The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Engineering Numerical Methods – 0943301 (3 Cr. – Required Course)**

Instructor: Dr. Omar El-Ghezawi
Office: E306, Telephone: 06/5355000 ext 22857, Email: ghezawi@ju.edu.jo
Office Hours: Will be posted soon

Course website: http://elearning.ju.edu.jo/

Catalog description: Mathematical preliminaries, numerical errors, loss of significance and error propagation. Numerical solution of nonlinear algebraic equations. Review of linear algebra (solution of systems of linear equations). Numerical solutions of systems of linear and non-linear algebraic equations. Interpolation and approximation and curve fitting. Numerical differentiation and integration. Numerical solution of differential equations. Eigenvalue problems. Introduction to numerical solution of partial differential equation. Engineering applications.

Prerequisites by course: **Mt** **0301202** Engineering Math (I) (pre- or co-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Calculus (differentiation and integration).
- Linear algebra.
- Solving differential equations.

Textbook: **Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven C. Chapra, McGraw-Hill Education, 4th edition, 2017.**

References:
1. Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms by Anne Greenbaum and Timothy P. Chartier, 1st Edition, Princeton University Press, 2012.
2. Numerical Analysis by Richard L. Burden, J. Douglas Faires and Annette M. Burden, 10th edition, Cengage Learning, 2015.
3. Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics by Justin Solomon, A K Peters/CRC Press, 1st Edition, 2015.
4. Numerical Methods for Engineers and Scientists by Joe D. Hoffman and Steven Frankel, CRC Press, 2nd Edition, 2001.
5. Numerical Methods for Engineers and Scientists by Amos Gilat and Vish Subramaniam, Wiley, 3rd Edition, 2013.

6. Numerical Methods with MATLAB: Implementations and Applications by Gerald W. Recktenwald, 2nd edition, Pearson, 2000.
7. Numerical Methods for Partial Differential Equations: Finite Difference and Finite Volume Methods by Sandip Mazumder, 1st edition, Academic Press, 2016.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to introduce the student to the concept of numerical solution of various mathematical problems, such as linear and nonlinear algebraic equations, differentiation, integration, eigenvalues, eigenvectors, ordinary and partial differential equations, interpolation, curve fitting, etc.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will: **[SO]**

1. Understand the advantages of numerical methods, the types of numerical errors, accuracy and precision. **[1, 7]**
2. Understand the most common numerical methods that can be used to find the roots of an equation using bracketing methods and open methods. **[1]**
3. Understand the method used to solve a system of linear equations and a system of nonlinear equations, and determine the eigenvalues. **[1]**
4. Understand the principles of curve fitting and the most common methods used for curve fitting such as linear regression and interpolation. **[1]**
5. Understand the methods used for numerical integration and numerical differentiation. **[1]**
6. Understand the numerical methods used to solve ordinary differential equations. **[1, 7]**

Course topics:		**Hrs**
1.	Advantages of numerical solution versus analytical solution. Error calculation and analysis.	**4**
2.	Solution of nonlinear system of equations: Bisection, False position, Simple iteration, Newton raphson, Secant.	**7**
3.	Solution of linear system of equations: Gaussian elemination, LU decomposition, iterative methods.	**7**
4.	Interpolation: Lagrange, Newton.	**3**
5.	Curve Fitting: Least square, linearization.	**3**
6.	Solution of differential equations: Euler, Huen, Runge – Kutta.	**6**
7.	Numerical Integration: Trapezoidal, Simpson, Gauss Legendre.	**8**
8.	Numerical Differentiation: Difference formulas.	**2**
9.	Introduction to partial differential equation and engineering applications.	**2**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021