The University of Jordan

Accreditation & Quality Assurance Center

COURSE Syllabus

Course Name:
Complex Analysis

1	Course title	**Complex Analysis**
2	Course number	(0301412)
3	Credit hours (theory, practical)	3
	Contact hours (theory, practical)	3
4	Prerequisites/corequisites	(0301212)
5	Program title	B.Sc.
6	Program code	
7	Awarding institution	The University of Jordan
8	Faculty	Science
9	Department	Mathematics
10	Level of course	College requirement
11	Year of study and semester (s)	all Semesters
12	Final Qualification	B.Sc. in Mathematics
13	Other department (s) involved in teaching the course	None
14	Language of Instruction	English
15	Date of production/revision	1.11.2016

16. Course Coordinator:

Office numbers, office hours, phone numbers, and email addresses should be listed.

Dr. Saja Hayajneh

17. Other instructors:

Office numbers, office hours, phone numbers, and email addresses should be listed.

18. Course Description:

As stated in the approved study plan.

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 of the form $\int_0^\infty f(z)\,dz$

19. Course aims and outcomes:

A- Aims:

1. To present basic properties, the algebra and geometry of complex numbers.
2. To visualize complex functions as mappings and transformations of regions of the plane and to introduce basic properties of Analytic function.
3. To extend elementary functions to the complex case.
4. To develop, in a rigorous and self contained manner, the elements of line and contour integrals and series.
5. To introduce Laurent series.
6. To present Residue theorem.
7. To use complex integration methods to evaluate Real Improper integrals.

B- Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to …

Successful completion of the course should lead to the following outcomes:

A. Knowledge and Understanding Skills: Student is expected to

A1. Manipulate and calculate with complex numbers, complex functions (polynomials, rational functions, exponential and trigonometric functions) and multi-valued functions (argument, logarithm and square root).

A2. Identify subsets of the complex plane and their geometric and topological properties (open, closed, connected, bounded, convex, star-shaped etc).

A3. Determine if a sequence of complex numbers is convergent, compute the limit of a given sequence and apply the Cauchy criterion.

A4. 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.

A5. 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.

B. Intellectual Analytical and Cognitive Skills: Student is expected to

B1. 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.

C. Subject- Specific Skills: Student is expected to

C1. 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.

C2. 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.

C3. Find Taylor and Laurent series for a complex function, compute residues and apply the residue theorem to evaluate integrals

D. Creativity /Transferable Key Skills/Evaluation: Student is expected to

D1. Use complex analysis to solve various problems in differential equations and other branches of mathematics.

20. Topic Outline and Schedule:

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
Properties of complex number, Modulus, complex conjugate of a complex number. Roots of unity and n^{th} roots of a complex number. Solving Problems. Topological properties of subsets of complex numbers as: interior, exterior and boundary points, open and closed sets, connected sets, domains, regions and accumulation points, point at ∞ .Solving Problems. Complex functions, domain of definitions, mappings: examples. Limit, continuity and differentially of a complex functions.	1-3				
Analyticity at a point, analyticity in a domain, and Cauchy - Riemann equations.Harmonic function, harmonic conjugate, and analyticity.	4-6				
Elementary functions: Basic properties of exponential function, Basic properties of Trigonometric functions, Basic properties of hyperbolic functions. Logarithmic function, general branch, principal branch, analyticity of a branch, choosing a suitable branch. Properties of general exponential function, and inverse function.	7-9				
Complex integral. Cantour integral, antiderivative, independence of path, Cauchy - Goarsat theorem for simply connected domain and for multiply connected domain, deformation of contours. Cauchy Integral formula, derivative of analytic function, Lieouville and Morera Theorems. Maximum modulus principles for analytic function and for harmonic function.	10-12				
Series of complex numbers Taylor series, Laurent series. Singular and Taylor parts of expansion of a complex function, types of singular points.	12-13				
Residue theorem: Residue of a function at a singularity, residue theorem. Applications: evaluating integral of trigonometric functions. Evaluating improper real integral.	14-15				

21. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

In order to succeed in this course, each student needs to be an active participant in learning – both in class and out of class.

- Class time will be spent on lecture as well as discussion of homework problems and some group work.
- To actively participate in class, you need to prepare by reading the textbook and doing all assigned homework before class (homework will be assigned each class period, to be discussed the following period).
- You should be prepared to discuss your homework (including presenting your solutions to the class) at each class meeting - your class participation grade will be determined by your participation in this.
- You are encouraged to work together with other students and to ask questions and seek help from the professor, both in and out of class.

22. Evaluation Methods and Course Requirements:

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

ILO/s	Learning Methods	Evaluation Methods	Related ILO/s to the program
	Lectures	Exam	

23. 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.
3. 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.
4. Test papers shall be returned to students after correction. His/her mark is considered final after a lapse of one week following their return.
5. Cheating is prohibited. The University of Jordan regulations on cheating will be applied to any student who cheats in exams or on homeworks.

24. Required equipment:

Data Shows

25. 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.
4. مبـادئ التحـليل المركـب د محمود كتكت

26. Additional information:

Name of Course Coordinator: Dr. Saja Hayajneh Signature: ------------------------- Date: 1/11/2016

Head of curriculum committee/Department: Dr. Hisham M. Hilow Signature: -----------------------

Head of Department: Dr. Baha Alzalg Signature: ---------------------------------

Head of curriculum committee/Faculty: Dr. Amal Al-Aboudi Signature: ---------------------------------

Dean: Dr. Sami Mahmood Signature: ---------------------------------

Copy to:
Head of Department
Assistant Dean for Quality Assurance
Course File