COURSE INFORMATON					
Course Title	*Code*	*Semester*	*L+P+L Hour*	*Credits*	*ECTS*
Numerical Methods	CE 523	-	3+0+0	3	10

Prerequisites	

Language of Instruction	English
Course Level	Master's Degree (Second Cycle Programmes)
Course Type	Departmental Elective
Course Coordinator	-
Instructors	Dr. Gulten Polat
Assistants	-
Goals	This is an entry-level graduate course aimed to give an introduction to widely used numerical methods through application to many civil and general engineering problems. The course is expected to lay the foundation for students beginning to engage in their thesis projects that involve numerical methods. The students will use MATLAB as a tool for their studies. Experience with MATLAB is not required.
Content	Introduction; numerical methods and their application in engineering problem; MATLAB Basics; Numerical Integration and Differentiation; Ordinary differential equations; Linear and non-linear system solution (direct and iterative methods); Partial differential equations; Optimization; Curve fitting and inverse problems; Finite Element Analysis

Course Learning Outcomes	**Program Learning Outcomes**	**Teaching Methods**	**Assessment Methods**
1) Describe and apply basic numerical methods for civil engineering problem solving.	1,2,5	1, 2	A, B
2) Develop algorithms and programs for solving civil engineering problems involving: (i) multi-dimensional integration, (ii) multivariate differentiation, (iii) ordinary differential equations, (iv) partial differential equations, (v) curve fitting or inverse problems, (vi) optimization, and the Finite Element Method in Engineering	1,2,5	1, 2	A, B

Teaching Methods:	1: Lecture, 2: Question-Answer
Assessment Methods:	A: Written Exam, B: Homework

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to numerical methods in civil engineering problems.	Lecture Notes and Textbook
2	MATLAB Basics: General MATLAB Commands; Numeric arrays, Cell arrays, Structure arrays; Flow control and Functions; Symbolic Computations; Engineering examples **Assignment 1** – MATLAB BASICS	Lecture Notes and Textbook
3	Numerical integration techniques and civil engineering applications- Newton-cotes formulas	Lecture Notes and Textbook
4	Multi-dimensional integrals, integrating tabular data, Gauss-quadrature, Monte-Carlo integration **Assignment 2-**Numerical Integration methods with applications	Lecture Notes and Textbook
5	Numerical differentiation with engineering applications – Newton's difference formulas,	Lecture Notes and Textbook
6	Higher order differentiation, multivariate differentiation, differentiation of tabular data **Assignment 3-**Numerical differentiation methods with applications	Lecture Notes and Textbook
7	Ordinary Differential Equations (ODE): Initial value problems, boundary value problems, and stiff systems with applications in engineering and science **Assignment 4 –** ODE methods and applications	Lecture Notes and Textbook
8	Linear and non-linear system solution (direct and iterative methods): Solving linear systems – Gaussian elimination, Gauss-Jordan, LU decomposition, Iterative methods (Gauss-Seidel)	Lecture Notes and Textbook
9	Solving nonlinear systems – Newton-Raphson method, engineering applications **Assignment 5-** Linear and nonlinear applications	Lecture Notes and Textbook
10	**Midterm Exam**: Open book materials	Lecture Notes and Textbook
11	Partial differential equations (PDE): Finite-difference methods – elliptic, parabolic and hyperbolic systems, boundary conditions.	Lecture Notes and Textbook
12	Applications in groundwater flow **Assignment 6:** PDE solution of groundwater applications	Lecture Notes and Textbook
13	Curve fitting and inverse problems: Linear and non-linear regression with applications **Mini-project** –The topic of the mini- project depends on your student's choice (Due 2 week from assigned date).	Lecture Notes and Textbook
14	Numerical Optimization: Basic Concepts and Algorithms	Lecture Notes and Textbook
15	The Finite Element Method in Engineering	Lecture Notes and Textbook

RECOMMENDED SOURCES

Lecture Notes	Notes prepared by the instructor
Textbook	Chapra, S.C., and, R.P. Canale, Numerical methods for engineers, McGraw Hill, 5th/6th/7th Edition, 2006/2010/2015. Chapra, S.C. Applied numerical methods with MATLAB for engineers and scientists, 3rd edition, McGraw Hill, 2012

MATERIAL SHARING	
Documents	Lecture notes delivered to the students
Assignments	Homeworks are returned to students after they are graded
Exams	Exams questions are solved if demanded

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	50
Quizzes	-	-
Assignment	6	30
Term Project	1	20
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE CATEGORY	Expertise/Field Courses

COURSE'S CONTRIBUTION TO PROGRAM						
No	Program Learning Outcomes	Contribution				
		1	2	3	4	5
1	Attains knowledge through wide and in-depth investigations his/her field and surveys, evaluates, interprets, and applies the knowledge thus acquired.				**X**	
2	Has a critical and comprehensive knowledge of contemporary engineering techniques and methods of application.				**X**	
3	By using unfamiliar, ambiguous, or incompletely defined data, completes and utilizes the required knowledge by scientific methods; is able to fuse and make use of knowledge from different disciplines.					
4	Has the awareness of new and emerging technologies in his/her branch of					

	engineering profession, studies and learns these when needed.					
5	Defines and formulates problems in his/her branch of engineering, develops methods of solution, and applies innovative methods of solution.				**x**	
6	Devises new and/or original ideas and methods; designs complex systems and processes and proposes innovative/alternative solutions for their design.					
7	Has the ability to design and conduct theoretical, experimental, and model-based investigations; is able to use judgment to solve complex problems that may be faced in this process.					
8	Functions effectively as a member or as a leader in teams that may be interdisciplinary, devises approaches of solving complex situations, can work independently and can assume responsibility.					
9	Has the oral and written communication skills in one foreign language at the B2 general level of European Language Portfolio.					
10	Can present the progress and the results of his investigations clearly and systematically in national or international contexts both orally and in writing.					
11	Knows social, environmental, health, safety, and legal dimensions of engineering applications as well as project management and business practices; and is aware of the limitations and the responsibilities these impose on engineering practices.					
12	Commits to social, scientific, and professional ethics during data acquisition, interpretation, and publication as well as in all professional activities					

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Excluding the exam weeks: 14x Total course hours)	14	3	42
Hours for off-the-classroom study (Pre-study, practice)	14	2	28
Midterm examination	1	3	20
Homework	6	20	120
Final examination	1	2	30
Total Work Load			240
Total Work Load / 25 (h)			10
ECTS Credit of the Course			10