

King Fahd University of Petroleum and Minerals  
Department of Mathematics and Statistics

**SYLLABUS**

Semester II: 2007-2008 (072)

**(Dr. Mohammad Samman)**

**Course #:** MATH 202 (Sec. 4 & 5)  
**Title:** Elements of Differential Equations  
**Textbook:** A First Course in Differential Equations by D.G. Zill, 8<sup>th</sup> Edition  
**Lecturer Info:** Office: **5-409** P hone: **2674** E-mail: [msamman@kfupm.edu.sa](mailto:msamman@kfupm.edu.sa)  
 Web Site: <http://faculty.kfupm.edu.sa/math/msamman>  
 Office hours: 11: 10 – 12: 10 SMW (Or by appointment)

| Week  | Date         | Sec.          | Topics   | Homework   | (CAS)             |
|---|--------------|---------------|--|--|-------------------|
| 1   | Feb 16-20    | 1.1           | Definition and Terminology   | 4, 7, 8, 9, 10, 13, 16, 20, 27, 28, 30                       | <b>(55)</b>       |
|   |              | 1.2           | Initial-Value Problems   | 2, 12, 20, 22, 27  | --                |
| 2   | Feb 23-27    | 2.1           | Solution Curves ( <i>light coverage</i> )  | 1, 21, 24  | <b>(5,7)</b>      |
|   |              | 2.2           | Separable Variables  | 8, 14, 20, 22, 23, 27, 45                                    | <b>(ex 4)</b>     |
| 3   | Mar 01-05    | 2.3           | Linear Equations   | 5, 13, 16, 18, 30, 37  | <b>(5,9)</b>      |
|   |              | 2.4           | Exact Equations  | 2, 5, 8, 15, 25, 27, 29, 31, 42(a), 43, 4                    | --                |
| 4   | Mar 08-12    | 2.5           | Solutions by Substitutions   | 4, 6, 10, 13, 18, 21, 26, 30                                 | --                |
|   |              | 1.3           | Mathematical Models ( <i>reading</i> ):<br>Growth and Decay, Newton's Law and of<br>Cooling Mixtures | <i>See Sec. # 3.1</i>  | --                |
|   |              | 3.1           | Linear Models  | 3, 6, 13, 14, 15, 19, 20, 21, 23                             | --                |
| 5   | Mar 15-19    | 4.1           | Linear Equations: Basic Theory   |  |                   |
|   |              | 4.1.1         | Initial-Value and Boundary-Value<br>Problems   | 3, 10, 12, 13<br>15, 21, 23, 28                              | --<br>--          |
|   |              | 4.1.2         | Homogeneous Equations  |  |                   |
| 6   | Mar 22-26    | 4.1.3         | Nonhomogeneous Equations   | 33, 36, 37(b,e)  | --                |
|   |              | 4.2           | Reduction of Order   | 1, 3, 12, 14, 19   | --                |
| 7   | Mar 29-Apr02 | 4.3           | Homogeneous Linear Equations with<br>Constant Coefficients   | 4, 9, 12, 15, 20, 34, 40, 49, 50, 51                         | <b>(57)</b>       |
|   |              | 4.5           | Undetermined Coefficients –<br>Annihilator Approach  | 8, 13, 22, 24, 34, 41, 48, 64, 67, 73                        | --                |
| 8   | Apr 05-09    | 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                     | <b>(44)</b>       |
| <b>Midterm Vacation: Sat-Wed, April 12-16, 2008</b> |              |               |  |  |                   |
| 9   | Apr 19-23    | 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   | --                |
| 10  | Apr 26-30    | 6.2           | Solutions about Singular Points <sup>©</sup>   | 3, 10, 13, 14, 19, 20, 27                                    | <b>(ex 5)</b>     |
| 11  | May 03-07    | <i>App II</i> | Matrices and Linear Systems<br>( <i>review</i> ) The Eigenvalue Problem                              | 14, 15, 19, 23, 27, 29, 31, 33, 39, 43<br>47, 49, 52, 53, 55 | --<br>--          |
|   |              | 8.1           | Preliminary Theory   | 4, 5, 8, 14, 15, 17, 23, 25                                  | --                |
| 12  | May10- 14    | 8.2           | Homogeneous Linear Systems   |  |                   |
|   |              | 8.2.1         | Distinct Real Eigenvalues  | 3, 7, 10, 13   | <b>(ex 2)</b>     |
|   |              | 8.2.2         | Repeated Eigenvalues   | 19, 21, 23, 25, 27   | --                |
| 13  | May 17-21    | 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   | <b>(35 (a,b))</b> |
| 14  | May 24-28    | 8.4           | Matrix Exponential   | 1, 5, 9, 2, 6, 4, 8  | <b>(27(a))</b>    |
|   |              | --            | Pace Adjustment<br>Review  | Last day of classes: Wednesday, June 4, 2008.                |                   |

<sup>©</sup> 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 259.

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

- 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** and then, for *Mathematica*, pressing **SHIFT**---**ENTER**. The students are urged to try various types of problems.
- For assignments no. 55 in Sec. 1.1 and no. 27(a) in Sec. 8.4, the following commands can be used in *Mathematica*:

**(1.1) – 55:**

```
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
```

- Remember that “**The best way to learn Mathematics is to do Mathematics.**” **Working as a group is ok. However, each student needs to write his own solution.**

**Homework:**

- Homework assignments will be collected every Monday. Late homework will not be accepted.
- There will be pop quizzes from the homework exercises.
- 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 362 is, of course, *omitted*.

**Exams:**

- Exam I: Tuesday, March 18, 2008.
- Exam II: Tuesday, April 29, 2008.
- Final Exam will be announced by the registrar later.

**Attendance:**

- Attendance is compulsory. KFUPM policy with respect to attendance will be strictly enforced.
- $\frac{1}{2}$  point will be deducted for each absence.

**Evaluation policy:**

|                            |   |
|----------------------------|---|
| Homework                   | 5% submitting + 10% pop quizzes out of the HW |
| Matlab                     | 5%  |
| Attendance                 | 4%  |
| Exam I                     | 20%   |
| Exam II                    | 20%   |
| Final Exam (Comprehensive) | 36%   |