M. G. Science Institute (Autonomous) B. Sc. (Hons.) Mathematics

Semester-V

DSC-C-MAT-351T: Analysis-I

Semester-V	Course Title: Analysis-I	Credit: 4
Course Code: 351T	Major-1(T)	Hours: 4/week

Cos with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Recall fundamental definitions, notations, and basic properties related to real numbers, sequences, series, and functions.
CO2	UNDERSTANDING	Explain key concepts such as convergence, limits, continuity, and differentiability using appropriate examples and counterexamples.
CO3	APPLYING	Apply standard theorems and techniques of real analysis to solve problems involving sequences, series, limits, and continuous functions.
CO4	ANALYZING	Analyze mathematical statements to determine convergence, continuity, and differentiability by examining underlying conditions and logical structure.
CO5	EVALUATING	Evaluate transformations, roots, and functional behaviors in the complex plane to test conformality and angle preservation.
CO6	CREATING	Evaluate the validity of mathematical arguments and proofs in real analysis and justify conclusions using rigorous reasoning.

Unit	Detailed Syllabus	No. of Hours of Teaching
Unit-I	**Real Number System** Algebra and order properties of $\mathbb{R}$. Upper and lower bounds; supremum, infimum. Completeness property of $\mathbb{R}$ and applications. Absolute value and triangle inequality.	**15**
Unit-II	**Sequences and Their Convergence** Sequences, convergence, limit theorems.Monotone sequences, Cauchy sequences.Sandwich (Squeeze) lemma. Subsequences, Bolzano–Weierstrass theorem. Some important standard limits.	**15**
Unit-III	**Continuity** Limit of a function (ε–δ approach).Limit theorems; continuity of functions. Algebra of continuous functions. Intermediate Value Theorem, Extreme Value Theorem. Uniform continuity, Lipschitz condition (optional enrichment).	**15**
Unit-IV	**Infinite Series** Definition and convergence of series.Special series: geometric, telescoping, harmonic.Cauchy criterion for series. Tests of convergence: comparison test, p-series, ratio test, root test, integral test, Cauchy condensation test, Abel–Pringsheim test. Absolute and conditional convergence.	**15**

Text Books:

1. **Gerald G. Bilodeau, Paul R. Thie, G.E. Keough** – *An Introduction to Analysis,* Jones & Bartlett.

Reference Books

- R.G. Bartle & D.R. Sherbert – *Introduction to Real Analysis*.
- W. Rudin – *Principles of Mathematical Analysis*.
- T.M. Apostol – *Mathematical Analysis*.
- K.A. Ross – *Elementary Analysis*.

M. G. Science Institute (Autonomous) B. Sc. (Hons.) Mathematics

Semester-V

DSC-C-MAT-352T: Complex Analysis and IKS

Semester-V	Course Title: Complex Analysis and IKS	Credit: 4
Course Code: 352T	Major-1(T)	Hours: 4/week

Cos with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Recall Vedic Mathematics sutras for algebraic multiplication, division, factorisation, HCF, and LCM, along with fundamental properties of complex numbers and elementary functions.
CO2	UNDERSTANDING	Explain concepts of complex numbers, exponential and trigonometric forms, convergence of sequences and series, and basic properties of analytic functions.
CO3	APPLYING	Apply Vedic Mathematics techniques to simplify algebraic computations and use complex number properties in problem solving.
CO4	ANALYZING	Examine mappings, Cauchy-Riemann equations, and harmonic functions to identify analyticity and differentiability.
CO5	EVALUATING	Evaluate transformations, roots, and functional behaviors in the complex plane to test conformality and angle preservation.
CO6	CREATING	Construct conformal mappings and apply transformations (linear, fractional, and w=1/z) to model regions in the complex plane.

Unit	Detailed Syllabus	No. of Hours of Teaching
Unit-I	**IKS (Vedic Mathematics)** Algebraic multiplication (Urdhva-Tiryagbhyam Sutra), Algebraic division (Paravartya Yojayet Sutra), Algebraic GCD or HCF (Lopanasthapanabhyam Sutra, Sankalana Vyavakalanabhyam Sutra, Adyamadyenantyamantyena Sutra), LCM by algebraic division (Paravartya Yojayet sutra), Factorisation of algebraic expression (Anurupyen, Adyamadyenantyamantyena, Vilokanam, Lopanasthapanabhyam, Urdhva-Tiryagbhyam)	**15**
Unit-II	**Complex Numbers and Elementary Functions** Sums and products, Basic algebraic properties, Vectors and moduli (Triangle inequality), Complex conjugates, Exponential form, Products and powers in exponential form, Arguments of products and quotients, Roots of complex numbers, Region in the complex plane, Exponential Function, Trigonometric functions, Hyperbolic functions, Convergence of sequences, Convergence of series	**15**
Unit-III	**Analytic Functions** Functions of complex variable, Mappings, Mappings by exponential function, Limits, Theorems on limits, Continuity, Derivatives, Differentiation formulas, Cauchy-Riemann equations, Sufficient conditions for differentiability, Polar co-ordinates, Analytic functions, Harmonic functions	**15**
Unit-IV	**Mapping by Elementary Functions and Conformal Mappings** Linear transformations, The transformation $w=1/z$, Mappings by $w=1/z$, Linear fractional transformations, An implicit form, Preservations of angles, Scale factors	**15**

Text Books:

1) Complex Variables and Applications, James Ward Brown and Ruel V. Churchil, McGraw Hill International Edition, Eighth edition. (For Unit-II to Unit-IV)

2) Elements of Vedic Mathematics, Udayan S. Patankar and Sunil M. Patankar, TTU Press. (For Unit-I)

Reference Books:

1) A Pathway to Complex Analysis, S. Kumaresan, Techno World (2022).

2) Complex Variables - Theory and Applications, H. S. Kasana, PHI.

3) Foundations of Complex Analysis, S. Ponnusamy, Narosa Publishing House.

4) Vedic Mathematics, Jagadguru Swami Sri Bharati Krsna Tirthaji Maharaja, Motilal Banarsidass.

MAM 353 P: Mathematics Major Practical

Semester: V	Course Title: Mathematics Major Practical	Credit: 4
Course No.: 353 P	Major (P)	Hours: 8/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Recall and define the fundamental concepts of Linear Programming Problems (LPP); identify and formulate problems and express them in standard and canonical forms.
CO2	UNDERSTANDING	Explain and interpret the graphical method, simplex method, Big-M method, and the principle of duality with suitable examples.
CO3	APPLYING	Apply the dual simplex method, and solve transportation problems using NWCM, LCM, and VAM methods; determine optimal solutions for balanced transportation and assignment problems.
CO4	ANALYSING	Analyze and compare variations in transportation and assignment problems; decompose complex linear programming models into subproblems; interpret computational outcomes.
CO5	EVALUATING	Evaluate and test the convergence of sequences and infinite series; distinguish between countable and uncountable sets; verify properties involving absolute value and triangle inequality.
CO6	CREATING	Construct and derive Fourier series representations; develop analytic functions and their harmonic conjugates; find transformations under f(z)=1 / z and apply De Moivre's theorem to complex problems.

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Examples of formulation of LPP.	5
2.	Examples of graphical method.	5
3.	Examples of simplex method.	5
4.	Examples of Big-M method.	5
5.	Examples of principal of duality.	5
6.	Examples of dual simplex.	5
7.	Examples of transportation problem by NWCM, LCM and VAM.	5
8.	Examples of optimal solution of balanced transportation problems.	5
9.	Examples of assignment problems.	5
10.	Variation in transportation problem and assignment problem.	5
11.	Fourier series -1.	5

12.	Fourier series -2.	5
14.	Examples of countable sets.	5
15.	Examples of uncountable sets.	5
16.	Examples of based on absolute value and triangle inequality.	5
17.	Examples of convergence of sequence.	5
18.	Convergence of infinite series-1.	5
19.	Convergence of infinite series-2.	5
20.	Application of De-Moivere's theorem.	5
21.	Examples of analytic function.	5
22.	Find the harmonic conjugate of a function and hence find corresponding analytic function.	5
23.	If $f(z) = u + iv$ is an analytic function then find $f(z)$ when $u, v, u - v$ or $u + v$ is given.	5
24.	Problems on transformation under function $(z) = 1/\mathrm{z}$.	5