SANKALCHAND PATEL UNIVERSITY, VISNAGAR

Faculty of Science & Humanities

Structure, Teaching Scheme and Syllabus of

B.Sc. (Honours and Honours with Research) Mathematics

Semester -7

as per NEP-2020

Program Code: SC104

With effect from: 2023-24

Faculty of Science and Humanities
B.Sc. (Mathematics) (Semester - VII)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Complex Analysis-I
Course Code:	17-MAM401-4C
Pre-requisite Course:	Basic Concept of Complex Number

Course Objectives:

- To able to know complex numbers and the geometry of the complex plane culminating in finding the nth roots of a complex number.
- To know about Set up and directly evaluate contour integrals.
- To understand Classification of singularities and absolute and uniform convergence of power series.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory (Marks)		**Practical (Marks)**		
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total (Marks)**
3	-	2	4	50	25	-	25	100

Subject Contents:

Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	A quick overview of complex number system, polar representation and roots of complex numbers, the extended plane and its spherical representation, elementary functions and properties.	15	34
2	Continuity, derivatives, Cauchy-Riemann equations, C-R equation in polar coordinates and complex form, analytic functions, harmonic functions, power series, power series as an analytic function, branch of logarithm - its analyticity, analytic functions as mappings.	15	33
3	Contours, contour integrals, anti-derivative, Zeros of an analytic functions, Cauchy's theorem, simply and multiply connected domains and Cauchy's Integral Formula, Cauchy inequality, Liouville's theorem, Fundamental theorem of Algebra, Morera's theorem, Cauchy's theorem and simple connectivity, Goursat's theorem. Gauss mean value theorem, Principle of deformation of paths, Maximum modulus principle.	15	33

Reference Books:

1. Churchil, R.V., Brown, J. and Verle, R., Complex Variables and Applications, McGraw-Hill Publ.Co., 1974.

2. Conway, J.B., Functions of One Complex Variable, (Second Edition), Narosa Publ. House, NewDelhi, 1994.
3. Ponnusamy, S., Foundations of Complex Analysis,Narosa Publ. House, New Delhi, 1995.
4. Choudhary, B., The Elements of Complex Analysis, (Second Edition), Wiley Eastern Ltd., NewDelhi, 1992

List of Open-Source Software/learning website:

1. https://youtu.be/HhlD7sX5Tp8
2. https://youtu.be/DS9VCjE3xok
3. https://www.youtube.com/watch?v=a_PWw2qB-xE

Practical

Application of Complex Analysis of Unit-1, Unit-2 and Unit-3.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	**Explain** complex number system, polar representation and roots of complex numbers, the extended plane and its spherical representation, elementary functions and properties.	4 Analysing
CLO2	**Discuss** Continuity, derivatives, Cauchy-Riemann equations, C-R equation in polar coordinates and complex form, analytic functions.	2 Understanding
CLO3	**Explain** harmonic functions, power series, power series as an analytic function, branch of logarithm – its analyticity, analytic functions as mappings and **solve** the example of its.	4 Analysing, 3 Applying
CLO4	**Explain** Contours, contour integrals, anti-derivative, Zeros of an analytic functions, Cauchy's theorem, simply and multiply connected domains and Cauchy's Integral Formula, Cauchy inequality and **create** example of its.	4 Analysing , 6 Creating
CLO5	**Discuss** Liouville's theorem, Fundamental theorem of Algebra, Morera's theorem, Cauchy's theorem and simple connectivity, Goursat's theorem. Gauss means value theorem, Principle of deformation of paths, Maximum modulus principle	2 Understanding
CLO6	**Define** complex number, polar representation and continuity.	1 Remembering

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CLO1	3	2	1	1	2	1			1	1							2	2		
CLO2	2	2		1	2				1								2	1		
CLO3	3	2	2	1	2	1			1	1							2	2	1	
CLO4	3	2	3	2	2	1			1	1							2	2	1	1
CLO5	2	2		1	2				1								2	1		
CLO6	1																1	1		

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Mathematics) (Semester - VII)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Advanced Linear Algebra
Course Code:	17-MAM402-4C
Pre-requisite Course:	Basic Concept of Linear Algebra

Course Objectives:

- To able to know concept of vector space, linear dependence and dual space.
- To know about the algebra of linear transformation and characteristic of roots.
- To understand canonical form and Jordan forms.

. **Teaching and Examination Scheme:**

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory (Marks)		**Practical (Marks)**		
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total (Marks)**
3	**--**	**2**	**4**	**50**	**25**	**--**	**25**	**100**

Subject Contents:

Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	Quick review of vector spaces, linear independence and basis, dual space.	15	34
2	The algebra of linear transformations. Characteristic roots. Matrices.	15	33
3	Canonical forms: triangular forms, Canonical forms of a Nilpotent linear Transformation. Decomposition of a finite dimensional vector space: Jordan Forms.	15	33

Reference Books:

1. Churchil Herstein, I. N., Topics in algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. Kumaresan, S., Linear Algebra: A Geometric Approach, Prentice Hall of India, 2000.
3. Simmons G. F., Introduction to Topology and Modern Analysis, McGraw-Hill Co., tokyo, 1963.
4. Helson, H., Linear Algebra, (Second Edition), Hindustan Book Agency, TRIM-4, 1994.
5. Kwak J. H., Hong S., Linear Algebra, (Second edition), Birkhauser

List of Open Source Software/learning website:

1. https://www.youtube.com/watch?v=Pc2dWW3aSrk
2. https://www.youtube.com/watch?v=CeqNHmkLn2w
3. https://www.youtube.com/watch?v=0dyvN40wKow

Practical

Application of Advanced Linear Algebra of Unit-1, Unit-2 and Unit-3.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	**Explain** vector spaces, linear independence and basis, dual space and **solve** the example of its.	4 Analysing, 3 Applying
CLO2	**Discuss** The algebra of linear transformations. Characteristic roots.	2 Understanding,
CLO3	**Explain** Matrices.	4 Analysing
CLO4	**Describe** triangular forms, Canonical forms of a Nilpotent linear Transformation.	1 Remembering, 3 Applying
CLO5	**Discuss** Decomposition of a finite dimensional vector space: Jordan Forms.	2 Understanding
CLO6	**Create** an example of vector spaces, linear independence, basis and Characteristic roots and	6 Creating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	3	2	1	1	2	1			1								2	2		
CLO2	2	2		1	2				1								2	1		
CLO3	2	2			2				1	1							2	1		
CLO4	3	2	1		2				1								2	2		
CLO5	2	2			2				1								2	1		
CLO6	3	2	3	1	2	1			1	1							2	2	1	1

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Mathematics) (Semester - VII)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Ordinary Differential Equations
Course Code:	17-MAM403-4C
Pre-requisite Course:	

Course Objectives:

- To able to know concept of Series solution near an ordinary point.
- To know about Legendre polynomial and its properties.
- To understand Gauss hypergeometric function and its properties.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory (Marks)		**Practical (Marks)**		
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total (Marks)**
3	**--**	**2**	**4**	**50**	**25**	**--**	**25**	**100**

Subject Contents:

Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	Classification of singularities, Series solution near an ordinary point, Frobenius method: series solution near regular singular point, Point at infinity.	15	34
2	Legendre equation, Legendre polynomial and its properties, Rodrigue's formula, Generating function for Legendre polynomial, Recurrence relations for $P_n(x)$.	15	33
3	Bessel's equation, Bessel's function of first and second kind and their properties, Generating function for Bessel's function, Recurrence relations for $J_n(x)$.	15	33

Reference Books:

1. "Introduction to Ordinary Differential Equations", A. L. Rabenstein, Academic Press.
2. "Advanced Differential Equations", M. D. Raisinghania, S. Chand &Co..
3. "Higher Engineering Mathematics", B. S. Grewal and J. S. Grewal, Khanna Publ., New Delhi.
4. "Advanced Engineering Mathematics" E. Kreyszig, Narosa Publ. House, New Delhi
5. "Differential equations with applications and historical notes", G. F. Simmons, McGrawHill
International Editions.

List of Open Source Software/learning website:

1. https://www.youtube.com/watch?v=URa1v3CW0Vg&list=PLVCBPCYGv7bDv4yw-Gw8bw4YXR4YiULqh
2. https://www.youtube.com/watch?v=Cx0zrEEi22c&list=PL5Xv9SnZb7HcqtwLE8GiEETxXDtkM2S2D
3. https://www.youtube.com/watch?v=-pfjHPimzfM&list=PLAPKGqvQGg6rXw7-CoRYH2ZvnZU49k7n9

Practical

Application of Ordinary Differential Equations of Unit-1, Unit-2 and Unit-3.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	**Explain**Classification of singularities, Series solution near an ordinary point and **solve** example of its.	4 Analysing 3 Applying
CLO2	**Discuss** Frobenius method: series solution near regular singular point, Point at infinity and **solve** example of its.	2 Understanding 3 Applying
CLO3	**Use** Legendre polynomial and **solve** Recurrence relations for $P_n(x)$	3 Applying
CLO4	**Explain** Rodrigue's formula, Generating function for Legendre polynomial, Recurrence relations for $P_n(x)$ and create example of its .	4 Analysing 6 Creating
CLO5	**Describe**Bessel's equation, Bessel's function of first and second kind and their properties.	2 Understanding
CLO6	**Explain** Generating function for Bessel's function, Recurrence relations for $J_n(x)$.	4 Analysing

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	3	2	1	1	2	1			1								2	2		
CLO2	3	2	1	1	2	1			1								2	2		
CLO3	3	2			2				1	1							2	2		
CLO4	3	2	3	1	2	1			1	1							2	2	1	
CLO5	2	2		1	2				1								2	1		
CLO6	3	2	1	1	2	1			1	1							2	2	1	

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Mathematics) (Semester - VII)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Introduction to "C" Language
Course Code:	17-MAE401-4C
Pre-requisite Course:	Basic knowledge of computer.

Course Objectives:

- To understand the basic concept of C Language.
- To understand how we use Conditional statements, Decision making and branching, Decision making and looping.
- To understand Some mathematical C- programs.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory (Marks)		**Practical (Marks)**		
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total (Marks)**
3	**--**	**2**	**4**	**50**	**25**	**--**	**25**	**100**

Subject contents:

Sr. No.	**Content**	**Lectures**	**Weightage**
1	Constants, variables and data types, operators and expressions, managing input and output Operators	15	33%
2	Conditional statements, Decision making and branching, Decision making and looping.	15	33%
3	Practical's: Largest among the numbers, Sum of individual digits of a given number Reverse order of a given number, evaluations of operators, Determination of roots of quadratic equations, Ax2+Bx+C=0.	15	34%

Reference Books:

1. "Programming in ANSI C" by E. Balagurusamy, The McGraw-Hill Pub. Co. Ltd., 1992.
2. Computer programming in C, V Rajaraman, PHI-2002
3. "The C Programming Language" by B. W. Kernighan and B. M. Ritchie. Prentice-Hall, 1977.
4. "The C Primer" by L. Hancock and M. Krieger, McGraw-Hill, 1987.

List of Open-Source Software/learning website:

1. https://www.youtube.com/watch?v=rQoqCP7LX60
2. https://www.youtube.com/watch?v=eU_gysTNtoM
3. https://www.youtube.com/watch?v=T_LNs7fxt3c

Practical

- Arranging given set of numbers in increasing/decreasing order, calculation of Mean.
- Evaluation of sum of power series eg. ex, sin x, cos x, log (1 + x).
- Calculation of GCD/LCM of two integers, sum of given numbers, Fibonacci numbers

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	**Discuss** basic definition which is using in C Language.	2 Understanding
CLO2	**Explain** managing input and output Operators.	2 Understanding
CLO3	**Use** C language programs **Discuss** Various definitions	3 Applying, 2 Understanding
CLO4	**Discuss** the basic concept of programs.	2 Understanding
CLO5	**Determination** of roots of quadratic equations, Ax2+Bx+C=0,.	5 Evaluating
CLO6	**Define** Constants, variables and data types	1 Remembering

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	2	2		1	1				1	1							2	1		
CLO2	2	2		1	1				1	2							2	2		
CLO3	3	2	1	1	2				1	2							2	2	1	
CLO4	2	2		1	1				1	1							2	1		
CLO5	3	2	1		2	1			1	2							2	2	1	
CLO6	1									1							1	1		

3: High, 2: Medium, 1: Low

Faculty of Science and Humanities
B.Sc. (Mathematics) (Semester - VII)
In Effect from Academic Year 2023-24

Branch Name:	B.Sc. Mathematics
Program Code:	SC104
Course Name:	Classical Mechanics
Course Code:	17-MAE401-4O
Pre-requisite Course:	

Course Objectives:

- To able to know Lagrangian formulation.
- To know about Mechanics in configuration space.
- To understand variational principle to real physical situations.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**				
				Theory (Marks)		**Practical (Marks)**		
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Total (Marks)**
3	**--**	**2**	**4**	**50**	**25**	**--**	**25**	**100**

Subject Contents:

Sr. No	**Topic**	**Total Hours**	**Weightage (%)**
1	Lagrangian formulation: D'almbert's principle, Principle of virtual work, Classification of constraints, Lagrange's equation for holonomic systems and illustrations.	15	34
2	Euler-Lagrange equation, Hamilton's variational principle, Derivation of Lagrange's equation from Hamilton's variational principle, Generalized momentum, Mechanics in configuration space, General conservation theorem and illustration.	15	33
3	Hamilton's canonical equation of motion, Relation with Lagrange's equation, Conservation theorems, Variational principal approach to Hamilton's equation of motion, Variational principle and Hamilton's equation and examples.	15	33

Reference Books:

1. "Classical Mechanics with Introduction to Nonlinear Oscillations and Chaos", Bhatia, Narosa Publ.
2. "Classical Mechanics", C. R. Mondal, Prentice Hall of India Pvt. Ltd.
3. "Classical Mechanics", Tai L. Chow, John Wiley and Sons Inc.
4. "Classical Mechanics-System of Particles and Hamiltonian Dynamics", Walter greiner, Springer.
5. "Classical Mechanics", H. Goldstein, C. Poole and J. Safko, Pearson Education, Inc.

List of Open Source Software/learning website:

1. https://www.youtube.com/watch?v=QGCdoGoZb9A
2. https://www.youtube.com/watch?v=F4Lkp_uBqFI&list=PLAPKGqvQGg6qpx3XzL5w6oB-h2Ot3IT7l
3. https://www.youtube.com/watch?v=pzyYVfup79A&list=PLNr6lMkF6EGCyOLXN3nC0lFyIfy7oc3yi

Practical

Application of Classical Mechanics of Unit-1, Unit-2 and Unit-3.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom'sTaxonomyLevel
CLO1	**Discuss** Lagrange's equation for holonomic systems and illustrations.	2 Understanding 3 Applying
CLO2	**Use** Hamilton's equation and **solve** the example of its.	3 Applying
CLO3	**Describe** variational principle approach to Hamilton's equation of motion.	1 Remembering
CLO4	**Explain**Infintesimal canonical transformations.	4 Analysing
CLO5	**Describe** General equation of motion .	1 Remembering
CLO6	**Decide** Poisson bracket formulation	5 Evaluating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Programme Outcomes (POs)																Programme Specific Outcome (PSOs)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PSO1	PSO2	PSO3	PSO4
CLO1	3	2			2												2	2		
CLO2	3	2			2												2	2		
CLO3	2	1			1												1	1		
CLO4	3	3			2												2	2		
CLO5	2	1			1												1	1		
CLO6	3	3	2		2	1			1								2	2	1	1

3: High, 2: Medium, 1: Low