

# KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Department of Mathematics

## Math208 Course Syllabus

Term – 222

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**Course Title:** Math208 (Introduction to Differential Equations and Linear Algebra)

**Course Description:** Systems of linear equations. Rank of matrices. Eigenvalues and eigenvectors. Vector spaces, subspaces, bases, dimensions. Invertible matrices. Similar matrices. Diagonalizable matrices. Block diagonal and Jordan forms. First order differential equations: separable and exact. The homogeneous differential equations with constant coefficients. Wronskian. Nonhomogeneous differential equations. Methods of undetermined coefficients and variation of parameters. Systems of differential equations. Non-homogeneous systems. Applications to linear models of first and second order.

**Credits:** 3-0-3

**Textbook:** Differential Equations and Linear Algebra, C.H. Edwards and D.E. Penny, Prentice Hall, Third Edition (2014)

**Objectives:** The course introduces elementary differential equations and linear algebra to students of Computer Science, Computer Engineering, System Engineering and Earth Science

**Learning Outcomes:** Upon successful completion of this course, a student should be able to:

- Solve various types of ordinary differential equations.
- Apply differential equations to solve certain real-world problems.
- Discuss basic concepts of linear algebra.
- Use linear algebra techniques to solve linear systems of differential equations with constant coefficients.

### The Course Grading Policy:

|                   | Date   | Time | Place | Materials     | Percentage    |
|-------------------|--|------|-------|---------------|---------------|
| <b>Exam I</b>     | 20 February, 2023  | TBA  | TBA   | 1.1-3.6       | 25% (100 pts) |
| <b>Exam II</b>    | 27 March, 2023   | TBA  | TBA   | 4.1-5.5       | 25% (100pts)  |
| <b>Final Exam</b> | TBA  | TBA  | 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>▪ The average <math>x</math> (out of 40) of the class work of each section should be in the interval <math>[28, 30]</math> (<math>[70\%, 75\%]</math> of the class work grade).</li></ul> |      |       |               | 10% (40pts)   |
| <b>HW</b>         | The Homework will be online through the blackboard   |      |       |               | 5% (20 pts)   |

### **Missing an Exam:**

In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), he must bring an official excuse from the Deanship of Student Affairs. Otherwise, he will get zero in the missed exam.

**Attendance:** Students are expected to attend all 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 classes.
  - 15 excused and unexcused absences in lecture 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.)

### **Academic Integrity:**

All KFUPM policies regarding ethics apply to this course.

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

**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 DN 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

### **Important Exam Rules:**

- No student will be allowed to take the exam if he doesn't bring his KFUPM, National, or Iqama ID card with him to the exam hall.
- Students are not allowed to carry mobiles, smart watches, or electronic devices to the exam halls/rooms.
- Students must take the exam in the place assigned to them.

**Letter Grades:** The letter grades are based on curve grading, which will depend on the average of all students taking the course.

| Week   | Dates              | Section           | Topic   | Suggested Review Exercises  |
|--|--------------------|-------------------|---|---|
| 1  | Jan. 15-19         | 1.1<br>1.2        | Differential Equations & Math. Models ( <b>Only Decay &amp; Growth</b> )<br>Integrals as General & Particular Solutions                                   | 2,6, 8,10,14,20,35,38<br>2, 4, 6, 8, 11, 17   |
| 2  | Jan. 22-26         | 1.4<br>1.5        | Separable Equations ( <b>Without Applications</b> )<br>Linear First Order Equations   | 2, 8, 10, 24, 26, 34,40   |
| 3  | Jan. 29 –<br>Feb.2 | 1.5<br>1.6        | Linear First Order Equations (Cont.)<br>Substitution Methods & Exact Eqs. ( <b>Only Exact Eqs</b> )   | 2, 8, 10, 21, 28, 32<br>32, 36, 40, 42  |
| 4  | Feb. 5-9           | 3.1-3.6           | <b>Review only:</b><br>Linear Systems, Matrices & Gaussian Elimination,<br>Reduced Row-Echelon Form, Matrix Operations,<br>Inverse Matrices, Determinants | <b>Sec 3.1:</b> 4, 13, 18, 24, 28 <b>Sec 3.2:</b> 2, 10, 15, 28<br><b>Sec 3.3:</b> 2, 6, 10, 26, 28 <b>Sec 3.4:</b> 1, 10, 14, 25<br><b>Sec 3.5:</b> 3, 8, 23 |
| 5  | Feb. 12-16         | 3.6<br>4.1<br>4.2 | Inverse & the Adjoint Matrix<br>The Vector Space $\mathbb{R}^3$<br>The Vector Space $\mathbb{R}^n$ & Subspaces  | <b>Sec 3.6:</b> 2,7,17,21 33,38<br>1, 4, 6, 8, 10, 16, 19, 20 2, 8,<br>12, 14, 17, 26   |
| <b>Exam I: Monday, February 20, 2023. [1.1- 3.6]</b> |                    |                   |   |   |
| 6  | Feb. 19-21         | 4.3<br>4.4<br>4.5 | Linear Combination & Independence of Vectors<br>Bases & Dimension for Vector Spaces<br>Row & Column Spaces ( <b>Rank of Matrices Only</b> )               | 2,6,12,17,25<br>2, 9, 12, 13, 16, 23<br>1,4,8,12,14,16  |
| <b>Saudi Foundation Day 22-23 February</b>           |                    |                   |   |   |
| 7  | Feb. 26-<br>Mar.2  | 5.1<br>5.2        | Introduction: Second Order Linear Equations<br>General Solutions of Linear Equation   | 2, 10, 15, 19, 26,28,43<br>3, 9, 14, 22, 26   |
| 8  | Mar. 5-9           | 5.3<br>5.5        | Homogeneous Eqs. With Constant Coefficients<br>Nonhomogeneous Eqs. & Undetermined Coefficients  | 3,4,14,19,22,28,31,33,39, 4,<br>8, 16, 21, 27, 42, 44   |
| 9  | Mar. 12-16         | 5.5<br>7.1        | Method of Variation of Parameters<br>First Order Systems & Applications   | 48, 52, 57, 58, 62<br>1,3,8,14,20,21  |
| 10   | Mar. 19-23         | 7.2<br>6.1        | Matrices & Linear Systems<br>Introduction to Eigenvalues  | 1, 6, 12, 16, 20,24<br>3, 7, 14, 25,31  |
| <b>Exam II: Monday, March 27, 2023. [4.1- 5.5]</b>   |                    |                   |   |   |
| 11   | Mar. 26-30         | 7.3               | The Eigenvalue Method for Linear Systems  | 1, 3, 9, 18, 25, 26   |
| 12   | Apr. 2-6           | 6.2<br>6.3        | Diagonalization of Matrices<br><b>Only</b> The Caley Hamilton Theorem   | 2, 10, 15, 18, 27<br>2, 15, 18, 22  |
| 13   | Apr. 9-13          | 7.5               | Multiple Eigenvalue Solutions<br>Jordan Normal Form   | 4, 9, 13, 16, 25, 28, 31 38, 40,<br>43  |
| <b>Eid Al-Fitr Holidays 14-27 April</b>              |                    |                   |   |   |
| 14   | Apr.30 –<br>May4   | 8.1               | Matrix Exponentials & Linear Systems  | 2, 6, 10, 24, 26  |
| 15   | May 7-11           | 8.2               | Nonhomogeneous Linear Systems ( <b>only Variation of Parameters Method</b> )  | 17, 19, 26, 32  |
|  | May 14             |                   | Catch-up and Review   | Normal Wednesday Classes  |
|  | May 15             |                   | Catch-up and Review   | Normal Thursday Classes   |