COURSE INFORMATION

Course Code	AAM 505	Course Name	Advanced Numerical Methods for Engineers					
Type of Course	**Level of Course**	**Semester**	**Language**	**Theory**	**Application (Practice)**	**Laboratory**	**Local Credits**	**ECTS**
Elective	Graduate	-	English	3	0	0	3	6

Department	: Aerospace Engineering
Prerequisites/Requirements for Admission	: -
Mode of Delivery	: Face to Face
Course Coordinator	: Assist. Prof. Dr. Ali Uğur SAZAKLIOĞLU
Course Lecturer(s)	: Assist. Prof. Dr. Ali Uğur SAZAKLIOĞLU
Course Assistant(s)	:
Course Description/Aim	: This course is designed to introduce some advanced numerical methods that are applied especially on engineering problems. Moreover, some numerical analysis are carried out by implementing the numerical methods on a software (MATLAB).
Course Contents	: Error analysis, numerical methods for solving nonlinear algebraic equations/systems, curve fitting and interpolations, optimization, numerical integration and differentiation, numerical methods for ordinary/partial differential equations
Recommended Optional Program Components	:
Compulsory Attendance	: 70%

Course Learning Outcomes

#	Learning outcome	Teaching Methods/Techniques	Assessment method(s)
At the end of this course; students will be able to:			
1	Solve the nonlinear algebraic equations and their systems by numerical methods.	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project
2	Employ curve fitting and interpolations.	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project
3	Optimize some mathematical models.	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project
4	Calculate numerical integration and differentiation.	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project
5	Analyze the numerical solutions of ordinary and partial differential equations.	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project
6	Apply the learned numerical methods on computer using a software (MATLAB).	Theoretical Lecture, Solving Exercises	Exams/Homeworks/Project

COURSE INFORMATION

Weekly Detailed Course Content

Week	Content	Recommended Resource(s)	Time (Hours)
1	Introduction and Mathematical Background	Textbook/ Lecture Notes	3
2	Nonlinear Algebraic Equations: Bisection, Fixed-Point Iteration, Newton-Raphson, and Secant Methods Nonlinear Algebraic Systems: Fixed-Point, Seidel, Newton Iteration Methods	Textbook/ Lecture Notes	3
3	Linear and Nonlinear Regressions	Textbook/ Lecture Notes	3
4	Newton's, Lagrange's, and Spline Interpolations	Textbook/ Lecture Notes	3
5	Optimization I	Textbook/ Lecture Notes	3
6	Optimization II	Textbook/ Lecture Notes	3
7	Numerical Integration: Simpson's Rules and Boole's Rule Numerical Differentiation	Textbook/ Lecture Notes	3
8	Finite Difference Methods for ODEs / Midterm Exam	Textbook/ Lecture Notes	3
9	Runge-Kutta Methods	Textbook/ Lecture Notes	3
10	Adaptive Runge-Kutta Methods	Textbook/ Lecture Notes	3
11	Finite Difference Methods for Parabolic Equations	Textbook/ Lecture Notes	3
12	Finite Difference Methods for Elliptic Equations	Textbook/ Lecture Notes	3
13	Finite Difference Methods for Hyperbolic Equations	Textbook/ Lecture Notes	3
14	Finite Element Method	Textbook/ Lecture Notes	3
15	Final Exam		
16	Final Exam		

Sources

Course Notes / Textbooks	Numerical Methods for Engineers by S.C. Chapra and R.P. Canale. Numerical Methods Using MATLAB by J.H. Mathews and K.D. Fink.
Supplemental Readings	

Evaluation System

Work Placement	Number	Percentage of Grade (%)
Attendance		
Quizzes		
Homework	3	15
Presentation	1	5
Laboratory/Practice		
Report(s)		
Graduate Thesis/Project		
Seminar		
Projects	1	10
Midterm exam(s)	1	30
Others		
Final exam	1	40
	Total	100
	Percentage of semester work	60
	Percentage of final exam	40
	Total	100

COURSE INFORMATION

Workload Calculation

Activity	Number	Time (hours)	Total Work Load (hours)
Course Hours	14	3	42
On-line Activity Hours			
Individual study	16	6	96
Midterm exam(s)	1	2	2
Final exam	1	2	2
Homework	3	6	18
Presentation	1	1	1
Project	1	20	20
		Total	181
		ECTS Credit *(Total/30)*	6

Contribution of Learning Outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
LO1	5	5	2	5	4	2	3	4	2
LO2	5	5	2	5	4	2	3	4	2
LO3	5	5	2	5	4	2	3	4	2
LO4	5	5	2	5	4	2	3	4	2
LO5	5	5	2	5	4	2	3	4	2
LO6	5	5	2	5	4	2	3	4	2

Contribution Level : 1: “Very low”, 2: “Low”, 3: “Medium”, 4: “High”, 5: “Very High”
LO: Learning Outcome of the Course
PO: Program Outcome