ESOGU ELECTRICAL-ELECTRONICS ENGINEERING DEPARTMENT
COURSE INFORMATION FORM

Course Title	Course Code
Numerical Methods	151223564

Semester in Program	Number of Course Hours per Week		ECTS Credit
	Theory	Practice	
3	3	0	5

Course ECTS Credit Distribution				
Basic Sciences	Engineering Sciences	Design	General Education	Social
5				

Language of Instruction	Course Level	Course Type
English	Undergraduate	Required

Prerequisite	None
Objectives of the Course	The objectives of this course is to teach the solution of mathematical engineering problems, which do not have analytical solutions, using numerical methods. The course aims to develop the necessary algorithms for students to apply these methods through computer programming, and to equip them with essential programming and computational skills.
Brief Course Content	The course covers root finding, solving systems of linear equations, single-variable unconstrained optimization, linear and nonlinear regression, polynomial and spline interpolation, numerical differentiation, numerical integration, and numerical solutions of differential equations.

	Learning Outcomes of the Course	Contributed POs	Teaching Methods *	Assessment Methods **
1	To provide the fundamental concepts of numerical methods and develop a basic mathematical foundation.	1,2	1	A,B
2	To develop the skills to solve science and engineering problems using numerical methods.	1,2	1	A,B
3	To develop computational skills using GNU Octave, to code algorithms for solving mathematical problems, and to obtain simulation results.	4,5	1,4	A,B
4				
5				

***Teaching Methods** **1:**Lecture, **2:**Discussion, **3:**Experiment, **4:**Simulation, **5:**Question-Answer, **6:**Tutorial, **7**:Observation, **8**:Case Study, **9:**Technical Visit, **10:**Problem Solving, **11:**Induvidual Work, **12**:Team/Group Work, **13**:Brain Storm, **14:**Project Design / Management, **15:**Report Preparation and/or Presentation

****Assessment Methods** **A:**Exam, **B:**Quiz, **C:**Oral Exam, **D:**Homework, **E:**Report, **F:**Article Examination, **G:**Presentation, **I:**Experimental Skill, **J:**Project Observation, **K**:Class Attendance; **L**:Jury Exam

Main Textbook	Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", ISBN: 978-1260571387, McGraw-Hill, 8th ed., 2020.
Supplementary Resources	Steven C. Chapra, "Applied Numerical Methods with MATLAB", McGraw-Hill, 3rd ed., 2012. Amos Gilat, Vish Subramaniam, "Numerical Methods for engineers and Scientists", Wiley, 3rd Ed., 2014. G.R. Lindfield, J.E.T. Penny, "Numerical Methods using MATLAB", Elsevier, 3rd Ed., 2012.
Necessary Course Material	Calculator, personal computer, GNU Octave software.

Course Weekly Schedule	
1	Fundamental concepts, programming, flowcharts, algorithms.
2	Taylor series, approximate calculations, and errors.
3	Computing and programming using GNU Octave.
4	Finding the roots of single-variable functions: Bisection, False position, Fixed point iteration, Newton-Raphson, and Secant methods, roots of polynomials.
5	Numerical solutions of linear equation systems: Gauss Elimination, LU decomposition, Gauss-Seidel, and Jacobi methods.
6	Finding the maximum/minimum in single-variable functions: Golden section, parabolic interpolation, Newton, Brent methods. Multidimensional optimization: Gradient and Hessian.
7	Curve fitting: Least Squares (LS) regression. Linear regression, polynomial regression, nonlinear regression.
8	Midterm Exams
9	Curve fitting: interpolation. Divided difference interpolating polynomials, Lagrange interpolating polynomials, spline interpolation. Curve fitting with Fourier series.
10	Numerical integration: Trapezoidal rule, Simpson's (1/3 and 3/8) rules. Newton-Cotes formulas.
11	Advanced numerical integration techniques: Romberg, Adaptive quadrature, and Gauss quadrature methods, indefinite integrals.
12	Numerical differentiation techniques: High-order divided difference formulas, Richardson extrapolation.
13	Numerical solutions of ordinary differential equations: Euler, Runge-Kutta methods.
14	Numerical solutions of boundary value problems.
15	Numerical solutions of eigenvalue problems.
16,17	Final Exams

Calculation of Course Workload			
Activities	**Count**	**Time (Hour)**	**Total Workload (Hour)**
Weekly classroom time	14	3	42
Weekly study time (review, reinforcing, preparation)	14	3	42
Homework			
Taking a quiz	5	1	5
Studying for a quiz	5	4	20
Oral exam			
Studying for an oral exam			
Report writing (Preparation and presentation time included)			
Project (Preparation and presentation time included)			
Mid-Term Exam	1	2	2
Studying for Mid-Term Exam	1	18	18
Final Exam	1	2	2
Studying for Final Exam	1	18	18
		Total workload	**149**
		Total workload / 30	**4.97**
		Course ECTS Credit	**5**

Assessment	
Activity Type	**%**
Mid-term	30
Quiz	20
Homework	
Final Exam	50
Total	100

COURSE CONTRIBUTION TO THE PROGRAM OUTCOMES (5: Very high, 4: High, 3: Middle, 2: Low, 1: Very low)		
NO	**PROGRAM OUTCOMES**	**Contribution**
1	a. Sufficient knowledge of mathematics	5
	b. Sufficient knowledge of basic sciences	
	c. Sufficient basic engineering and Electrical-Electronics engineering knowledge	
	d. Skill of applying all these knowledge and experience to complicated Electrical-Electronics engineering problems	
2	Skill of defining, identifying, formulating and solving the complicated problems in Electrical-Electronics engineering and related areas by applying appropriate analysis and modelling methods.	3
3	Skill of designing a complicated process, system, equipment or product by applying modern design methods under realistic constraints and conditions.	
4	To analyze and solve the complicated engineering problems: a. skill of developing, selecting and applying the required techniques and devices	
	b. skill of using information technologies effectively	5
5	To study the complicated on the complicated Electrical-Electronics engineering problems and research subjects: a. skill of experimental design	
	b. skill of performing the experiments, collecting the data and analyzing and interpreting the results	4
6	a. Skill of performing individual studies	
	b. Skill of performing intra and interdisciplinary and multidisciplinary teamwork and studies	
7	a. Skill of effective oral and written communication in Turkish and English	
	b. Skill of improving and using foreign language knowledge	
	c. Skill of effective reporting, understanding the reports and preparing the design and production reports	
	d. Skill of effective presentation and giving and getting clear and understandable instructions.	
8	Awareness of the necessity of life-long learning and skill of accessing to information and following the improvements in contemporary science and technology	
9	a. Awareness of necessity of behaving in accordance with the ethical principles and awareness of the importance of having professional ethical responsibilities	
	b. Knowledge about legal regulations and standards of engineering	
10	a. Knowledge about project management, risk management and change management	
	b. Awareness of the significance of entrepreneurship and innovation	
	c. Knowledge about sustainable development	
11	Knowledge about the effects of engineering applications and practices on the global and social health, ecology and safety, knowledge about the current problems in relation to the working areas of Electrical-Electronics engineering; and awareness of the legal issues resulting from engineering solutions	
12	Knowledge about modern problems in local and universal scale	

INSTRUCTORS				
Prepared by	Assoc. Prof. Dr. Hasan Serhan YAVUZ			

Date:18.07.2024