UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN MATHEMATICS

SYLLABUS WITH EFFECT FROM 2023-2024

<table>
<tr><td>Title of the Course</td><td colspan="7">COMPLEX ANALYSIS</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">528C3A</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">5</td><td>1</td><td>--</td><td colspan="2">6</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">UG level Complex Analysis</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">To Study Cauchy integral formula, local properties of analytic functions, general form of Cauchy’s theorem, Riemann Mapping theorem and monodromy theorem</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I :Cauchy’s Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions:Removable Singularities-Taylors’s Theorem – Zeros and poles – The local Mapping – The Maximum Principle.
Chapter 4 : Section 2 : 2.1 to 2.3Chapter 4 : Section 3 : 3.1 to 3.4</td></tr>
<tr><td colspan="7">UNIT-II :The general form of Cauchy’s Theorem : Chains and cycles- Simple Continuity - Homology - The General statement of Cauchy’s Theorem - Proof of Cauchy’s theorem - Locally exact differentials- Multiply connected regions - Residue theorem - The argument principle.
Chapter 4 : Section 4 : 4.1 to 4.7 Chapter 4 : Section 5: 5.1 and 5.2</td></tr>
<tr><td colspan="7">UNIT-III :Riemann mapping Theorem : Statement and Proof – Boundary Behaviour – Use of the Reflection Principle. Conformal mappings of polygons : Behaviour at an angle Schwarz-Christoffel formula – Mapping of a rectangle.Harmonic Functions : Functions with mean value property – Harnack’s principle.
Chapter 6 : Sections 1.1 to 1.3 (Omit Section1.4)
Sections 2.1 to 2.3 (Omit section 2.4), Section 3.1 and 3.2</td></tr>
<tr><td colspan="7">UNIT-IV :Weierstrass Theory : The Weierstrass $\wp$-function – The functions $\zeta(s)$ and $\sigma(s)$ – The differential equation – The modular equation $\lambda(\tau)$ – The Conformal mapping by $\lambda(\tau)$.
Chapter 7 : Sections 3.1 to 3.5</td></tr>
<tr><td colspan="7">UNIT-V: Analytic Continuation :The Weiesrtrass Theory – Germs and Sheaves – Sections and Riemann surfaces – Analytic continuation along Arcs – Homotopic curves – The Monodromy Theorem – Branch points.
Chapter 8 : Sections 1.1 to 1.7</td></tr>
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Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
Reference Books	1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990. 2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978 3. E. Hille, *Analytic function Thorey*(2 vols.), Gonm& Co, 1959. 4. M.Heins, *Complex function Theory*, Academic Press, New York,1968.
Website and e-Learning Source	http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics, http://www.opensource.org , http://en.wikipedia.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1: Analyze and evaluate local properties of analytical functions and definite integrals.

CLO2: Describe the concept of definite integral and harmonic functions.

CLO3: Demonstrate the concept of the general form of Cauchy's theorem

CLO4: Prove Riemann Mapping theorem and Harnack Principle.

CLO5 The Monodromy Theorem – Branch points.

	POs						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	3	1	3	2	3	3	3	2	1
CLO2	2	1	3	1	3	3	3	2	1
CLO3	3	2	3	1	3	3	3	2	1
CLO4	1	2	3	2	3	3	3	2	1
CLO5	3	1	2	3	3	3	3	2	1