SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Course/ Subject Code: BE100303

Course/Subject Name: Complex Variables and Applications

w.e.f.Academic Year:	2025-26
Semester:	3rd Semester/ 2nd Year
Category of the Course:	Basic Science Course

Prerequisite:	Geometry, trigonometry, calculus and ODE.
Rationale:	This subject is a powerful tool for solving a wide array of applied problem

Teaching and Examination Scheme –

Hours per Week			Course Credits	Examination Marks				
				Theory Marks		Practical Marks		
L	T	P		E	M	I	V	100
3	2	0	5	60	40	0	0	

Detailed Syllabus –

Unit	Content	Hours	% of Weightage
1	Polar Form of Complex Numbers, Powers and Roots, Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	12	**29%**
2	Complex Variable - Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Sequences, Series, Convergence Tests, Power Series, Functions Given by Power Series, Taylor and Maclaurin Series, Uniform Convergence.	8	**19%**
3	Laurent's series; Zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Residue Integration Method, Residue Integration of Real Integrals.	6	**14%**
4	First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method	6	**14%**
5	Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	10	**24%**
	Total Teaching Hours	**42**	**100%**

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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
7	28	35	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Course Outcome:After Completion of the Course, Student will able to:

Co No.	Course Outcomes	RBT level
CO-1	Convert complex numbers to polar form, plot roots, find harmonic conjugate of analytic functions, and apply conformal mapping.	Apply
CO-2	Evaluate complex integrals, test convergence of series, and expand analytic functions in Taylor's series.	Analyze
CO-3	Find Laurent's series and poles, and apply Cauchy Residue Theorem to evaluate real integrals.	Analyze
CO-4	Form and solve first-order linear and nonlinear partial differential equations	Apply
CO-5	Solve higher-order PDEs and model real-world problems related to Heat, Wave, and Laplace equations.	Apply & Evaluate

CO-PO Mapping

PO \ CO	CO1	CO2	CO3	CO4	CO5
PO1 – Engineering Knowledge	3	3	3	3	3
PO2 – Problem Analysis	2	3	3	2	2
PO3 – Design/Development of Solutions	0	0	0	0	2
PO4 – Investigation of Complex Problems	1	2	2	2	3
PO5 – Modern Tool Usage	2	2	2	1	2
PO6 – The Engineer and Society	0	0	0	0	0
PO7 – Environment and Sustainability	0	0	0	0	0
PO8 – Ethics	0	0	0	0	0
PO9 – Individual and Team Work	0	0	0	0	0
PO10 – Communication	0	0	0	0	0

PO11 – Project Management and Finance	0	0	0	0	0
PO12 – Life-long Learning	0	0	0	0	0

CO-PSO

CO \ PSO	PSO1 - Apply mathematical concepts to solve real-world engineering problems	PSO2 – Develop models and use simulation tools to analyze engineering systems
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	3

References/Suggested Learning Resources:

(a) Books:

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
- Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
- Dennis G. Zill, 4th edition, Advanced Engineering Mathematics, 4th Edition, Jones and Bartlett Publishers.
- Dennis G. Zill, Patrick D. Shanahan, A First Course in Complex Analysis with Applications, Jones and Bartlett Publishers.
- S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
- Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill.
- J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill.

(b) Opensource software and website:

- MIT Open course ware. NPTEL.

Swaminarayan University

Teaching & Examination Scheme

Course – Faculty of Engineering (Degree)

Branch – Automobile Engineering

Semester – 3rd

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100301	Technical Writing & Communication Skills	Humanities and Social Science	2	0	2	3	60	40	20	30	150
BE100302	Indian Constitution	Mandatory	2	0	0	0	50	0	0	0	50
BE100303	Complex Variables and Applications	Basic Science	3	2	0	5	60	40	0	0	100
BE101301	Material Science and Metallurgy	Engineering Science	3	0	2	4	60	40	20	30	150
BE101302	Engineering Thermodynamics	Professional Core	4	0	2	5	60	40	20	30	150
BE101303	Kinematics and Theory of Machines	Professional Core	4	0	2	5	60	40	20	30	150
	Total		**18**	**2**	**8**	**22**					

L=Lecture, T=tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External