Numerical Methods in Mechanical Engineering

Course Code:

ME 371

Course Period:

Autumn

Course Type:

Core

Credits:

3

Theoric:

2

Practice:

0

Laboratory Hour:

2

ECTS:

6

Prerequisite Courses:

Restricted Elective I (Programming Courses) [1]
Linear Algebra [2]
Course Language:

English

Courses given by:

Onur Cem Namlı [3]
Koray K. Şafak [4]
Course Objectives:

This course serves as an introduction to numerical procedures that are common to engineering discipline, and their implementation using Matlab or an equivalent software.

Course Content:

Computer arithmetic, sources of error, error propagation. Approximating.functions. Linear system of equations. Direct methods, iterative methods. The eigenvalue problem. Roots of nonlinear algebraic equations. Function interpolation.

Course Methodology:

1: Lecture, 3: Homework, 5: Laboratory

Course Evaluation Methods:

A: Midterm and final exams, C: Homework, G: In-class practice

Learning Outcomes	**Program Outcomes**	**Teaching Methods**	**Assessment Methods**
1) define the consequences of digital arithmetic, estimate numerical accuracy of floating-point computations, function approximation and error propagation.	2	1,3	A,C
2) Formulate an approximate solution procedure to an engineering problem, apply basic numerical techniques in this procedure and assess the accuracy and stability of the resulting solution.	4	1,3	A,C
3) Select and customize appropriate algorithms from numerical libraries, implement them as computer code files, and integrate files to construct a complete set of procedures.	13	3,5	C,G

COURSE CONTENT		
Week	**Topics**	**Study Materials**
1	Introduction to numerical analysis	textbook
2	Approximate calculation of functions	textbook
3	Polynomial Evaluation, Binary Number System.	textbook
4	Computing Anomalies, Machine Numbers	textbook
5	Error and its propagation through computations	textbook
6	Rootfinding Problems, Newton's Method.	textbook

7	Secant Method, Fixed-Point Iteration.	textbook
8	Curve Fitting	textbook
9	Function Interpolation on Lagrange basis	textbook
10	Function Interpolation using divided differences	textbook
11	Numerical Integration.	textbook
12	Quadrature methods.	textbook
13	Numerical differentiation.	textbook
14	Ordinary Differential Equations.	textbook

RECOMMENDED SOURCES	
Textbook	“Applied Numerical Methods with MATLAB for Engineers and Scientists”, Steven C. Chapra, McGrawHill, 3rd Ed.
Additional Resources	Atkinson, K., Elementary Numerical Analysis, 3nd Ed, Wiley, 1993. MATLAB reference manual

MATERIAL SHARING	
Documents	Lecture notes, related links
Assignments	Homeworks
Exams	Exams and solutions

ASSESSMENT		
IN-TERM STUDIES	**NUMBER**	**PERCENTAGE**
Mid-terms	1	55
Assignment	6	10
Laboratory work	10	35
Total		**100**
CONTRIBUTION OF FINAL EXAMINATION TO OVERALL GRADE		40
CONTRIBUTION OF IN-TERM STUDIES TO OVERALL GRADE		60
Total		**100**

COURSE'S CONTRIBUTION TO PROGRAM								
No	Program Learning Outcomes		Contribution					
		NA	1	2	3	4	5	
1	Adequate knowledge in mathematics, science and engineering subjects pertaining to the relevant discipline; ability to use theoretical and applied knowledge in these areas in complex engineering problems.	**X**						
2	Ability to identify, formulate, and solve complex engineering problems; ability to select and apply proper analysis and modeling methods for this purpose.					**X**		
3	Ability to design a complex system, process, device or product under realistic constraints and conditions, in such a way as to meet the desired result; ability to apply modern design methods for this purpose.	**X**						
4	Ability to devise, select, and use modern techniques and tools needed for analyzing and solving complex problems encountered in engineering practice; ability to employ information technologies effectively.	**X**						
5	Ability to design and conduct experiments, gather data, analyze and interpret results for investigating complex engineering problems or discipline specific research questions.						**X**	
6	Ability to work efficiently in intra-disciplinary and multi-disciplinary teams; ability to work individually.	**X**						
7	Ability to communicate effectively in Turkish, both orally and in writing; knowledge of a minimum of one foreign language; ability to write effective reports and comprehend written reports, prepare design and production reports, make effective presentations, and give and receive clear and intelligible instructions.	**X**						
8	Recognition of the need for lifelong learning; ability to access information, to follow developments in science and technology, and to continue to educate him/herself.	**X**						
9	Consciousness to behave according to ethical principles and professional and ethical responsibility; knowledge on standards used in engineering practice.	**X**						

10	Knowledge about business life practices such as project management, risk management, and change management; awareness in entrepreneurship, innovation; knowledge about sustainable development.	**X**						
11	Knowledge about the global and social effects of engineering practices on health, environment, and safety, and contemporary issues of the century reflected into the field of engineering; awareness of the legal consequences of engineering solutions.	**X**						
12	Ability to work professionally in both thermal and mechanical systems areas, including design and realization.	**X**						
13	Ability to verify and validate numerical solutions to engineering problems.					**X**		

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION			
Activities	Quantity	Duration (Hour)	Total Workload (Hour)
Course Duration (Including the exam week: 16x Total course hours)	16	4	64
Hours for off-the-classroom study (Pre-study, practice)	16	2	32
Mid-terms	1	12	12
Homework	4	6	24
Final examination	1	16	16
Total Work Load			148
Total Work Load / 25 (h)			5.92
ECTS Credit of the Course			6