The University of Jordan
School of Engineering
Department of Mechatronics Engineering
2ed Semester – A.Y. 2018/2019

Course: Engineering Numerical Methods – 0908311 (3 Cr. – Core Course)
Lecture Time (Mon, Wed: 11:00 – 12:30)

Instructor: Prof. Zaer S. Abo-Hammour
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Office Hours: (Mon, Wed: 9.30-11.00)

Course Website: `http://elearning.ju.edu.jo`

Catalog Data:

Prerequisites by Course: Engineering Mathematics I (301202).
Computer Applications for Mechatronics (0908231)

Prerequisites By Topic: Students are assumed to have sufficient knowledge pertaining to the following:
1. Calculus (Differentiation, Integration)
2. Linear Algebra
3. Differential Equations
4. Matlab computer language

Textbook & References:
- **Numerical Methods for Engineers,** *Chapra S.C. and Canale R.P.*, McGraw Hill, Latest Edition
- **Numerical Methods for Engineers and Scientists**. Hoffman J.D., McGraw Hill, Latest Edition
- **Applied Numerical Analysis Using MATLAB**, *Fausett L.V*, Prentice Hall, 1999
- **An Introduction to Numerical Analysi,** *Atkinson K.E.*, John Wiley, 2nd Edition, 1997

Schedule & Duration: 15 Weeks, 30 lectures (75 minutes each) plus exams.

Minimum Student Material: Text book, class handouts, and an access to Personal Computer with MATLAB

Instructional Methods
1. Lecture/Problem solving sessions.
2. Case studies using MATLAB.
3. Bonus homeworks.

Minimum College Facilities: Classroom with whiteboard and projection display facilities, library, computational facilities with MATLAB and Simulink.

Course Objectives: Upon the successful completion of this course students are expected to develop the following skills/understandings:
1. to design algorithms for solving engineering problems.
2. to figure out the importance of round-off and truncation errors.
3. to determine error propagation and how to control numerical errors. understand the concepts of "condition", "stability", and "convergence".
4. to find root of nonlinear algebraic equations in single variable.
5. to find solution for systems of linear algebraic equations.
6. to find solution for systems of non-linear algebraic equations.
7. to use numerical approximations and curve-fitting: interpolation and regression.
8. to perform numerical differentiation numerical integration.
9. to solve ordinary differential equations: initial and Boundary value problems.
10. to use computer languages to solve mathematical problems.

ABET SO:

1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Course Learning Outcomes and Relation to ABET Student Outcomes:

Upon successful completion of this course, a student should:

1. Understand the basic concepts of Numerical Methods and computations including their classifications, motivations of use, significant figures, integer and floating-point representation, accuracy and precision.
2. Know different types of numerical errors including truncation and round-off errors, error propagation, and condition number of functions.
3. Find the roots of equations for nonlinear functions of single variable.
4. Find the roots of equations for systems of nonlinear equations.
5. Solve systems of linear algebraic equations.
6. Introduce the concept of curve fitting.
7. Apply the methods of regression, interpolation, and splines.
8. Understand the definition of numerical differentiation and integration.
9. Use numerical methods to find the derivative and integral of data points and functions.
8. Solve ordinary differential equations.
9. Solve the boundary value problems and eigenvalue problems.
10. Use MATLAB to perform numerical calculations of all algorithms.

Course Topics:

	Topic Description	Hrs
1.	**Introduction to Numerical Analysis:** Area of study in numerical analysis, benefits of studying the numerical analysis, computer and numerical analysis, mathematical subjects area, Approximation and Numerical Error.	3
2	**Roots of Equations:** Bracketing Methods, Open Methods, System of Nonlinear Equations.	5
3.	**System of Linear Equations:** Gauss Elimination Method, Gauss Jordan Method, Decomposition Method, Matrix Inverse, Iteration Method.	5
4.	**Curve Fitting:** Introduction, Least Square Regression, Nonlinear Regression Models, Multiple Linear Regression, Multi-Dimensional Regression, Interpolation, Splines.	5
5.	**Numerical Differential and Integration:** Numerical Differentiation, Numerical Integration, The Trapezoidal Rule, the Simpson's rule, Integration with unequal segments, Integration of function.	5
6.	**Ordinary Differential Equations (ODE):** Introduction, Euler's Method, Runge-Kutta Method, Adams Multi-step Methods, Boundary Value Problem, Eigenvalues Problem**.**	5
7.	**MATLAB Programming**	2

Ground Rules:

- **Attendance:**

Students are expected to attend EVERY CLASS SESSION and they are responsible for all material, announcements, schedule changes, etc., discussed in class. The university policy regarding the attendance will be strictly adhered to.

- **Make up Examinations**

There will be no make up exams for any exam that will be taken during the course. exceptions to this rule is restricted only to the following cases:-

1. death of only first order relatives (father, mother, sister, or brother).
2. hospital entry (in-patient) during thr time of the examination.

Any other cases will be given the zero mark in the corresponding exam.

- **Special Notes**
  1. Seating plan will be as given in the attendance sheet.
  2. Students creativity is welcomed and will receive additional marks

Assessments:

Exams, Quizzes, Projects, and Assignments.

Grading policy:

Assessments	Mark	SOs
MATLAB Programming Exam	10	1
Class Activates and HomeWorks	10	
Midterm Exam	30	
Final Exam	50	
Total	**100**	

Last Updated:

September. 2019