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| **Course Information** | |
| **Course Title** | Numerical Analysis II |
| **Course Number** | 303421 |
| **Prerequisites** | Numerical Analysis I (303321) |
| **Instructor** |  |
| **Office Location** |  |
| **Office Hours** |  |
| **E-mail** |  |
| **Course Description** | |
| The course deals with the following topics: Initial - value problems for ordinary differential equations, Direct methods for solving linear systems, and Iterative techniques in Matrix Algebra. | |

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| **Text Book** | |
| **Title** | Numerical Analysis |
| **Author(s)** | Richard L.Burden and J.Doglas Fairs |
| **Publisher** | Thomson learning |
| **Year** | 2011 |
| **Edition** | Ninth Edition |
| **References** | 1. J. Stoer and R. Bulirsch, *Introduction to Numerical Analysis*, Springer-Verlag. 2. L.N. Trefethen and D. Bau, *Numerical Linear Algebra*, Society of Industrial and Applied Mathematics. 3. C.T. Kelley, *Iterative methods for linear and nonlinear equations*, Society of Industrial and Applied Mathematics |

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| **Assessment Policy** | | |
| **Assessment Type** | **Expected Due Date** | **Weight** |
| **First Exam** | To be announced by the department | 20% |
| **Second Exam** | To be announced by the department | 20% |
| **Final Exam** | To be announced by the department. | 40% |
| **Assignment** | Five assignments will be considered | 20% |
| **Over all** |  | 100% |

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| **Course Objectives** |
| 1. Approximating the solution of initial value problems using different numerical methods. |
| 1. Understanding some concepts in numerical analysis such as stability, consistency, and convergence. |
| 1. Applying different numerical methods to solve system of linear equations |
| 1. Knowing how to find the least square approximations |
| 1. Approximating the eigenvalues of matrices using different numerical methods. |

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| **Course Content** | | |
| **Week** | **Topics** | **Chapter in Text (handouts)** |
| **Iterative techniques in Matrix Algebra** | | |
| 1-4 | 7.1 Norms of Vectors and Matrices  7.2 Eigenvalues and Eigenvectors  7.3 The Jacobi and Gauss-Siedel Iterative Techniques  7.4 Relaxtion Techniques for Solving Linear Systems  6.1 Special Types of Matrices | **Chapter 7** |
| **Initial-Value Problems for Ordinary Differential Equations** | | |
| 5-7 | 5.1 The Elementary Theory of Initial-Value problems  5.2 Euler’s Method  5.3 Higher-Order Taylor Methods  5.4 Runge-Kutta Methods | **Chapter 5** |
| **First Exam** | | |
| 8-9 | 5.6 Multistep Methods  5.9 Higher-Order equations and Systems of DEs  5.10 Stability | **Chapter 5** |
| **Approximation Theory** | | |
| 10-12 | 8.1 Discrete Least Squares Approximation  8.2 Orthogonal Polynomials and Least Squares Approximation  8.3 Chebyshev Polynomials and Economization of Power Series | **Chapter 8** |
| **Second Exam** | | |
| **:** **Approximation Eigenvalues** | | |
| 13- 15 | 9.1 Linear Algebra and Eigenvalues  9.2 Orthogonal Matrices and Similarity Transformations  9.3 The Power Method  9.4 Householder’s Method | **Chapter 9** |

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| **Course outcomes** |
| 1. Working with computer, particularly Mathematica, to solve problems numerically. 2. Developing an appreciation for the applicability of the Mathematics theorems and rules to the real world. 3. Using numerical analysis to solve problems from Physics and Chemistry. 4. Comparing between numerical methods. 5. Deriving numerical methods for various mathematical operations and tasks, such the solution of linear system, least square approximation and the solution of differential equations. |

**Teaching Strategies and Assessments**

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| **Evaluation** | **Assessments** | **Learning activities** | **Teaching Strategies** | **Outcomes** |
| Final Exams | Mathematica Assignments | Exercises, Discussion | Lectures | Working with computer, particularly Mathematica, to solve problems numerically. |
| Final Exams | Exams | Exercises, Discussion | Lectures | Developing an appreciation for the applicability of the Mathematics theorems and rules to the real world. |
| Final Exams | Exams | Exercises, Discussion | Lectures | Using numerical analysis to solve problems from Physics and Chemistry. |