Course Information

COURSE INFORMATION

Course Title	Code	Semester	L+U Hour	Credits	ECTS
Advanced Numerical Analysis	FZ5009		3 + 0	3.0	7.5

Prerequisites	None

Language of Instruction	Turkish
Course Level	Second Cycle
Course Type	Elective
Mode of delivery	Face to face
Course Coordinator	Assist. Prof. Dr. Melis ULU DOĞRU
Instructors	Assist. Prof. Dr. Melis ULU DOĞRU
Assistants	
Course Objectives	The aim of course is to be apply numerical analysis, differantial equations and initial value problem, special functions, matrix algebra, functions of a complex variable, special functions on mathematical and physical problems.
Course Content	Errors, Big O Notation, Stability and Condition Number, Taylor's Theorem. The Solution of Nonlinear Equations : Bisection Method, Fixed Point Iteration. NewtonRapson Method, Secant Method. The Solution of Linear System [pic]: Solving Triangular System, Gauss Elimination and Pivoting LUFactorization, Tridiagonal System, Vector and Matrix Norms Sensitivity of Linear Equations. Condition Number and Stability. Iterative Methods for Linear Systems: Jacobi Method. Gauss Seidel Method. Diagonally Dominant Matrix. Errors in Solving Linear Systems. System of Nonlinear Equations: Newton's Method. Interpolating and Polynomial Approximation: Lagrange interpolation polynomial, Newton Interpolation. Numerical Differentiation: Forward Difference, Backward Difference and Centered Difference. Numerical Integration: Trapezoid Rule, Composite Trapezoid Rule. Simpson's Rule. Composite Simpson's Rule. Gaussian Numerical Integration (Quadrature), Weighted Gaussian Quadrature. Numerical Solution of Ordinary Differential Equations: The Method of Succesive Approximations. Euler's Method. Trapezoidal Method. Higher Order Taylor Methods. RungeKutta Methods: Midpoint Method. Trapezoidal Method. Higher Order Taylor Methods. RungeKutta Methods: Midpoint Method. RungeKutta Method. The AdamsBashforth/AdamsMoulton Method. Numerical Solution of HigherOrder Equations, Systems. Solution of Boundary Value Problems: Shooting Method. Finite Difference Methods for Linear BVP's. Finite Difference Methods for Nonlinear BVP's. IntegroInterpolation methods. Variational Problems. Ritz and Galerkin methods. Numerical Solution of Partial Differential Equations Parabolic Equations: Forward Difference Method. Stability Analysis of Forward Difference Method. Backward Difference Method.
Course Learning Outcomes	1) define Errors, Big O Notation, Stability and Condition Number, Taylor's Theorem 2) solve Nonlinear Equations. 3) solve Linear Systems 4) calculate Eigenvalues and Eigenvectors. solve System of Nonlinear Equations. calculate Interpolating and Polynomial Approximation. solve Numerical Differentiation. 5) solve Nonlinear BVP's by using Finite Difference Methods 6) solve Variational problems.

	7) understand Ritz and Galerkin Method 8) solve Numerical Solution of Partial Differential Equations and analyze stability.

WEEKLY COURSE CONTENT

Week	Topics	Teaching and Learning Methods and Techniques	Study Materials
1. Week	Errors, Big O Notation, Stability and Condition Number, Taylor's Theorem. The Solution of Nonlinear Equations [pic]: Bisection Method, Fixed Point Iteration.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
2. Week	NewtonRapson Method, Secant Method. The Solution of Linear System [pic]: Solving Triangular System, Gauss Elimination and Pivoting	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
3. Week	LUFactorization, Tridiagonal System, Vector and Matrix Norms Sensitivity of Linear Equations. Condition Number and Stability	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
4. Week	Iterative Methods for Linear Systems: Jacobi Method. Gauss Seidel Method. Diagonally Dominant Matrix. Errors in Solving Linear Systems	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
5. Week	System of Nonlinear Equations: Newton's Method. Interpolating and Polynomial Approximation: Lagrange interpolation polynomial, Newton Interpolation.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
6. Week	Numerical Differentiation: Forward Difference, Backward Difference and Centered Difference.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
7. Week	Numerical Integration: Trapezoid Rule, Composite Trapezoid Rule. Simpson's Rule. Composite Simpson's Rule. Gaussian Numerical Integration (Quadrature), Weighted Gaussian Quadrature. midterm exam	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
8. Week	Numerical Solution of Ordinary Differential Equations: The Method of Succesive Approximations. Euler's Method. Trapezoidal Method. Higher Order Taylor Methods. RungeKutta Methods: Midpoint Method.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
9. Week	Trapezoidal Method. Higher Order Taylor Methods. RungeKutta Methods: Midpoint Method.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
10. Week	RungeKutta Method. The AdamsBashforth/AdamsMoulton Method. Numerical Solution of HigherOrder Equations, Systems	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
11. Week	Solution of Boundary Value Problems: Shooting Method. Finite Difference Methods for Linear BVP's.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
12. Week	Finite Difference Methods for Nonlinear BVP's. IntegroInterpolation methods.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	

13. Week	Variational Problems. Ritz and Galerkin methods.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
14. Week	Numerical Solution of Partial Differential Equations Parabolic Equations: Forward Difference Method. Stability Analysis of Forward Difference Method. Backward Difference Method.	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
15. Week	general review	Oral lectures with interactive discussions, Homeworks, Applications, Pratic	
16. Week	final exam	exam	

RESOURCES

Recommended Sources
1)Elementary Numerical Analysis (Third edition) by Kendall Atkinson, Weimin Han, John Wiley and Sons, Inc
2) Numerical Analysis by Timothy Sauer, 2006, Pearson –Addison Wesley
3) Applied Numerical Analysis Using Matlab (Second Edition) by Laurene V.Fausett, 2008, PearsonPrentice Hall.

ASSESSMENT

Measurement and Evaluation Methods and Techniques
Mid-term exam, final, other

COURSE CATEGORY

Course Category	Percentage
Support Courses	% 100

CONTRIBUTION OF COURSE LEARNING OUTCOMES TO PROGRAMME OUTCOMES

Programme Outcomes	Contribution Level	DK1	DK2	DK3	DK4	DK5	DK6	DK7	DK8
PY1	0	0	0	0	0	0	0	0	0
PY2	0	0	0	0	0	0	0	0	0
PY3	4	4	4	4	4	4	4	4	4
PY4	5	5	5	5	5	5	5	5	5
PY5	5	5	5	5	5	5	5	5	5
PY6	0	0	0	0	0	0	0	0	0
PY7	0	0	0	0	0	0	0	0	0
PY8	4	4	4	4	4	4	4	4	4
PY9	0	0	0	0	0	0	0	0	0
PY10	0	0	0	0	0	0	0	0	0
PY11	0	0	0	0	0	0	0	0	0
PY12	0	0	0	0	0	0	0	0	0
PY13	0	0	0	0	0	0	0	0	0
PY14	0	0	0	0	0	0	0	0	0

PY15	0	0	0	0	0	0	0	0	0

*DK = Course's Contrubution.

	0	1	2	3	4	5
Level of contribution	None	Very Low	Low	Fair	High	Very High

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ECTS CREDITS AND COURSE WORKLOAD

Event	Quantity	Duration (Hour)	Total Workload (Hour)
Final Exam	1	3	3
Class Hours (14 weeks)	14	3	42
Mid Term Exam 1	1	3	3
Assignment 1	16	5	80
Mid Term Exam Preparation	1	30	30
Final Exam Preparation	1	34	34
		Total Workload	192
		Total Workload / 25.5 (s)	7.53
		ECTS Credit of the Course	8