The University of Jordan

الجامعة الاردنية

Form: Course Syllabus	**Form Number**	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
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	Number of Pages	09

1.	**Course Title**	**Complex Analysis**
2.	**Course Number**	0331412
3.	**Credit Hours (Theory, Practical)**	3
	Contact Hours (Theory, Practical)	3
4.	**Prerequisites/ Corequisites**	0331212
5.	**Program Title**	B.Sc.
6.	**Program Code**	
7.	**School/ Center**	Science
8.	**Department**	Mathematics
9.	**Course Level**	Bsc
10.	**Year of Study and Semester (s)**	Second or third
11.	**Other Department(s) Involved in Teaching the Course**	
12.	**Main Learning Language**	English
13.	**Learning Types**	■Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	■Moodle ■Microsoft Teams
15.	**Issuing Date**	28-10-2024
16.	**Revision Date**	29-10-2024

17. Course Coordinator:

Name: Saja Hayajneh Contact hours:(Su, Tue, Thu)11:30-12:30

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18. Other Instructors:

Name:
Office number:
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Contact hours:
Name:
Office number:
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Email:
Contact hours:

19. Course Description:

The structure of complex numbers (modulus, conjugate, polar form, roots, regions). Complex valued functions. (examples, limits, continuity). The derivative of a complex valued function. Formulas for differentiation. Cauchy - Riemann equations. Analytic functions (definition and basic properties). Harmonic functions (definition and basic properties). Elementary complex valued functions (exponential, trigonometric, hyperbolic, and logarithmic functions: their definitions and basic properties and inverse functions). Branches of logarithmic functions. Contours and contour integration. The Cauchy-Goursat theorem. Simply and multiply connected regions. The Cauchy integral formula. Morera's Theorem. Maximum modulus principle. Entire functions and Liouville's theorem. The fundamental theorem of algebra. Sequences and series of complex numbers (limits, convergence) Taylor series Laurent series. Absolute and uniform convergence of power series. Integration and differentiation of power series. Series representations of analytic functions on regions. Residues and Residue theorem. Poles. Residues at poles. Computations of residues. Improper integrals

20. Program Student Outcomes (SO's):

(To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

1. Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline

7. Utilize research methods, critical and creative thinking skills to assess and analyze information) to solve problems properly, then draw valid reasoning and logical conclusions leading to true consequences.

21. Course Intended Learning Outcomes (CLO's):

(Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Manipulate and calculate with complex numbers, complex functions (polynomials, rational functions, exponential and trigonometric functions) and multi-valued functions (argument, logarithm and square root).
2. Identify subsets of the complex plane and their geometric and topological properties (open, closed, connected, bounded, convex, star-shaped etc).
3. Determine if a sequence of complex numbers is convergent, compute the limit of a given sequence and apply the Cauchy criterion.
4. Define the limit of a complex function at a point and apply properties of limits. Compute the limit of a complex function at a point and determine whether a given complex function is continuous.
5. Define the derivative of a complex function, state and prove properties of the derivative and compute the derivative of a given complex function. Derive the Cauchy-Riemann equations for a complex differentiable function and identify whether a function is complex differentiable at a point.
6. Determine if an infinite series of complex numbers is convergent. Describe the convergence properties of a complex power series, derive formulae for and compute the radius of convergence.
7. Identify and construct examples of paths satisfying prescribed properties. Evaluate complex path integrals and state and prove properties of such integrals. Define the index function for a path, describe its properties and evaluate winding numbers.
8. State and prove versions of Cauchy's theorem and its consequences including Cauchy's integral formula, the power series representation for analytic functions, Liouville's theorem and the Fundamental Theorem of Algebra.

9. Find Taylor and Laurent series for a complex function, compute residues and apply the residue theorem to evaluate integrals

10. Use complex analysis to solve various problems in differential equations and other branches of mathematics.

Course CLOs	The learning levels to be achieved					
	Remembering	Understanding	Applying	Analysing	evaluating	Creating
1		■				
2		■				
3		■				
4		■				
5		■				
6				■		
7					■	
8				■		
9					■	
10						■

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SO's / Course CLO's	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)	SO (6)	SO (7)	SO (8)
CLO (1)	■						■	
CLO (2)							■	
CLO (3)							■	
CLO (4)							■	
CLO (5)							■	
CLO (6)							■	
CLO (7)	■							
CLO (8)							■	
CLO (9)	■							
CLO (10)							■	

23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types Face to Face (FF) Blended (BL) Fully Online (FO)	Platform Used	Synchronous (S) Asynchronous (A)	Evaluation Methods	Learning Resources
1	1.1	Properties of complex number, Modulus, complex conjugate of a complex number.	1	FF	Teams	S		Text Book
	1.2	Roots of unity and nth roots of a complex number.	1	FF	Teams	S		Text Book
	1.3	Solving Problems. Topological properties of subsets of complex numbers as: interior, exterior and boundary points, open and closed	2	FF	Teams	S		Text Book

		sets, connected sets, domains, regions and accumulation points, point at ∞						
2	2.1	Complex functions, domain of definitions, mappings: examples.	4	FF	Teams	S		Text Book
	2.2	Limit, continuity and differentially of a complex functions.	4	FF	Teams	S		Text Book
	2.3	Analyticity at a point, analyticity in a domain, and Cauchy - Riemann equations .Harmonic function, harmonic conjugate, and analyticity.	5	FF	Teams	S		Text Book
3	3.1	Elementary functions: Basic properties of exponential function, Basic properties of Trigonometric functions, Basic properties of hyperbolic functions.	5	FF	Teams	S		Text Book
	3.2	Logarithmic function, general branch, principal branch, analyticity of a branch, choosing a suitable branch.	5	FF	Teams	S		Text Book
	3.3	Properties of general exponential function, and inverse function.	5	FF	Teams	S		Text Book
4	4.1	Complex integral. Cantour integral, antiderivative, independence of path, Cauchy - Goarsat theorem for simply connected domain and for multiply connected domain, deformation of contours.	7	FF	Teams	S		Text Book
	4.2	Cauchy Integral formula, derivative of analytic function, Lieouville and Morera Theorems.	8	FF	Teams	S		Text Book

	4.3	Maximum modulus principles for analytic function and for harmonic function.	8	FF	Teams	S		Text Book
5	5.1	Series of complex numbers Taylor series, Laurent series.	9	FF	Teams	S		Text Book
	5.2	Singular and Taylor parts of expansion of a complex function, types of singular points.	9	FF	Teams	S		Text Book
6	6.1	Residue theorem: Residue of a function at a singularity, residue theorem.	9	FF	Teams	S		Text Book
	6.2	Applications: evaluating integral of trigonometric functions.	10	FF	Teams	S		Text Book
	6.3	Evaluating improper real integral.	10	FF	Teams	S		Text Book

24. Evaluation Methods:

Opportunities to demonstrate achievement of the CLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLO/s Linked to the Evaluation activity	Period (Week)	Platform
Midterm exam	30		1+2+3+4+5	8	On campus
Second exam	20		6+7+8	11	On campus
Final	50		1+2+3+4+5+ 6+7+8+9+10	Final exams period	On campus

25. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform…etc.):

-Data show, Microsoft Teams account.

26. Course Policies:

1. Attendance is absolutely essential to succeed in this course. You are expected to attend every class; please notify your instructor if you know you are going to be absent. All exams must be taken at the scheduled time. Exceptions will be made only in extreme circumstances, by prior arrangement with the instructor.
2. If a student is absent for more than 10% of lectures without an excuse of sickness or due to other insurmountable difficulty, then he/she shall be barred from the final examination also he/she will get a failing grade in this course. Medical certificates shall be given to the University Physician to be authorized by him. They should be presented to the Dean of the Faculty within two weeks of the student's ceasing to attend classes.
3. Test papers shall be returned to students after correction. His/her mark is considered final after a lapse of one week following their return.
4. Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on homeworks.

27. References:

A- Required book (s), assigned reading and audio-visuals:

Complex variables and applications J. Brown and R. Churchill., 6th Edition, Mc Grow-Hill, Inc.

B- Recommended books, materials, and media:

1. Fundamentals of complex analysis. E Saff, and A. Snider.
2. Complex Variables with Applications, By A. D. Wunsch
3. Complex Analysis. By S. Lang.

28. Additional information:

Name of the Instructor or the Course Coordinator: **Dr. Saja Hayajneh**	Signature: ……	Date: 29-10-2024
Name of the Head of Quality Assurance Committee/ Department: **Prof. Manal Ghanem**	Signature: ……	Date: ……
Name of the Head of Department: **Prof. Baha Alzalg**.	Signature: ……	Date: ……
Name of the Head of Quality Assurance Committee/ School of Science: **Prof. Emad A. Abuosba**	Signature: ……	Date: ……
Name of the Dean or the Director: **Prof. Mahmoud I. Jaghoub**	Signature: ……	Date: ……