P.B. SIDDHARTHA COLLEGE OF ARTS & SCIENCE

Siddhartha Nagar, Vijayawada – 520 010
Reaccredited at ‘A+’ level by NAAC
Autonomous&ISO 9001:2015 Certified

Title of the Course: COMPLEX ANALYSIS
Semester : II

Course Code	22MA2T1	Course Delivery Method	Blended Mode
Credits	4	CIA Marks	30
No. of Lecture Hours / Week	4	Semester End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Year of Introduction : 2020-21	Year of offering : 2022-23	Year of Revision: ---	Percentage of Revision : ---

Course Objectives:
The main objective of the course is to learn the basic properties of complex numbers, analytical functions, differentiation and integration of complex valued functions.

CO-NO	COURSE OUTCOME	BTL	PO	PSO
CO1	use the Cauchy-Riemann equations to find the derivative of a complex valued function.	**K3**	**1**	**2**
CO2	Apply Cauchy integral formula to evaluate complex contour integrals.	**K3**	**7**	**2**
CO3	find power series representations of analytic functions.	**K3**	**3**	**2**
CO4	classify singularities and evaluate complex integrals using the residue theorem.	**K3**	**7**	**2**
CO5	Understand Rouche’s theorem and Linear Transformations.	**K3**	**1**	**1**

Mapping of Course Outcomes:

CO-PO-PSO MATRIX										
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
22MA2T1	**CO1**	**2**								**3**
	CO2							**3**		**3**
	CO3			**3**						**3**
	CO4							**3**		**3**
	CO5	**3**							**2**	

UNIT-I

Analytic Functions: Continuity- Derivatives- Differentiation Formulas-Cauchy-Riemann Equations-Sufficient conditions for Differentiability-Polar Coordinates- Analytic Functions-Harmonic Functions. [Sec 18 to 26 of Chapter 2 of the Prescribed Text Book [1]]

UNIT-II

Integrals: Derivatives of functions w(t)-Definite integrals of functions w(t)- Contours-Contour Integrals- Cauchy-Goursat theorem- Proof of the theorem- Simply Connected Domains- Multiply Connected Domains- Cauchy Integral Formula- An extension of Integral Formula- Some Consequences of the extension- Liouville's Theorem and the Fundamental Theorem of Algebra.

[Sec 37 to Sec 41 and Sec 46 to Sec 53 of chapter 4 of the Prescribed Text Book [1]]

UNIT-III

Series: Convergence of Sequences- Convergence of Series-Taylor's series – Proof of Taylor's theorem- Examples- Laurent's series – Proof of Laurent's Series- Examples.

[Sec 55 to 62 of Chapter-5 of the Prescribed Text Book [1]]

UNIT-IV

Residues and Poles: Isolated singular points- Residues – Cauchy's residue theorem- Residue at Infinity- the three types of isolated singular points - Residues at poles, Zero's of analytic function- Zeros and Poles- Evaluation of improper integrals.

[Sec 68 to 76 of chapter 6 and sec 78, 79 of chapter 7 of the Prescribed Text Book [1]]

UNIT-V

Argument principle- Rouche's theorem- Linear Transformations: The transformation w=1/z - Mappings by 1/z - Linear fractional transformations - The transformation w=sin z.

[Sec 86 &87 of chapter7, sec 90 to 93, 96 of chapter 8 of the Prescribed Text Book [1]]

Prescribed Text Book:

1. "Complex Variables and Applications", James Ward Brown, Ruel V. Churchill, McGraw-Hill International Editions, Eighth Edition.

Reference Books:

1. "Complex analysis for Mathematics and Engineering", John H. Mathews and Russel W, Howell, Narosa Publishing house.
2. "Complex Variables", H. S. Kasana, Prentice Hall of India.

Course has Focus on :Foundation

Websites of Interest: 1. www. nptel.ac.in

2. www.epgp.inflibnet.ac.in

3. www.ocw.mit.edu

P B SIDDHARTHA COLLEGE OF ARTS AND SCIENCE::VIJAYAWADA

(An autonomous college in the jurisdiction of Krishna University)

M. Sc. Mathematics

Second Semester

COMPLEX ANALYSIS– 22MA2T1

Time: 3 hours **Max. Marks: 70**

SECTION-A

Answer all questions. All questions carry equal marks. **(5x4=20)**

1 a) Check the differentiability of f (z) = $\bar{z}$ (CO1, L2)

(OR)

b) Show that the function f(z) = z^2 is an entire function. (CO1, L2)

2 a) Evaluate $\int_c f(z)$, where f(z) = $2e^{i\theta}$ and $0\leq \theta\leq 2\pi$. (CO2, L2)

(OR)

b) Define simply connected domain and multiply connected domain.

Give an example for each. (CO2, L2)

3 a) Find the Taylors series expansion of the function f (z) = 1 / (1 + z) at the point 0.

(CO3, L3)

(OR)

b) Find the Laurent series expansion of the function f(z) = $\frac{1}{z(1+z)}$ at the point 0 in the domain $1 < |z| < \infty$ (CO3, L3)

4 a) Find the residue of the function f (z) = 2z / $(z – 1)^2$ at z = 1. (CO4, L2)

(OR)

b) Find the residue of the function f(z) = $\frac{1}{z+z^2}$ at z = 0 (CO4, L2)

5 a) Find the linear transformation that maps (2, i, -2) onto (1, i, -1) (CO5, L2)

(OR)

b) Find the fixed points of $f(z) = \frac{z-1}{z+1}$ (CO5, L2)

SECTION – B

Answer all questions. All questions carry equal marks. (5X10=50)

6 a) Suppose that the complex function f (z) = u + iv is differentiable at $z_0=x_0+iy_0$, then prove that the first order partial derivatives of 'u' and 'v' are exist and satisfies Cauchy Riemann equations $u_x = v_y$ and $u_y = -v_x$ at (x_0,y_0). (CO1, L2)

(OR)

b) If a function f(z) = u + i v is analytic in a domain D, then show that u and v are harmonic in D. Also find a harmonic conjugate of $u(x, y) = y^3-3x^2 y$ (CO1, L2)

7 a) State and Prove Cauchy-Goursat Theorem. (CO2, L3)

(OR)

b) State and Prove Cauchy Integral formula. (CO2, L3)

8 a) State and prove Taylor's theorem. (CO3, L3)

(OR)

b) State and prove Laurent's theorem. (CO3, L3)

9 a) State and prove Cauchy's residues theorem. (CO4, L3)

(OR)

b) Using residue theorem, evaluate the improper integral $\int_0^\infty \frac{x^2}{x^6+1}dx$ (CO4, L3)

10 a) State and prove Rouche's Theorem. (CO5, L3)

(OR)

b) Discuss the transformation w = 1/z (CO5, L3)

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