INDRASHIL UNIVERSITY

(Established by an Act under the Gujarat Private Universities Act, 2009)

A Life Sciences University

"Sustained Excellence with Relevance"

SCHOOL OF SCIENCE

M. SC. MATHEMATICS

PROGRAM STRUCTURE & DETAILED SYLLABUS

2022-2024

INDRASHIL UNIVERSITY

(Established by an Act under the Gujarat Private Universities Act, 2009)

A Life Sciences University

"Sustained Excellence with Relevance"

Course Structure

Semester - 1

Course Code	Course Title	L	T	P	C
MA 101	C Programming and its applications	3	0	2	4
MA 102	Linear Algebra	3	1	0	4
MA 103	Ordinary Differential Equations	3	1	0	4
MA 104	Real Analysis	3	1	0	4
MA 105	Abstract Algebra	3	1	0	4

Semester - 2

Course Code	Course Title	L	T	P	C
MA 201	Complex Analysis	3	1	0	4
MA 202	Topology	3	1	0	4
MA 203	Partial Differential Equations	3	1	0	4
MA 204	Optimization Techniques	3	1	0	4
MA 205	Probability and Statistics	3	1	0	4

INDRASHIL UNIVERSITY

(Established by an Act under the Gujarat Private Universities Act, 2009)

A Life Sciences University

"Sustained Excellence with Relevance"

Semester - 3

Course Code	Course Title	L	T	P	C
MA 301	Functional Analysis	3	1	0	4
MA 302	Multivariate Calculus	3	1	0	4
MA 303	Integral equations and calculus of variations	3	1	0	4
MA ***	Elective - 1	3	1	0	4
MA ***	Elective - 2	3	1	0	4

Semester - 4

Course Code	Course Title	L	T	P	C
MA 401	Advanced Discrete Mathematics	3	1	0	4
MA ***	Elective - 3	3	1	0	4
MA ***	Elective - 4	3	1	0	4
MA ***	Elective - 5	3	1	0	4
MA ***	Elective – 6 / Project	3	1	0	4

Summary:

Code	Course Description	Credits
MA	Core	56
MA	Elective/Interdisciplinary	24
	Total	80

Note: One Computer Lab for courses related to programming will be required.

INDRASHIL UNIVERSITY

(Established by an Act under the Gujarat Private Universities Act, 2009)

A Life Sciences University

"Sustained Excellence with Relevance"

MA 101: C Programming and its applications

Theory

1. Introduction to Programming languages, C-language and its features
2. Understanding structure of programming C
3. Basic data types, Libraries in C
4. Operators and Expressions in C
5. Functions used for input and output in C
6. Conditional Branching in C, use of If-Then
7. Looping in C, use of forloop, whileloop, do-whileloop, nested loops
8. Algorithm and flowchart

Practical

1. Some simple programmes using C
2. Leap year
3. Generate first n-primes
4. Roots of quadratic equation
5. Convert a number to any given base
6. Generate first n perfect numbers
7. Sine and cosine series by Taylor series
8. Addition and multiplication of matrices
9. Inverse of a matrix
10. Transpose of a matrix
11. Finding roots of a polynomial using Bisection Method
12. Newton-Raphson Method
13. Regula-Falsi Method
14. Gauss Elimination Method
15. Gauss-Seidal Method
16. Simpson's 1/3rd rule and 3/8th rule
17. Trapezoidal Rule
18. Solution of differential equation using Euler's Method
19. Runge-Kutta Method
20. Lagrange's Interpolation

Reference books:

1. The C Programming Language, Brian Kernighan and Dennis Ritchie , PHI Publications.
2. Let us C, Yashavant Kanetkar, BPB Publications.
3. Programming in C , Balaguruswamy, McGraw Hill Education.
4. S. S. Sastry, Introductory methods of Numerical Analysis, Prentice-Hall of India, 2006.

MA 102: Linear Algebra

Unit-1:

Quick review of vector spaces, examples of sequence and function spaces. Linear spans; linear dependence/independence and basis, examples of finite dimensional and infinite dimensional vector spaces, quotient space and its dimension, dual space, dual basis, dimension of the annihilator. Solution of the system of simultaneous linear homogeneous equations.

Unit-2:

Definitions and examples of algebra, algebra analog of Cayley theorem, minimal polynomial of a linear transformation, rank of a linear transformation, characteristic roots, characteristic vectors and results related to characteristic vectors.

Unit-3:

Matrix associated with a linear transformation on finite dimensional vector space, isomorphism between the space of linear transformations and the space of matrices, similarity of matrices and similarity of linear transformations, Relation of the minimal polynomials of a linear transformation and its induced linear transformation on a quotient space, triangular matrix associated to a linear transformation, nilpotent linear transformation, canonical matrix associated to a nilpotent linear transformation, existence and uniqueness of invariants of a nilpotent linear transformation. Jordan form of a linear transformation, Trace and its applications, Jacobson's lemma, transpose of a matrix.

Unit-4:

Definition of the determinant of a matrix, determinant of a triangular matrix, a matrix with equal rows, a product of matrices, application of determinant: regularity of a matrix, Cramer's rule to solve system of simultaneous non-homogeneous linear equations, quadratic forms: diagonalization of a symmetric matrix, symmetric matrix associated to a quadratic form, classification of quadrics.

Reference books:

1. 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. RamachandraRao A. and Bhimasankaram P., Linear Algebra (Second Edition), Hindustan Book Agency, TRIM-19, 2000.

MA 103: Ordinary Differential Equations

Unit-1:

Linear equations of first order, The second order homogeneous equation, initial value problems, Linear dependence and independence, A formula for the Wronskian, The homogeneous equation of order n, The non-homogeneous equation of order n, special method for solving non-homogeneous equation.

Unit-2:

Linear equations with variable coefficients ,Initial value problem, solution of thehomogeneousequation,Wronskianandlinearindependence,reductionoforderof ahomogeneousequation,Non-homogeneous equation, Homogeneous equations with analytic coefficients, The Legend re equation, The Euler equation, second or derequation with regular singular points, The Bessel equation.

Unit-3:

Equations with variables separated, exact equation, The method of successive approximations, The Lipschitz condition, convergence of successive approximations, Non-local existence of solutions, approximations to and uniqueness of the solutions.

Unit-4:

Some special equation, complex n-dimensional space, system as vector equations, existence and uniqueness of solution to systems, existence and uniqueness of solution for linear systems, equations of ordern.

Reference books:

1. E.A. Coddington, An Introduction to Ordinary Differential Equation, Prentice-Hall of India Pvt. Ltd., New Delhi.
2. G. F. Simmons, Differential Equations with Applications and Historical Notes, (2nd edition)McGraw Hill Book Co.
3. G. Birkh off and G.C. Rota, Ordinary Differential Equations, John Wiley and Sons.

MA 104: Real Analysis

Unitt-1:

Definition of the Riemann integral, Properties of the Riemann integral, Integration and Differentiation. Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation.

Unit-2:

Drawbacks of the Riemann Integration, Recipes for extending the Riemann integral, the Lebesgue measure and its properties.

Unit-3:

Lebesgue integral, dominated convergence theorem, convergence in measure, relation with convergence a. e. Vitali's theorem (statement only).

Unit-4:

Absolute continuity, differentiability of monotone functions, Functions of bounded variation, Fundamental theorem of calculus for Lebesgue integral and its applications.

REFERENCE BOOKS:

1. I. K. Rana, An Introduction to Measure and Integration, Narosa Publishing House,2004.
2. H. L. Royden, Real Analysis, Macmaillan Publishing Company, 1995.
3. Walter Rudin, Real and complex Analysis, Tata-McGraw-Hill Publishing Co. Ltd.,1987.
4. J. H. Williamson, Lebesgue Integration, Holt, Rienhart and Winston Inc., 1962.
5. Richard R.Goldberg, Methods of Real Analysis, Oxford & IBH publishing Co. Pvt. Ltd..
6. Tom M. Apostol, Mathematical Analysis, Narosa pub. House (2nd Edi.)
7. Bartle, R.G. and Sherbert, D.R., Introduction to real analysis (2nd edition), John Wiley & Sons, Inc., New York.

MA105: Abstract Algebra

Unit-1:

Quick review: Definition and examples of Groups, Subgroups, order of an element of a group, Lagrange's Theorem, Cyclic groups, Normal subgroups, Fundamental theorem of homomorphism. Permutation groups.

Unit-2:

Group actions and permutation representations, Groups acting on themselves by left multiplication – Cayley's theorem, Groups acting on themselves by left multiplication – Class equations, Automorphisms, The Sylow's theorems, the simplicity of A_n.

Unit-3:

Ring, subring, ring homomorphism and quotient rings, ideal of aring , Maximal Ideals, Prime ideals. Integral domain, Field, Imbedding theorem, Euclidian domain, Principal ideal domain, Unique factorization domain.

Unit-4:

Polynomial rings over fields, irreducibility criteria, Filed extensions, Algebraic field extensions and examples, Finite field extensions, Finite fields.

REFERENCE BOOKS:

1) I. N. Herstein, Topics in Algebra, Wiley, 2008.
2) J. Fraleigh, A First Course in Abstract Algebra, Pearson, 2003.
3) P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press, 1995.
4) D. Dummit and R. Foote, Abstract Algebra, Wiley, 2004.
5) N. McCoy and G. Janusz, Introduction to Abstract Algebra, 7th Edn., Trustworthy Communications, Llc, 2009

MA 201: Complex Analysis

Unit -1:

Functions of a Complex Variable, Mappings, Limits, Theorems on Limits, Limits Involving the Point at Infinity, Continuity, Derivatives, Cauchy–Riemann Equations, Sufficient Conditions for Differentiability, Polar Coordinates, Analytic Functions, Harmonic Functions, Uniquely Determined Analytic Functions, Reflection Principle, Elementary functions.

Unit -2:

Definite Integrals of Functions, Contour Integrals, Branch Cuts, Upper Bounds for Moduli of Contour Integrals, Anti derivatives, Cauchy–Goursat Theorem, Simply Connected Domains, Cauchy Integral Formula, Liouville's Theorem and the Fundamental Theorem of Algebra, Maximum Modulus Principle, Schwarz's lemma (fromPonnusammy's book) Convergence of Sequences and series, Taylor Series, Laurent Series, Absolute and Uniform Convergence of Power Series.

Unit - 3:

Isolated Singular Points, Residues,Cauchy's Residue Theorem,Residue at Infinity, TheThree Types of Isolated Singular Points, Residues at Poles,Zeros of Analytic Functions, Zerosand Poles, Behaviourof functions nearisolated singular points,

Unit-4:

Evaluation of Improper Integrals, Jordan's Lemma, Definite Integrals Involving Sines and Cosines, Argument Principle, Rouch´e's Theorem. Mapping by elementary functions.

Reference books:

1. R. V. ChurchillandJ. W. Brown, Complex Variables and Applications (eighth edition),McGraw Hill Publication.
2. Foundation of Complex Analysis-S.Ponnusamy, Narosa Publication, Second Edition.

3. Functions of one Complex Variable-John B.Convey, Narosa Publishing House.
4. Complex Analysis-L.V. Ahlfors, McGrawHill.
5. Functions of Complex Variables-H. Silverman
6. Complex Analysis-T.W. Gamelin, Springer Publications.

MA 202: Topology

Unit-1:

Topological Spaces, Basis for Topology, The Order Topology, The product Topology, The Subspace Topology , Closed Sets and Limit Points , Continuous functions, The Metric Topology.

Unit-2:

Connected Spaces, Connected Subspace on Real Line. Compact Spaces, Compact Sub space on the Real Line, Limit Point Compactness, Local Compactness.

Unit-3:

Countable Axioms: First countable, Second Countable, Separable, Lindel of, Separation Axioms: Regular and Normal spaces.

Unit-4:

The Urysohn's Lemma, The Urysohn Metrization Theorem and the Tychon off Theorem.

Reference books:

1. James R. Munkres: Topology, A first course, Prentice Hall of India. Pvt. Ltd. New Delhi-2000.
2. J. Dugundji Allya and Bacon, Topology,(1966)reprinted: Prentice Hall of India.
3. W. J. Pervin: Foundations of general topology, academic press Inc. N. Y. HiS.
4. T.Hu: Elements of general topology. HoldendayInc.1965.
5. StephenWillard,GeneralTopology,Addison-WesleyPublishingCompany,1970
6. Sheldon W. Davis, Topology (The Walter Rud in Student Seriesin Advanced Mathematics), TATAMcGraw-Hill.2006.
7. Sidney A Morris, Topology without Tears,2011 Version.

MA 203: Partial Differential Equations

Unit-1:

First order PDE, classification of integrals, Linear equations of first order, Pfaffi and ifferential equations, compatible systems, Charpit's method, Jacobi's method.

Unit-2:

Classification of second order PDE, one dimension alwave equation, Laplace equation, Theory of Green's function for Laplace equation, Heat conduction problem, Duhamel's principle.

Unit-3:

Fourier Series: Piecewise Continuous Functions, Fourier Cosine Series, Fourier Sine Series, Fourier series, adaptations to other intervals.

Unit-4:

Convergence of Fourier Series: One-Sided Derivatives, A Property of Fourier Coefficients, Two lemmas, A Fourier Theorem, Discussion of the theorem and its corollary, convergence on other intervals, A Lemma, Absolute and Uniform Convergence of Fourier Series, Differentiation of Fourier Series, Integration of Fourier Series.

Reference books:

1. T. Amarnath: An elementary course in PDE (2nd edition), Narosa Publishing House.
2. W. E. Williams: "Partial Differential Equations", Clared on Press Oxford.
3. E. T. Copson:"Partial Differential Equations", Cambridge University Press.
4. I.N. Sneddon : "Elements of Partial Differential Equation", McGraw Hill.

MA 204: Optimization Techniques

Unit-1:

Operations research and its scope, Necessity of operations research in industry, Linear programming problems, Convex sets, Simplex method, Theory of simplex method, artificial variable technique, Duality theory, Dual simplex method. Revised simplex method and Sensitivity analysis.

Unit-2:

Transportation and Assignment problems, travelling salesman problem.

Unit-3:

Game Theory: Introduction, competitive game, finite and infinite game, two person zero sum game, rectangular game, solution of game. PERT-CPM, product planning control with PERT-CPM.

Unit-4:

Inventory Control: Costs Associated with Inventories-Factors affecting Inventory Control-Economic Order Quantity (EOQ), Deterministic Inventory Problems with no Shortages and with Shortages, Characteristics and Corollary. Queuing theory: Steady state solution of Markovian queuing models: M/M/1,M/M/1 with limited waiting space.

Reference books:

1. Dr. R. K. Gupta: Linear Programming, Krishna Prakashan Mandir.
2. F. S. Hillier and G. J. Liebermann, Introduction to Operations Research (6thEd.), McGraw Hill International Edition, Industrial Engineering Series,1995.
3. Kanti swaroop, P. K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
4. G.Hadley, Linear Programming, Narosa publishing House,1995.
5. G. Hadley, Non linear and Dynamic Programming, Addison-Wesley, Reading

Mass.

6. H. A. Taha, Operations Research: An Introduction, Macmillan Publishing Company, New York.
7. S. S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.
8. Prem Kumar Gupta and D. S. Hira, Operations Research-An Introduction S. Chand & company Ltd, New Delhi.
9. N. S. Kambo, Mathematical Programming Techniques. Affiliated East-West Press Pvt. Ltd, New Delhi.

MA 205: Probability and Statistics

Unit-1:

Sets and classes, limit of a sequence of sets, fields, sigma-fields, monotone classes. Sample Space and Events, Axioms of Probability, Sample Spaces Having Equally Likely Outcomes, Conditional Probabilities, Bayes Formula, Independent Events.

Unit-2:

Random Variables, Distribution Functions, Discrete Random Variables, Expected Value, Expectation of a Function of a Random Variable, Variance, Discrete distributions: uniform, binomial, geometric, negative binomial, hyper geometric, Poisson. Continuous distributions: uniform, exponential, gamma, Weibull, beta, normal, Cauchy.

Unit-3:

Joint Distribution Functions, Independent Random Variables, Sums of Independent Random Variables, Conditional Distributions: Discrete Case and Continuous Case, Joint Probability Distribution of Functions of Random Variables. Expectation of Sums of Random Variables, Covariance, Variance of Sums, and Correlations, Conditional Expectation, Moment Generating Functions, Joint Moment Generating Functions.

Unit-4:

Problems on Che by shev's and other inequalities, Modes of Convergence, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.

Reference books:

1. Sheldon Ross, A First Course in Probability, PRENTICEHALL India.
2. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, second edition, Wiley series.
3. Murray R. Speigel, Schaum's Outline of Probability and Statistics.
4. J. S. Milton & J. C. Arnold, Introduction to Probability and Statistics.

5. H. J. Larson, Introduction to Probability Theory and Statistical Inference.
6. S. M. Ross, Introduction to Probability and Statistics for Engineers and Scientists.
7. P. Halmos, Measure Theory (for algebra of sets)
8. Feller, W., Introduction to Probability Theory and its Applications, 3rd Ed., Wiley Eastern, 1978.
9. PrakashRao, B.L.S., A First Course in Probability and Statistics, World Scientific, 2009.

***