Jordan University of Science and Technology
Faculty of Engineering
Electrical Engineering Department

BME 302 Numerical Methods for Engineers

Course Catalog

3 Credit hours (3 h lectures). Introduction to strategies in problem solving and mathematical modeling; Understanding flowcharts and how to write computer source codes; Number system representation and machine epsilon; Round-off and truncation errors; Review of Taylor series; Error analysis; Linear system of equations; Non-linear equations; Gauss elimination and iterative methods; Curve fitting and least squares interpolation; Spline interpolation; Numerical integration; Integration of equations; Numerical differentiation; Ordinary differential equations.

Textbook

Chapra S. and Canale R. (2010). *Numerical Methods for Engineers,* 6th ed. McGraw Hill.

Reference

Gerlard C. F. and Wheatly P. O. (1999). *AppliedNumerical Analsis*. 6th ed. Addison-Wiesley.

Prerequisites

Prerequisites by topic Tools for Biomedical Engineers, Ordinary Differential Equations
Prerequisites by course BME 230, MATH 203

Topics Covered

	Topics	Chapters in Text	Hours
1	Introduction to Numerical Methods, Programming and Software. Approximation and Sources of Errors	**1,2,3,4**	**7**
2	Roots of Equations using Bracketing Methods: Bisection and False-Position Methods	**5**	**5**
3	Roots of Equations using Open Methods: Newton- Raphson, Fixed-Point, Secant Method	**6**	**4**
4	Solving System of Linear Equations Analytically (Gaussian Elimination, LU Decomposition, Cramer's rule, Matrix Inverse) and Numerically (Gauss-Seidal and Jacobi)	**9, 10, 11**	**5**
5	Solving Nonlinear System of Equations using Newton-Raphson Method.	**9.6**	**1**
6	Curve Fitting: Least Square Regression, General Linear Least Square, and Nonlinear Regression	**17**	**6**
7	Interpolation: Newton's Divided- Difference and Lagrange Interpolating Polynomials, Spline Interpolation	**18**	**5**
8	Numerical Integration: Trapezoidal and Simpson rules, Single and Multiple Application, Integration with Unequal Segments, Multiple integrals, Integration of Equations.	**21, 22**	**4**
9	Numerical Differentiation: Forward, Centered and Backward Finite-Divided Difference Formulas, Unequally Spaced Data.	**23**	**1**
10	Solving Differential Equations: Eular, Heun, Mid-Point, and General Runge-Kutta Methods, System of Equations, Boundary Value Problem.	**25, 26**	**7**

Evaluation

Assessment Tool	Expected Due Date	Weight
Programming Assignment Homeworks (2 Homeworks)(*)	One week after homework problems are assigned	10%
First Exam	Thursday 17/7/2014 3:00 – 4:00 PM	25 %
Second Exam	Sunday 10/8/2014 4:15 – 5:15 PM	25 %
Final Exam	According to the University final examination schedule	40 %

(*)The students have to submit a report for each programming assignment which includes: Flowchart, Source code commented, Executable file of the source code, Results, Comments on the results and the numerical methods used. The students have to submit a softcopy and a hardcopy of the report and the source code.

Objectives and Outcomes[1]

Objectives	Outcomes
1. Ability to solve problems using numerical techniques including those in root finding, linear systems, curve fitting, integration, differentiation, and ODEs. [1]	1.1. Recognize the needs for numerical methods. 1.2. Differentiate between numerical and analytical methods. [1] 1.3. Understanding strategies in problem solving and mathematical modeling. [1]
2. Understand useful computing techniques for solving general and practical engineering problems. [1]	2.1. Explain the major computing techniques for solving general and practical engineering problems .[1] 2.2. Appreciate the use of Taylor series in numerical computing techniques. [1]
3. Strengthen programming skills using compliers or packages such as MATLAB. [1, 2, 6]	3.1. Understanding flowcharts and how to write computer source codes. [1, 2, 6] 3.2. Identify the needs for programming in numerical approaches. 3.3. Appreciate the use of software packages such as MATLAB. [1, 2, 6]
4. Ability to present numerical results in appropriate fashion. [1]	4.1. Understanding number system representation and machine epsilon. [1]
5. Estimate numerical errors in application of numerical methods and recognize their importance in real life applications. [1, 2, 6]	5.1. Differentiate between round-off and truncation errors. [1, 2, 6] 5.2. Perform error analysis. [1, 2, 6] 5.3. Recognize numerical errors importance in real life applications.

Contribution of Course to Meeting the Professional Component

The course contributes to building the fundamental concepts and strategies in problem solving, mathematical modeling and numerical techniques used in engineering problem solving.

Relationship to Program Outcomes (%)

1	2	3	4	5	6	7	8	9
5	5				6			

Relationship to Electrical Engineering Program Objectives

PEO1	PEO2	PEO3	PEO 4
√		√	

Prepared by: Eng. Razan Shatnawi
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