REPUBLIKA E SHQIPËRISË

"ISMAIL QEMALI" UNIVERSITY
FACULTY OF TECHNICAL AND NATURAL SCIENCES
COMPUTER SCIENCE DEPARTMENT

SYLLABUS
MAT 156E COMPLEX ANALYSIS

Curriculum Developer	**Assoc. Prof. Ermal Feleqi** *Ph.D. in Mathematics*

Credits and hours	Credits	Hour in the classroom						Individual study	Total
		Lectures	Seminars	Labs	Practise	Course project	Total		
	6 ECTS	45	30	0	0	0	75	75	150

Course Typology	A - General education (basic) discipline
Academic year /semester	2025-2026/ First year, second semester
Nature and requirement of the course	Mandatory course
Study program	Bachelor in Computer Engineering
Course Code	MAT 156E
Email of curriculum developer / lecturer	ermal.feleqi@univlora.edu.al

SUMMARY AND LEARNING OUTCOMES

Course Description	Complex analysis is a basic tool with a great many practical applications to the solution of physical problems. It revolves around complex analytic functions—functions that have a complex derivative. Unlike calculus using real variables, the mere existence of a complex derivative has strong implications for the properties of the function. Applications reviewed in this class include harmonic functions, two dimensional fluid flow, easy methods for computing (seemingly) hard integrals, Laplace transforms, and Fourier transforms with applications to engineering and physics.
Course Objectives	▪ Learn the fundamentals of Complex Analyis and be able to make significant applicatinzs.
Expected Outcomes	At the end of the course, students will be proficient in Complex Analysis and its applications.

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FUNDAMENTAL CONCEPTS

- complex algebra and functions;
- analyticity; contour integration,
- Cauchy's theorem;
- singularities,
- Taylor and Laurent series;
- Residues, evaluation of integrals;
- Multivalued functions, potential theory in two dimensions; Fourier analysis and Laplace transforms.

Week	COURSE TOPICS	Reference Literature	Teaching Methodology
I.	*Complex Algebra. Complex Plane. Motivation and History* *Polar Form. Complex Exponential. DeMoivre's Theorem.*	*Syllabus MAT 156E* *[1] Sections 1.1 & 1.2* *Sections 1.3 - 1.5*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
II.	*Complex Functions. Analyticity* *Cauchy-Riemann Eqns. Harmonic Functions*	*[1] Sections 2.1 - 2.3* *Sections 2.4 - 2.6*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
III.	*Exponential and Trig. Functions. Logarithmic Function* *Branch Cuts. Applications* *Complex Powers and Inverse Trig. Functions*	*[1] Sections 3.1 & 3.2, handout* *[1] Section 3.3*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
IV.	*Contour Integrals* *Path Independence*	*[1] Sections 4.3 & 4.4a*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
V.	*Cauchy's Theorem*	*[1] Section 4.4b*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*

Week	COURSE TOPICS	Reference Literature	Teaching Methodology
VI.	*Cauchy's Integral Formula* *Differentiable implies analytic in the complex variable*	*[1] Section 4.5*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
VII.	*Liuville's Theorem. Mean Value and Max. Modulus* *Dirichlet Problem*	*[1] Section 4.6*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
VIII.	*Taylor Series. Radius of Convergence*	*[1] Sections 5.1, 5.2 and handout*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
IX.	*Laurent Series* *Zeros. Singularities. Point at Infinity*	*[1] Sections 5.6 & 5.7*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
X.	*Residue Theorem. Integrals over the Unit Circle* *Real Integrals. Conversion to Complex Contours*	*[1] Sections 6.1, 6.2 and handout* *[1] Section 6.3*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
XI.	*Trig. Integrals. Jordan's Lemma* *Indented Contours. Principal Value*	*[1] Section 6.4* *[1] Section 6.5 and handout*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
XII.	*Integrals Involving Multi-valued Functions* *Argument Principle and Rouche's Theorem*	*[1] Section 6.6 and handout* *[1] Section 6.7 and handout*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*

Week	COURSE TOPICS	Reference Literature	Teaching Methodology
XIII.	*Complex Fourier Series* *Oscillating Systems. Periodic Functions* *Applications of Fourier Series*	*[1] Section 8.1 - up to page 374, Section 3.4, handout*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
XIV.	*Clent Fourier Transform and Applications* *Laplace Transform and Inversion Formula*	*[1] Section 8.2* *[1] Section 8.3*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*
XV	*Invariance of Laplace's Eqn. Conformality* *Inversion Mapping. Bilinear Mappings* *Examples and Applications*	*Sections 7.1, 7.2 and handout* *Section 7.3 and handout* *Section 7.6*	Lecture 1 hour Lecture 1 hour Lecture 1 hour *Seminars 2 hours*

KNOWLEDGE ASSESSMENT						
ATTENDANCE	Attendance for lectures and seminars is mandatory at 75%. Otherwise, the student loses the right to take the exam. Absences are the personal responsibility of the student, as are any missed assignments or tests. A student who has less than 75% attendance for the period relevant to any partial exam, during which they will be tested, will not be allowed to take the corresponding exam and will be graded with an M (Missing). If the student has attended the course but does not show up for the next exam, they will be graded NP (Not Present).					
CONTINUOUS ASSESSMENT	*Assessment Method*	*Assessment Time*	*Learning Topics to be Assessed*	*Maximum Points*	*Knowledge Testing Method*	*Test Content*
	Partial Exam	Week 7-8	1-15	25 points	Written exam	Concepts and exercises
	Final Exam	End of the semester	16-45	60 points	Written exam	Concepts and exercises
	Continuous Assessment* (Course Assignment*)	During the semester	-	15 points	Written raport and oral presentation	Homework assignments, maybe a small write-up on some topic or application of Complex Analysis

	* Continuous Assessment – *The student will realize a project, that will start at the beginning of the semester.*

The conversion of points to the final grade is as follows:						
0 - 40 points	41 - 50 points	51 - 60 points	61 - 70 points	71 - 80 points	81 - 90 points	91 - 100 points
4	5	6	7	8	9	10

LITERATURE	
Primary literature	[1] Saff, Edward and Arthur David Snider. Fundamentals of Complex Analysis. 3nd ed. Upper Saddle River: Prentice Hall, 1993. ISBN: 0133274616.
Recommended literature	1. J. H. Mathews and R.W. Howell, Complex Analysis for Mathematics and Engineering, 3rd edition, Narosa, 1998. 2. T. Needham,Visual Complex Analysis, Oxford, 1997. 3. Auxiliary study materials: https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring-2018/pages/study-materials/ 4. https://opencw.aprende.org/courses/mathematics/18-04-complex-variables-with-applications-fall-2003/index.htm
FINAL REMARKS FROM THE COURSE INSTRUCTOR	
Provisions	Students are expected to develop values and an ethics that reflect their interests and behavior from a professional perspective. Students must respect individual differences, be cooperative, and in accordance with ethical rules, they should respect ethnic differences and assist individuals with disabilities with inclusive and supportive attitudes.
Delays	Delays in lectures and seminars will not be tolerated.
Academic integrity and copyright	Each test or written work must be completely individual and original. Plagiarism (mixed combinations) or theft of information through various means will not be allowed.

HEAD OF DEPARTMENT OF COMPUTER SCIENCES
Dr. Alketa HYSO