Homogeneous Equations | 15, 21, 23, 28 | -- |
| | | 4.1.3 | Nonhomogeneous Equations | 33, 36, 37(b,e) | -- |
| | | 4.2 | Reduction of Order | 1, 3, 12, 14, 19 | -- |
| 4 | July 15-19 | 4.3 | Homogeneous Linear Equations with Constant Coefficients | 4, 9, 12, 15, 20, 34, 40, 49, 50, 51 | (57) |
| | | 4.5 | Undetermined Coefficients – Annihilator Approach | 8, 13, 22, 24, 34, 41, 48, 64, 67, 73 | -- |
| | | 4.6 | Variation of Parameters | 6, 11, 13, 24, 25, 28 | -- |
| | | 4.7 | Cauchy-Euler Equation (<i>Both Methods</i>) | 3, 5, 10, 11, 14, 16, 19, 31, 34, 37, 39 | (44) |
| 5 | July 22-26 | 6.1 | Solutions About Ordinary Points | | |
| | | 6.1.1 | Review of Power Series | 1, 10, 11 | -- |
| | | 6.1.2 | Power Series Solutions | 15, 17, 20, 22, 32 | -- |
| | | 6.2 | Solutions about Singular Points [©] | 3, 10, 13, 14, 19, 20, 27 | (ex 5) |
| 6 | July 29-August 02 | <i>App II</i> | Matrices and Linear Systems (<i>review</i>) | 14, 15, 19, 23, 27, 29, 31, 33, 39, 43 | -- |
| | | | The Eigenvalue Problem | 47, 49, 52, 53, 55 | -- |
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| | | 8.2 | Homogeneous Linear Systems | | |
| 7 | August 05-09 | 8.2.1 | Distinct Real Eigenvalues | 3, 7, 10, 13 | (ex 2) |
| | | 8.2.2 | Repeated Eigenvalues | 19, 21, 23, 25, 27 | -- |
| | | 8.2.3 | Complex Eigenvalues | 33, 34, 36, 39, 41, 45 | -- |
| | | 8.3 | Nonhomogeneous Linear Systems | | |
| | | 8.3.2 | Variation of Parameters | 11, 12, 23, 32 | (35) |
| | | 8.4 | Matrix Exponential | 1, 5, 9, 2, 6, 4, 8 | (a,b) (27(a)) |
| 8 | August 12-14 | -- | Pace Adjustment Review | | |

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The Syllabus (Cont'd): Remarks

Homework:

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- For assignments no. 55 in Sec. 1.1 and no. 27(a) in Sec. 8.4, the following commands can be used in *Mathematica*:

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y[x]
Simplify [y''''[x] - ... .. 841 y[x]]
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(8.4) – 27(a):

```
A={{4,2},{3,3}};
c={c1,c2};
m=MatrixExp[A t];
sol=Expand[m.c]
Collect[sol,{c1,c2}]/MatrixForm
```

Review Material: In the introduction of each section in the textbook, *review material*, if any, is indicated. The **student** must do all reviews. He should make a plan, based on the Syllabus, for all the reviews required for the course.

Attendance:

- Attendance is compulsory. KFUPM policy with respect to attendance will be strictly enforced.

*****Best Wishes for a Pleasant Summer*****