University of Bahrain
Quality Assurance and Accreditation Center

Course Syllabus Form

Instructor Name: Prof. Ebrahim Mattar					Office No: 14-146-A		
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Office Hours:					SUNDAY, MONADY, TUESDAY		
1. College: Engineering							
2. Department: All Departments							
3. Program: PhD in Engineering							
4. Course code: ENGG 701							
5. Course title: Advanced Numerical Methods							
6. Course credits: Lecture--Credit Hours 3-0-3							
7. Pre-requisites: None							
8. Lectures Timing & Location: U 16:30-19:30 (14-140)							
9. Course web-page: **https://www.dr-e-mattar-uob.com/**							
10. Course coordinator: Prof. Ebrahim Mattar							
11. Academic year: 2022-2023							
12. Semester:		First		Second		Summer	
13. Textbook(s): J.H. Mathews and K. D. Fink, Numerical Methods using Matlab.							
14. References: Textbook(s): J.H. Mathews and K. D. Fink, Numerical Methods using Matlab R. L. Burden and J. D. Faires, Numerical Analysis Advanced Numerical Methods with Matlab® 2 Bouchaib Radi and Abdelkhalak El Ham Lectures on Numerical Analysis Dennis Deturck and Herbert S. Wilf Department of Mathematics University of Pennsylvania Philadelphia, PA 19104-6395 Copyright 2002, Dennis Deturck and Herbert Wilf April 30, 2002							
15. Contribution of Course to Meeting the Professional Component College-level mathematics and basic science: 0 credits Engineering topics: 3 credits General education: 0 credits							
16. Other resources used (e.g. e-Learning, field visits, periodicals, software, etc.): References: S. C. Chapra and R. P. Canale, Numerical methods for Engineers T. J. Akai, Applied Numerical methods for Engineers							

17. Course description (from the catalog):

ENGG 701 Advanced Numerical Methods(3-0-3)
This course aims at covering advanced methods of numerical analysis. It briefs introduction to numerical computing, approximation and errors which is followed by methods of solving system of nonlinear equations and approximation of functions. Numerical solutions of ordinary differential equations; initial value problems and boundary value problems, simultaneous differential equations, Runga-Kutta methods, finite difference method. Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations. Methods will be implemented using toolboxes of MATLAB.

18. Course Intended Learning Outcomes (CILOs):

	Mapping to PILOs										
CILOs	a	b	c	d	e	f	g	h	i	j	k
1. To identify other advanced and complex methods of numerical analysis and computing.											
2. To present methods for solving system of linear and non-linear equations numerically.											
3. Apply advanced numerical techniques to approximate derivative and definite integral.											
4. Solve ordinary differential (linear and nonlinear) equations numerically.											

19. Course assessment:

Assessment Type	Number		Weight
Midterm	1		30 %
Assignments	5		20 %
Projects	1		10 %
Project work with a presentation	1		10 %
FINAL with a presentation	1		30 %

20. Description of Topics Covered

Topic Title (e.g. chapter title)	Description

21. Course Weekly Breakdown:

Week		Topics Covered (e.g. chapter/section title)	CILOs	Teaching Method	Assessment
1		SOLUTION OF NONLINEAR EQUATIONS Graphical Method, Bisection Method, Fixed Point Iteration,	1	Presentation	Assignment (1)
2		Fixed Point Iteration, Aitken's Acceleration, Steffensen's Method	1	Presentation	Assignment (1)
3		SOLUTION OF NONLINEAR EQUATIONS (III) Roots of Nonlinear Equations, Newton-Raphson Method,	1	Presentation	Assignment (1)
4		Difficulties of Newton-Raphson, Order of Convergence, Secant Method, False Position	2	Presentation	Assignment (2)

5		Difficulties of Newton-Raphson, Order of Convergence, Secant Method, False Position	2	Presentation	Assignment (2)
6		Numerical solutions of ordinary differential equations; initial value problems and boundary value problems, simultaneous differential equations	2,3	Presentation	Assignment (3)
7		Runga-Kutta methods, finite difference method. Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations. Methods will be implemented using toolboxes of MATLAB	2,3	Presentation	Assignment (3)
8		Runga-Kutta methods, finite difference method. Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations. Methods will be implemented using toolboxes of MATLAB	3	Presentation	Assignment (4)
9		SYSTEM OF NON-LINEAR EQUATIONS Solution of Nonlinear Simultaneous Equations, Substitution Method, Graphical Method, Fixed-Point Iteration, Gauss-Seidel Method	3	Presentation	Assignment (5)
10		NONLINEAR SYSTEMS OF EQUATIONS (II), Newton Raphson Method SYSTEM OF LINEAR EQUATIONS: Roots of Simultaneous Equations, System of Linear Equations, Direct Methods, (Direct and Iterative Methods), Gaussian Elimination Partial Pivoting, Scaling, ILL-Conditioning Matrices	3	Presentation	Midterm
11		Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations.	3,4	Presentation	Assignment (5)
12		Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations. Methods will be implemented using toolboxes of MATLAB.	3,4	Presentation	Assignment (5)
13		Numerical solution techniques for linear, elliptic, parabolic and hyperbolic partial differential equations. Methods will be implemented using toolboxes of MATLAB.	3,4	Presentation	Assignment (5)
14		Interpolation and curve Fitting: INTERPOLATION AND POLYNOMIAL APPROXIMATION, Interpolation, Polynomials, Newton Polynomial, Newton Gregory	1,4	Presentation	TEST (2)
15		LAGRANGE APPROXIMATION: Linear Interpolation, Lagrange Polynomials CURVE-FITTING: Curve-Fitting, Least-Squares Curve-Fitting, Non-Polynomials LSCF, Linearization	4	Presentation	Project work with a presentation
16		Runga-Kutta methods, finite difference method.	4	Presentation	FINAL (for ALL)

Academic Integrity Statement
Honesty and integrity are integral components of the academic process. Students are expected to be honest and ethical at all time in their pursuit of academic goals in accordance with Regulations of Professional Conduct Violations for University of Bahrain Students, UOB Plagiarism Policy and UoB Guide to Students Rights and Duties. Any breach of academic integrity will be dealt according to the Regulations for Professional Conduct Violations

Prepared by: Prof. Ebrahim Mattar

Date: Wednesday, February 8, 2023