

**King Fahd University of Petroleum and Minerals**

**Department of Mathematics & Statistics**

**Math 202 Syllabus, Term 191**

**Coordinator: Muhammad Yousuf**

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**The Course Code and Name:** Math 202, Elements of Differential Equations

**The Course Credit Hours:** 3-0-3

**Textbook:** A First Course in Differential Equations by D.G. Zill, 10th Edition

**The Course Content:** First-order and first-degree differential equations. Linear Models. Homogeneous differential equations with constant coefficients. Undetermined Coefficients: annihilator approach, reduction of order, variation of parameters, and Cauchy-Euler equation. Series solutions. Systems of linear first-order differential equations

**The Course Prerequisite:** MATH 102

**The Course Learning Outcomes:** Upon completion of the course, students should be able to:

1. Recognize basic definitions and terminology associated with differential equations and their solutions.
2. Describe the region in which a first-order initial-value problem has a unique solution.
3. Identify and solve first-order differential equations of various types.
4. Solve some real-life problems using linear models.
5. Recognize the basic theory of linear differential equations.
6. Apply the method of Reduction of Order to homogeneous linear second-order differential equations.
7. Find the general solution of homogeneous linear  $n$ th-order differential equations with real constant coefficients.
8. Use the method of Undetermined Coefficients to find a particular solution of a nonhomogeneous  $n$ th-order differential equation with real constant coefficients.
9. Use the method of Variation of Parameters to find a particular solution of a second-order linear nonhomogeneous differential equation.
10. Solve a Cauchy-Euler Equation.
11. Find Power Series and Series solutions of linear second-order differential equations about ordinary and regular singular points, respectively.
12. Solve systems of linear homogeneous and nonhomogeneous differential equations using eigenvalues and eigenvectors.
13. Solve systems of linear homogeneous and nonhomogeneous differential equations using Matrix Exponentials.

### The Course Grading Policy:

|                            | Date   | Time             | Place    | Materials     | Percentage    |
|----------------------------|--|------------------|----------|---------------|---------------|
| <b>Exam I(Written)</b>     | October 03, 2019   | 06:00 – 08:00 pm | Build 57 | 1.1 – 4.1.1   | 25% (100 pts) |
| <b>Exam II(Written)</b>    | November 07, 2019  | 05:30 – 07:30 pm | Build 54 | 4.1.2 – 4.7   | 25% (100 pts) |
| <b>Final Exam(Written)</b> | December 19, 2019  | 07:00 – 10:00 pm | TBA      | Comprehensive | 35% (140 pts) |
| <b>Class Work</b>          | <ul style="list-style-type: none"><li>▪ It is based on quizzes, class tests, or other class activities determined by the instructor.</li><li>▪ Any quiz or test should be of a written type and not of a multiple-choice type.</li><li>▪ The average x (out of 60) of the class work of all sections taught by the same instructor should be in the interval [42, 45]. ([70%, 75%] of the class work grade).</li></ul> |                  |          |               | 15% (60 pts)  |

**The Course Passing Grade:** A student must score at least 50% (200/400) to pass the course.

**Upgrade Policy:** The upgrade policy is applied when 4 points out of 400 are needed to get the next higher grade. For instance, the passing grade (D) starts at 200/400. If a student gets 198/400 or 199/400, then his grade will be automatically upgrade to D. However, if a student gets 197/400 or 196/400, his grade will be upgraded to D only if his final exam score is greater than or equal 200/400 (70/140).

### Exams:

**Exam Questions:** The questions of the exams are based on the examples, homework problems, and exercises in the textbook.

**Cheating in Exams:** Cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of **F** in the course along with reporting the incident to the higher university administration. Cheating in exams includes (but is not limited to)

- Looking at the papers of other students
- Talking to other students
- Using mobiles or any other electronic devices

### **Missing an Exam:**

**Exam I or II:** No make-up exam will be given under any circumstances. In case a student misses Exam I or Exam II for a legitimate reason (such as medical emergencies), his grade for this exam will be determined based on the existing formula which depends of his performance in the non-missed exam and in the final exam.

**Final Exam:** If a student misses the final exam for a legitimate reason (such as medical emergencies), he will be given a make-up final exam.

**Attendance:** Students are expected to attend all lecture and recitation classes.

- If a student misses a class, he is responsible for any announcement made in that class.
- A DN grade will be awarded to any student who accumulates
  - 9 unexcused absences in lecture and recitation classes.
  - 15 excused and unexcused absences in lecture and recitation classes.

(Note: the general rule for DN: 20% unexcused absences of the number of classes, and 33% excused and unexcused absences of the number of classes.)

**The Usage of Mobiles in Class:** Students are not allowed to use mobiles for any purpose during class time. Students who want to use electronic devices to take notes must take permission from their instructor. Violations of these rules will result in a penalty decided by your instructor.

**Academic Integrity:** All KFUPM policies regarding ethics apply to this course. See the Undergraduate Bulletin.

### The Weekly Schedule

| W  | Date         | Sec.  | Topics  | homework  |
|--|--------------|-------|---|---|
| 1  | Sep 1-5      | 1.1   | Definitions and Terminology                             | 2, 5, 10, 13, 14, 18, 20, 23, 29, 32, 36, 38 10 <sup>th</sup> |
|  |              |       |   | 2, 5, 10, 13, 14, 18, 20, 23, 33, 36, 40, 41 11 <sup>th</sup> |
|  |              | 1.2   | Initial Value Problems                                  | 2, 5, 13, 19, 22, 24, 26, 30                                  |
| 2  | Sep 8-12     | 2.2   | Separable Variables                                     | 6, 10, 12, 21, 24, 26, 30, 32, 48                             |
|  |              | 2.3   | Linear Equations  | 4, 12, 15, 18, 20, 22, 28, 30, 36                             |
| 3  | Sep 15-19    | 2.4   | Exact Equations   | 4, 5, 8, 12, 15, 20, 24, 28, 30, 33, 34, 42, 43               |
|  |              | 2.5   | Solutions by Substitutions                              | 2, 6, 8, 10, 12, 16, 22, 25, 28, 29                           |
| Monday, September 23, 2019: National Day Holiday   |              |       |   |   |
| 4  | Sep 22-26    | 2.5   | Continue  |   |
|  |              | 3.1   | Linear Models: Growth & Decay, Newton's Law of Cooling  | 4, 6, 7, 15, 17, 20   |
| <b>Exam I: Thursday October 3, Time: 06:00-08:00 pm, Place: Bldg:57, Material: [1.1 – 4.1.1]</b> |              |       |   |   |
| 5  | Sep 29-Oct 3 | 4.1.1 | Initial and Boundary Value Problems                     | 2, 4, 6, 10, 12, 13 (c), 14(d)                                |
|  |              | 4.1.2 | Homogeneous Equations                                   | 16, 22, 24, 25, 28, 30  |
| 6  | Oct 6-10     | 4.1.3 | Nonhomogeneous Equations                                | 31, 34, 36 (a, b, c)  |
|  |              | 4.2   | Reduction of Order                                      | 4, 6, 10, 13, 16, 18, 19                                      |
| 7  | Oct 13-17    | 4.3   | Homogeneous Linear Equations with Constant Coefficients | 5, 8, 12, 14, 18, 22, 28, 32, 36, 42, 49, 50                  |
|  |              | 4.5   | Undetermined Coefficients: Annihilator Approach         | 2, 8, 14, 20, 23, 25, 28, 32, 34, 44, 48, 50, 61, 64, 68, 71  |

|  |           |                 |   |  |
|--|-----------|-----------------|---|--|
| 8  | Oct 20-24 | 4.5             | Continuation                              |  |
|  |           | 4.6             | Variation of Parameters                   | 2, 4, 6, 11, 12, 18, 22, 24, 26, 27, 28 10 <sup>th</sup> |
|  |           |                 |   | 2, 4, 6, 11, 12, 18, 22, 28, 30, 31, 32 11 <sup>th</sup> |
| 9  | Oct 27-31 | 4.7             | Cauchy-Euler Equation (Both Methods)      | 1, 8, 9, 11, 16, 18, 22, 29, 32, 36, 38, 40              |
|  |           | 6.1             | Review of Power Series                    | 2, 3, 4, 8, 10, 12, 16, 24, 29                           |
| <b>Exam II: Thursday, November 07, 2019, Time: 05:30-07:30 pm, Place: Bldg:54, Material: [4.1.2 – 4.7]</b> |           |                 |   |  |
| 10   | Nov 3-7   | 6.2             | Solutions about Ordinary Points           | 2, 4, 11, 12, 16, 20, 21, 22                             |
| 11   | Nov 10-14 | 6.3             | Solutions about Singular Points           | 1, 4, 8, 12, 14, 16, 19, 24, 30, 32                      |
|  |           | App II.1 & II.2 | Matrices and Linear Systems (Review)      | 12, 18, 22, 23, 26, 30 (a, b, e), 36, 40, 44             |
| 12   | Nov 17-21 | App II.3        | Eigenvalue Problem                        | 48, 49, 53, 54, 56, 59, 60, 61                           |
|  |           | 8.1             | Preliminary Theory-Linear Systems         | 2, 3, 6, 8, 10, 14, 15, 16, 19, 22, 24, 25, 26           |
| 13   | Nov 24-28 | 8.2             | Homogeneous Linear Systems                | NA   |
|  |           | 8.2.1           | Distinct Real Eigenvalues                 | 2, 6, 7, 9, 10, 14                                       |
|  |           | 8.2.2           | Repeated Eigenvalues                      | 22, 24, 26, 27, 29, 30 10 <sup>th</sup>                  |
| 24, 26, 28, 29, 31, 32 11 <sup>th</sup>  |           |                 |   |  |
| 14   | Dec 1-5   | 8.2.3           | Complex Eigenvalues                       | 34, 37, 38, 42, 46 10 <sup>th</sup>                      |
|  |           |                 |   | 36, 39, 40, 44, 48 11 <sup>th</sup>                      |
|  |           | 8.3.2           | Variation of Parameters                   | 12, 14, 15, 28, 30, 31 10 <sup>th</sup>                  |
|  |           |                 |   | 14, 16, 17, 30, 32, 33 11 <sup>th</sup>                  |
| 15   | Dec 8-12  | 8.4             | Matrix Exponential (No Laplace Transform) | 1, 5, 6, 8, 9, 10  |
|  |           |                 | Catch -Up & Review                        |  |
| 16   | Dec 15    |                 | Review (Normal Monday Class)              |  |
| <b>Final Exam: Thursday, December 19, 2019 at 7:00 PM (Comprehensive)</b>                                  |           |                 |   |  |