The University of Jordan
School of Engineering

Department	Course Name	Course Number	Semester
Mechanical Engineering	Engineering Numerical Methods	0904302	

2019 Course Catalog Description

Mathematical preliminaries, numerical errors, loss of significance and error propagation. Numerical solution of nonlinear algebraic equations in single variable and systems of linear and non-linear algebraic equations. Numerical approximations: Interpolation and regression. Numerical differentiation and integration. Numerical solution of ordinary differential equations of initial value, boundary-value and characteristic-value problems. Introduction to numerical solution of partial differential equation: elliptic, parabolic and hyperbolic. Where appropriate, Software packages is used in the numerical solutions mentioned above.

Instructors

Name	E-mail	Sec	Office Hours		Lecture Time	

Text Books

	Text book 1	Text book 2
Title	"Numerical Methods for Engineers"	(Handouts)
Author(s)	Chapra S.C. and Canale R.P.	-
Publisher, Year, Edition	McGraw Hill, 2011, Sixth edition	

References

Books	1. Hoffman J.D., "Numerical Methods for Engineers and Scientists", McGraw Hill, 1993. 2. Fausett L.V., "Applied Numerical Analysis Using MATLAB", Prentice Hall, 1999. 3. Atkinson K.E., "An Introduction to Numerical Analysis", John Wiley, second Edition, 1997.
Journals	
Internet links	

Prerequisites

Prerequisites by topic	Calculus (Differentiation, Integration) , Linear Algebra, Differential Equations: ordinary and partial, Computer Programming for Engineers / Matlab
Prerequisites by course	Engineering Math I 0301202 + Computer Programming for Engineers 0914202
Co-requisites by course	
Prerequisite for	

Topics Covered

Week	Topics	Chapter in Text	Sections
1 -2	Introduction to Numerical Methods, Computer representation of numbers and Approximations and errors.		
3-4	Solution of Non-linear Algebraic equations in single variables with computer applications.		
5	Solution of systems of linear and nonlinear algebraic equations with computer applications.		
6	Curve fitting: Polynomial interpolations, Linear Regression with computer applications.		

7-8	Numerical differentiation and numerical integration		
9-10	Solution of ordinary differential equations using numerical methods: IVP with applications to high order ODEs.		
11-12	Solution of Ordinary differential equations using numerical methods, BVP		
13-14	Numerical Solutions of Partial Differential Equations: Elliptic, Hyperbolic and Parabolic PDEs.		

Mapping of Course Outcomes to ABET Student Outcomes

SOs	Course Outcomes
1	1. Find solution for systems of linear algebraic equations: by direct or iterative methods 2. Apply regression analysis and correlation coefficients, least squared method, and calculating error to define a best-fit curve. 3. Determine error propagation and learn how to control numerical errors. 4. Appreciate the concepts of "condition", "stability", and "convergence". 5. Perform numerical differentiation and integration. 6. Solve PDE /Partial differential equations: Elliptic, Hyperbolic and Parabolic equations. 7. Find root of nonlinear algebraic equations in single variable. 8. Design algorithms for solving engineering problems. 9. Interpolating polynomials, Correlation coefficient, Statistical best fit measures. 10. Perform Curve fitting. 11. Use numerical approximations and curve fitting: interpolation (Newton Divided-difference and Lagrangean polynomials) and regression using the method of least squares (Linear applied also to power, exponential and logarithmic forms).
7	12. Use computer languages/MatLab to solve mathematical problems. 13. Solve ODE /ordinary differential equations using numerical methods and to compare with available analytical solution of some problems. 14. Manage the personnel, deliverable, financial and schedule tasks incorporated in class project.

Evaluation

Assessment Tools	Expected Due Date	Weight
Project, Homework, Quizzes		20%
Midterm Exam		30%
Final Exam		50%

Contribution of Course to Meet the Professional Components

The course contributes to building the fundamental basic concepts of numerical analysis of engineering design problems.

Relationship to Student Outcomes

SOs	1	2	3	4	5	6	7
Availability	X						X

Relationship to Mechanical Engineering Program Objectives (MEPOs)

MEPO1	MEPO2	MEPO3	MEPO4	MEPO5

ABET Student Outcomes (SOs)

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

2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3	An ability to communicate effectively with a range of audiences
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
Updated by ABET Committee, 2024	