DAYALBAGH EDUCATIONAL INSTITUTE
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS: 2024-25

Courses offered to B.Sc.

Course Number	Course Title	T/P	Course Type	Credits	End Sem. Exam.Exists
SEM I					
MAM101	STATISTICS I	T	DS Major/Minor	4.0	Yes
MAM102	DISCRETE MATHEMATICS	T	DS Major/Minor	4.0	Yes
MAM103	SEMINAR & GROUP DISCUSSION I	P	AEC	1.0	No
ENL101	ENGLISH ENHANCEMENT COURSE I	T	AEC	2.0	Yes
HIL101	HINDI BHASHA KAUSHAL	T	AEC	2.0	Yes
STL101	BHASHA SAMPRESHAN – I	T	AEC	2.0	Yes
MAH101	COMPUTATIONAL TECHNIQUES	T	MDC	2.0	Yes
MAH102	REAL ANALYSIS	T	MDC	2.0	Yes
MAW101	MATHEMATICAL WRITING	P	SEC	2.0	No
CEC191	CULTURAL EDUCATION	T	VAC	2.0	No
ESC191	ENVIRONMENTAL STUDIES	T	VAC	2.0	No
GKC191	SC.METH. G.K. & CURRENT AFFAIRS I	T	VAC	1.0	No
RDC191	RURAL DEVELOPMENT	P	SEC	1.0	No
SEM II					
MAM201	ANALYSIS I (CALCULUS OF 1 VARIABLE)	T	DS Major/Minor	4.0	Yes
MAM202	ALGEBRA I (GROUP & RINGS)	T	DS Major/Minor	4.0	Yes
MAM203	SEMINAR & GROUP DISCUSSION II	P	AEC	1.0	No
ENL201	ENGLISH ENHANCEMENT COURSE II	T	AEC	2.0	Yes
HIL201	GYAN KE VIVIDH KSHETRA AUR HINDI	T	AEC	2.0	Yes
STL201	BHASHA SAMPRESHAN – II	T	AEC	2.0	Yes
MAH201	COMPUTATIONAL TECHNIQUES	T	MDC	2.0	Yes
MAH202	REAL ANALYSIS	T	MDC	2.0	Yes
MAW201	MATHEMATICAL SKILLS	P	SEC	2.0	No
RDC291	RURAL DEVELOPMENT	P	SEC	1.0	No
RDC292	AGRICULTURAL OPERATIONS	p	SEC	1.0	No
CAC291	CO-CURRICULAR ACTIVITIES	p	VAC	3.0	No
CRC291	COMPARATIVE STUDY OF RELIGION	T	VAC	2.0	No
GKC291	SC.METH. G.K. & CURRENT AFFAIRS II	T	VAC	1.0	No
SEM III					
MAM301	ANALYSIS II INTEGRATION & CONVERGENCE	T	DS Major/Minor	4.0	Yes
MAM302	ALGEBRA II (LINEAR ALGEBRA)	T	DS Major/Minor	4.0	Yes
MAM303	OPERATIONS RESEARCH	T	DS Major/Minor	4.0	Yes
MAM304	SEMINAR & GROUP DISCUSSION III	P	AEC	1.0	No
SDC391	SAFETY & DISASTER MANAGEMENT	T	MDC	2.0	Yes
MAW301	MATHEMATICAL APPLICATIONS	P	SEC	2.0	No
GKC391	SC.METH. G.K. & CURRENT AFFAIRS II	T	VAC	1.0	No
SEM IV					
MAM401	DIFFERENTIAL EQUATIONS I (O.D.EQNS.)	T	DS Major/Minor	4.0	Yes
MAM402	STATISTICS II	T	DS Major/Minor	4.0	Yes
MAM403	ANALYSIS III (VECTOR CALCULUS)	T	DS Major/Minor	4.0	Yes
MAM404	SEMINAR & GROUP DISCUSSION IV	P	AEC	1.0	No
CAC491	CO-CURRICULAR ACTIVITIES	P	VAC	3.0	No
GKC491	SC.METH. G.K. & CURRENT AFFAIRS IV	T	VAC	1.0	No
SEM V					
MAM501	METHODS OF APPLIED MATHEMATICS	T	DS Major	4.0	Yes
MAM502	DIFFERENTIAL EQUATIONS II (P. D. E.)	T	DS Major	4.0	Yes
MAM503	METRIC SPACES	T	DS Major	4.0	Yes
MAM504	CURVES & SURFACES	T	DS Major	4.0	Yes
MAM505	INTRODUCTION TO 'C'	T	DS Major	2.0	Yes
MAM506	PROGRAMMING LAB I (C)	P	DS Major	2.0	Yes

MAM507	SEMINAR & GROUP DISCUSSION V	P	AEC	1.0	No
MAM511	METHODS OF APPLIED MATHEMATICS	T	DS Minor	4.0	Yes
MAM512	DIFFERENTIAL EQUATIONS II (P. D. E.)	T	DS Minor	4.0	Yes
SIC501	SUMMER INTERNSHIP	P	SEC	3.0	No
SEM VI					
MAM601	NUMERICAL ANALYSIS	T	DS Major	4.0	Yes
MAM602	NUMBER THEORY	T	DS Major	4.0	Yes
MAM603	COMPLEX ANALYSIS	T	DS Major	4.0	Yes
MAM604	ALGEBRA III (SYLOW'S THEOREM & I.P.S)	T	DS Major	4.0	Yes
MAM605	DATA STRUCTURES IN 'C'	T	DS Major	2.0	Yes
MAM606	PROGRAMMING LAB II (DATA STRUCTURES)	P	DS Major	2.0	Yes
MAM607	SEMINAR & GROUP DISCUSSION VI	P	AEC	1.0	No
MAM611	NUMERICAL ANALYSIS	T	DS Minor	4.0	Yes
MAM612	NUMBER THEORY	T	DS Minor	4.0	Yes
SEM VII					
MAM701	MEASURE & INTEGRATION	T	DS Major	4.0	Yes
MAM702	TOPOLOGY	T	DS Major	4.0	Yes
MAM703	THEORY OF DIFFERENTIAL EQUATIONS	T	DS Major	4.0	Yes
MAM704	RINGS & CANONICAL FORMS	T	DS Major	4.0	Yes
MAM705	BASIC RES. METH., SC. COMPUT. & ANAL.	T	DS Major	4.0	Yes
MAM706	ANALYTICAL MECHANICS	T	DS Major	4.0	Yes
MAM711	MEASURE & INTEGRATION	T	DS Minor	4.0	Yes
SEM VII (WITH RESEARCH)					
MAM701	MEASURE & INTEGRATION	T	DS Major	4.0	Yes
MAM702	TOPOLOGY	T	DS Major	4.0	Yes
MAM703	THEORY OF DIFFERENTIAL EQUATIONS	T	DS Major	4.0	Yes
MAM704	RINGS & CANONICAL FORMS	T	DS Major	4.0	Yes
MAM705	BASIC RES. METH., SC. COMPUT. & ANAL.	T	DS Major	4.0	Yes
MAM707	PRE-DISSERTATION	P	DS Major	4.0	Yes
MAM711	MEASURE & INTEGRATION	T	DS Minor	4.0	Yes
SEM VIII					
MAM801	OPTIMIZATION	T	DS Major	4.0	Yes
MAM802	FIELD THEORY	T	DS Major	4.0	Yes
MAM803	FUNCTIONAL ANALYSIS	T	DS Major	4.0	Yes
MAM804	STOCHASTIC PROC. & STAT. INFERENCE	T	DS Major	4.0	Yes
MAM805	TENSOR ANALYSIS	T	DS Major	4.0	Yes
MAM806	MATHEMATICAL MODELING	T	DS Major	4.0	Yes
MAM811	OPTIMIZATION	T	DS Minor	4.0	Yes
SEM VIII (WITH RESEARCH)					
MAM801	OPTIMIZATION	T	DS Major	4.0	Yes
MAM802	FIELD THEORY	T	DS Major	4.0	Yes
MAM803	FUNCTIONAL ANALYSIS	T	DS Major	4.0	Yes
MAM804	STOCHASTIC PROC. & STAT. INFERENCE	T	DS Major	4.0	Yes
MAM807	DISSERTATION I	P	DS Major	8.0	Yes

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MAM701	MEASURE & INTEGRATION	4.0	Yes	T
MAM702	TOPOLOGY	4.0	Yes	T
MAM703	THEORY OF DIFFERENTIAL EQUATIONS	4.0	Yes	T
MAM704	ANALYTICAL MECHANICS	4.0	Yes	T
MAM705	RINGS & CANONICAL FORMS	4.0	Yes	T
MAM706	OOP AND MATHEMATICAL SOFTWARE LAB	2.0	Yes	P
MAM707	COMPUTER SYSTEMS ARCHITECTURE **(SAME AS CSM302)**	4.0	Yes	T
MAM708	DATA MANAGEMENT, VISUALIZATION & R	4.0	Yes	T
MAM801	OPTIMIZATION	4.0	Yes	T
MAM802	FIELD THEORY	4.0	Yes	T
MAM803	FUNCTIONAL ANALYSIS	4.0	Yes	T
MAM804	FLUID DYNAMICS	4.0	Yes	T

MAM805	STOCHASTIC PROC. & STAT. INFERENCE	4.0	Yes	T
MAM806	SOFTWARE LAB II	2.0	Yes	P
MAM812	GRAPH THEORY	4.0	Yes	T
MAM001	BASIC RES. METH., SC.COMPUT.& ANAL.	4.0	Yes	T
MAM002	PRE-DISSERTATION	4.0	No	P
MAM901	DISSERTATION	12.0	Yes	P
MAM902	MATHEMATICAL MODELLING	4.0	Yes	T
MAM903	INTRODUCTION TO RIEMANNIAN GEOMETRY	4.0	Yes	T
MAM904	FUZZY SETS & SYSTEMS	4.0	Yes	T
MAM951	DISSERTATION I	8.0	Yes	P
MAM953	SELF STUDY COURSE	4.0	Yes	P
MAM954	ADV. SCIENTIFIC METHODOLOGY& ANALYSIS	4.0	Yes	T
MAM955	SPECIAL TOPICS IN MATHEMATICS	4.0	Yes	T

(ONLY FOR M.SC. MATHEMATICS STUDENTS)
Compulsory
MAM701 MEASURE & INTEGRATION
MAM702 TOPOLOGY
MAM703 THEORY OF DIFFERENTIAL EQUATIONS
MAM704 ANALYTICAL MECHANICS
MAM705 RINGS & CANONICAL FORMS
MAM706 OOP AND MATHEMATICAL SOFTWARE LAB

(ONLY FOR M.SC. MATHEMATICS STUDENTS)
Compulsory
MAM801 OPTIMIZATION
MAM802 FIELD THEORY
MAM803 FUNCTIONAL ANALYSIS
MAM804 FLUID DYNAMICS
MAM806 SOFTWARE LAB II
Choose any one of the following:
MAM805 STOCHASTIC PROC. & STAT. INFERENCE
MAM812 GRAPH THEORY
Any course offered by the Dept. of Physics & Computer Science, Faculty of Science

(ONLY FOR M.SC. MATHEMATICS STUDENTS)
Compulsory
MAM901 DISSERTATION
MAM903 INTRODUCTION TO RIEMANNIAN GEOMETRY
Choose any one of the following:
MAM902 MATHEMATICAL MODELLING
MAM904 FUZZY SETS & SYSTEMS
Any course offered by the Dept. of Physics & Computer Science, Faculty of Science

(ONLY FOR M.SC. MATHEMATICS WITH SPECIALIZATION IN COMPUTER SCIENCE STUDENTS)
Compulsory Courses
MAM701 MEASURE & INTEGRATION
MAM702 TOPOLOGY
MAM703 THEORY OF DIFFERENTIAL EQUATIONS
MAM707 COMPUTER SYSTEMS ARCHITECTURE **(SAME AS CSM302)**
MAM708 DATA MANAGEMENT, VISUALIZATION & R
MAM706 OOP AND MATHEMATICAL SOFTWARE LAB

(ONLY FOR M.SC. MATHEMATICS WITH SPECIALIZATION IN COMPUTER SCIENCE STUDENTS)
Compulsory Courses
MAM801 OPTIMIZATION
MAM805 STOCHASTIC PROC. & STAT. INFERENCE
MAM806 SOFTWARE LAB II
Choose any Three out of the following:
MAM803 FUNCTIONAL ANALYSIS
MAM804 FLUID DYNAMICS
MAM812 GRAPH THEORY
Any course offered by the Dept. of Physics & Computer Science, Faculty of Science

(ONLY FOR M.SC. MATHEMATICS WITH SPECIALIZATION IN COMPUTER SCIENCE STUDENTS)
Compulsory Courses
MAM901 DISSERTATION
Choose any Two out of the following:
MAM902 MATHEMATICAL MODELLING
MAM903 INTRODUCTION TO RIEMANNIAN GEOMETRY
MAM904 FUZZY SETS & SYSTEMS
Any course offered by the Dept. of Physics & Computer Science, Faculty of Science

Courses offered to B.Tech. & M.Tech. Classes

Course Code	Course Title	Credits	End Sem. Exam.Exists	Theory/ Practical
MAM181	ENGINEERING MATHEMATICS I	3.0	Yes	T
MAM281	ENGINEERING MATHEMATICS II	3.0	Yes	T
MAM381	ENGINEERING MATHEMATICS III	3.0	Yes	T
MAM481	ENGINEERING MATHEMATICS IV	3.0	Yes	T
MAM581	DISCRETE MATHEMATICS	3.0	Yes	T
MAM582	PROBABILITY & STATISTICS **(For session 2024-2025)** NUMERICAL ANALYSIS **(Applicable from 2025-26)**	3.0	Yes	T
MAM681	ADVANCED OPTIMIZATION TECHNIQUES	3.0	Yes	T
PMA101	COMPUTATIONAL METHODS	4.0	Yes	T

MAM581 IS FOR CS SPECIALIZATION STUDENTS
MAM582 IS FOR OTHER B.TECH. STUDENTS

Course No: MAM101, Course Title: STATISTICS I

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods (55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem: 52
[APPLICABLE FROM 2024-25]

UNIT 1
Measures of Dispersion, Range, Mean Deviation, Standard Deviation, Coefficient of Variation, Quartile Deviation, Moments, Measures of Skewness and Kurtosis.
UNIT 2
Important concepts of probability, Different approaches to Probability, Addition Theorem of Probability, Conditional Probability, Multiplication Theorem of Probability, Independent Events, Multiplication Theorem of Probability for independent events, Total Probability Rule, Bayes' Theorem.
UNIT 3
Random Variables: Discrete and Continuous, Probability mass function, Probability Density Function, Distribution Function for Discrete and Continuous Random Variables. Mathematical Expectation, Expected Value of Function of Random Variable, Properties of Expectation, Mean, Variance and Covariance of a random variable using Expectation, Means and Variances of Linear Combination of Random Variables.
UNIT 4
Discrete Probability Distributions: Probability Function and Properties of Bernaulli, Binomial, Poisson, Negative Binomial, Geometric and Hypergeometric distributions, Moment Generating Functions, Moment Generating Functions of Discrete Probability Distributions.
UNIT 5
Continuous Probability Distributions: Probability Density Functions of Rectangular (Uniform) Distribution, Normal Distribution and their Moment Generating Functions.
SUGGESTED READING:
MATHEMATICAL STATISTICS: Freund
PROBABILITY & STATISTICS FOR ENGINEERS & SCIENTISTS: Walpole & Myers
PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS: Sheldon Ross
BASIC STATISTICS FOR BUSINESS AND ECONOMICS: Lind Marchal Wathen
ESSENTIAL OF STATISTICS FOR BUSINESS AND ECONOMICS: Anderson, Sweeney, Williams
INTRODUCTION TO MATHEMATICAL STATISTICS: Hogg RV, Craig AL

Course: MAM102, Title: DISCRETE MATHEMATICS

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
[APPLICABLE FROM 2024-25]

UNIT 1

Propositions, Connectives, propositional formulae, truth tables, equivalence of formulas, tautological implications, normal forms: disjunctive and conjunctive; Theory of inference for propositional calculus; Predicate calculus: predicates, variables and quantifiers, free and bound variables, universe of discourse, nested quantifiers.

UNIT 2

Russel's Paradox, Arbitrary Union, Arbitrary Intersection, Finite sets, Countable and uncountable sets, Axiom of choice, Partially Ordered Set, Ordered Set, Dictionary Order Relation, Upper Bound/ Lower Bound, Maximal/Minimal Element, Supremum, Infimum, Lattice, Zorn's Lemma, Well ordering principle.

UNIT 3

Principles of Mathematical Induction, Division Algorithm, Prime Numbers, Euclid's lemma, Greatest Common Divisor, Euclidean Algorithm, Fundamental Theorem of Arithmetic.

UNIT 4

Congruence, Properties of Congruence, Integers Modulo n. Combinatorics: Pigeonhole principle, multinomial theorem, principle of exclusion and inclusion, derangements, permutations with forbidden positions.

UNIT 5

Discrete numeric functions, Generating functions, Recurrence relations.

SUGGESTED READING:

Kenneth H Rosen, Discrete Mathematics and its Applications (7th ed.), McGraw-Hill Education, 2012.

Ralph P. Grimaldi, Discrete and Combinatorial mathematics-An Applied Introduction (5th ed.), Pearson Addison Wesley, 2003.

Gerald Berman and K. D. Fryer, Introduction to Combinatorics, Academic Press, 1972.

Course: MAM103, Title: SEMINAR & GROUP DISCUSSION

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2022-23
Total Credits:1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26

Seminar and Group Discussion based on MAM101 and MAM102 courses.

Course No.: MAH101, Course Title: COMPUTATIONAL TECHNIQUES

Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2022-23
Total Credits: 2, Periods(55 mts. each)/week:3(L-3-0+P/S-0), Min.pds./sem:39
[APPLICABLE FROM 2024-25]

UNIT 1: Mathematical Logic: Propositions, Connectives, Propositional formulae, Truth tables, Equivalence of formulae, Tautological implications

UNIT 2: Fast Computational Methods (with reasoning) for Multiplication: vertical and crosswise for multiplication of two digit, three and four digit numbers, special multiplication (by 11, 12, 111, 101 etc.), Squares, Square root

UNIT 3: Divisibility, Fast Computational Methods (with reasoning) for Division by 9, 8 etc., straight division method

UNIT 4: Fast Computational Methods (with reasoning) to solve various forms of Linear Equations and Simultaneous Equations

UNIT 5: Fast Computational Methods (with reasoning) to solve various forms of Quadratic Equations

SUGGESTED READING:

Vedic Mathematics: Dhaval Bhatia
Discrete and Combinatorial Mathematics: Ralph P. Grimaldi
Vedic Maths: Jagad Guru Swami Bharat Krishna Tirthaji Maharaj

Course No.: MAH102, Course Title: REAL ANALYSIS

Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2023-24
Total Credits: 2, Periods(55 mts. each)/week:3(L-3-0+P/S-0), Min.pds./sem:39
[APPLICABLE FROM 2024-25]

UNIT 1: Introduction to Functions, Modulus, Composition of functions, Graphs

UNIT 2: Limit ($\in -\delta$ concept), Continuity of real-valued functions of one variable

UNIT 3: Differentiation, Sum Rule, Product Rule, Quotient Rule, Chain Rule

UNIT 4: Increasing and decreasing functions, Maxima, Minima

UNIT 5: Integration: Definite integral (Riemannian sum concept), indefinite integral, fundamental theorem of integral calculus (statement only), Sum Rule, Product Rule, its application in finding definite integral

Course No.: MAW101, Course Title: MATHEMATICAL WRITING
Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2023-24
Total Credits:2, Periods(55 mts. each)/week:2(L-2-0+P/S-0), Min.pds./sem:26
[APPLICABLE FROM 2024-25]

Unit1: Writing definitions and proofs through grammatically sound statements and proper explanation of symbols (problems may be based on advanced set theoretic topics such as set theoretic results involving functions and their inverses, wored problems, etc.)
Unit2: Mathematical typing using MS word (Use of equation editor, symbols, tables, importing files from Excel, etc.)
Unit3: Editing tools (Tools in MS-Word, Use of Grammarly etc.)
Unit4: Proof Reading (symbols and marks)
Unit5: Power Point Presentation of a Mathematical document

Course No.: MAM201, Course Title: ANALYSIS I (CALCULUS OF ONE VARIABLE)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1
Real Number System and the Completeness Property, Intervals, Open Sets as Union of Open Intervals, Closed Sets, Archimedean Property of Real Numbers, Rational Density Theorem, Irrational Density Theorem, Existence of n-th roots
UNIT 2
Sequences in R, Limit of a Sequence, Monotone Sequences, Cauchy Sequence, Convergence of Infinite Series, Alternating Series, Absolute Convergence, Conditional Convergence, Tests for Convergence of Series, Decimal, Binary and Ternary Representation of Real Numbers, Uncountability of Real Numbers.
UNIT 3
Limit of a Function, Continuous Function, Algebra of Continuous Functions, Types of Discontinuities, Limits at Infinity, Infinite Limits, Asymptotes, Bounded Function, Intermediate Value Theorem, Extreme Value Theorem.
UNIT 4
Derivative of a Real Function, Algebra of Differentiable Functions, Chain Rule, Implicit Differentiation, Slope of a Curve, Tangent, Vertical Tangent, Normal, Higher Order Derivative, Leibnitz Rule, Mean Value Theorem, Rolle's Theorem, Intermediate Value Theorem for Derivatives.
UNIT 5
Indeterminate Forms, Applications of Derivatives, Local Maxima Minima, Increasing and Decreasing Functions, Concavity, Point of Inflection, Graphing in Cartesian Coordinates, Polar Coordinates, Polar Equations, Graphing in Polar Coordinates.
SUGGESTED READING:
CALCULUS AND ANALYTICAL GEOMETRY: Thomas & Finney
PRINCIPLES OF MATHEMATICAL ANALYSIS: Rudin
INTRODUCTION TO REAL ANALYSIS: Bartle

Course No.: MAM202, Course Title: ALGEBRA I (GROUPS & RINGS)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
[APPLICABLE FROM 2024-25]

UNIT 1
Group, Matrix groups-GL(n, R), SL(n, R), Subgroup, Cosets, Lagrange's Theorem
UNIT 2
Order of an Element, Cyclic Group, Fundamental Theorem of Cyclic Groups and its Applications, Normal Subgroup, Quotient Group
UNIT 3
Group Homomorphism, Group Isomorphism, Properties, Fundamental Theorem of Group Homomorphism, Automorphism, Inner Automorphism, Aut (Z_n), Cayley's Theorem
UNIT 4
Ring, Integral Domain, Field, Characteristic, Subring, Subfield, Ideal, Maximal Ideal
UNIT 5
Quotient Ring, Quotient Ring as a Field, Homomorphism, Isomorphism, First Ring Isomorphism Theorem
SUGGESTED READING:
ABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
CONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian

Course No.: MAM203, Course Title: SEMINAR & GROUP DISCUSSION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2022-23
Total Credits: 1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26
Seminar and Group Discussion based on MAM201 and MAM202 courses.

Course No.: MAH201, Course Title: COMPUTATIONAL TECHNIQUES
Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2022-23
Total Credits: 2, Periods(55 mts. each)/week:3(L-3-0+P/S-0), Min.pds./sem:39
[APPLICABLE FROM 2024-25]
UNIT 1: Mathematical Logic: Propositions, Connectives, Propositional formulae, Truth tables, Equivalence of formulae, Tautological implications
UNIT 2: Fast Computational Methods (with reasoning) for Multiplication: vertical and crosswise for multiplication of two digit, three and four digit numbers, special multiplication (by 11, 12, 111, 101 etc.), Squares, Square root
UNIT 3: Divisibility, Fast Computational Methods (with reasoning) for Division by 9, 8 etc., straight division method
UNIT 4: Fast Computational Methods (with reasoning) to solve various forms of Linear Equations and Simultaneous Equations
UNIT 5: Fast Computational Methods (with reasoning) to solve various forms of Quadratic Equations
SUGGESTED READING:
Vedic Mathematics: Dhaval Bhatia
Discrete and Combinatorial Mathematics: Ralph P. Grimaldi
Vedic Maths: Jagad Guru Swami Bharat Krishna Tirthaji Maharaj

Course No.: MAH202, Course Title: REAL ANALYSIS
Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2023-24
Total Credits: 2, Periods(55 mts. each)/week:3(L-3-0+P/S-0), Min.pds./sem:39
[APPLICABLE FROM 2024-25]
UNIT 1: Introduction to Functions, Modulus, Composition of functions, Graphs
UNIT 2: Limit ($\in -\delta$ concept), Continuity of real-valued functions of one variable
UNIT 3: Differentiation, Sum Rule, Product Rule, Quotient Rule, Chain Rule
UNIT 4: Increasing and decreasing functions, Maxima, Minima
UNIT 5: Integration: Definite integral (Riemannian sum concept), indefinite integral, fundamental theorem of integral calculus (statement only), Sum Rule, Product Rule, its application in finding definite integral

Course No.: MAW201, Course Title: MATHEMATICAL SKILLS
Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2023-24
Total Credits:2, Periods(55 mts. each)/week:2(L-2-0+P/S-0), Min.pds./sem:26
[APPLICABLE FROM 2024-25]
UNIT1: Mathematical Reasoning (Proof, Counter-Example, Existential Operators, Contrapositive, Converse, etc.)
UNIT2: Fast Computational methods for problems in Arithmetic (multiplication, squares, square-roots, etc.)
UNIT3: Generalization and Abstraction (Research flavored topics, e.g. Number theoretic problems, Pythagoras theorem to Fermat's Last theorem, Quadratic equation to Galois Theory, etc.)
UNIT4: Graphical Representation of data through Excel
UNIT5: Graphical Interpretation (Interpreting time acceleration curve from time velocity curve, Interpretation of histogram involving several variables, scattered graph involving several variables, Interpretation of multiple graphs)

Course No.: MAM301, Course Title: ANALYSIS II (INTEGRATION & CONVERGENCE)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1
Riemann Integration: Partition of a Set, Step Function, Riemann Integral of a Step Function, Upper Riemann Integral, Lower Riemann Integral, Riemann Integral of a Bounded Function, Mean Value Theorem of Integral Calculus, Fundamental Theorem of Calculus.
UNIT 2
Techniques of Integration, Applications of Integration: Area, Volume, Surface Area, Length of an Arc, Improper Integrals.
UNIT 3
Power Series, Radius and interval of convergence, Circular, exponential functions etc as examples, Taylor's series, Uniform Convergence and Pointwise Convergence of Sequence of Functions, Cauchy Criterion for Uniform Convergence, Tests for Uniform Convergence.
UNIT 4
Uniform Convergence and Pointwise Convergence of Series of Functions, Weierstrass M test, Dini's theorem and other tests for Uniform convergence of series. Consequences of Uniform convergence of series and sequences.
UNIT 5
Geometric and algebraic explanation of Elementary Functions, Natural Logarithms, Exponential Function, Inverse Function, Trigonometric and Inverse-Trigonometric Function, Hyperbolic Functions, their Continuity & Derivatives, Beta and Gamma Functions.
SUGGESTED READING:
CALCULUS AND ANALYTICAL GEOMETRY: Thomas & Finney
Rudin W.: PRINCIPLES OF MATHEMATICAL ANALYSIS
Bartle: INTRODUCTION TO REAL ANALYSIS
TM Apostol: MATHEMATICAL ANALYSIS

Course No.: MAM302, Course Title: ALGEBRA II (LINEAR ALGEBRA)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 23-24
Total Credits: 3, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
[APPLICABLE FROM 2024-25]
UNIT 1
Vector Space, Subspaces, Sum of Subspaces, Linear Independence, Basis and Dimension, Co-ordinate, Change in Co-ordinates with Change in Basis.
UNIT 2
Linear Transformation, Isomorphism, Algebra of Linear Transformations, Composition of Linear Transformations
UNIT 3
Matrix Representation of a Linear Transformation, Linear Transformation associated with a Matrix, Similarity of Matrices and Linear Transformation, Rank and Nullity of Linear Transformations and Matrices, Rank and Nullity Theorem
UNIT 4
Determinant of a Matrix over a Ring as a Map, Existence and Uniqueness of Determinant of matrices of order 2 and 3, Inverse of a Matrix over a Ring, Determinant of Matrices in Block Form, Determinant of a Linear Transformation, Right Handed Co-ordinate System, Application to Area and Volume
UNIT 5
Eigen Values and Eigen Vectors of a Linear Transformation and a Matrix, Eigen Space, Characteristic Polynomial, Characteristic Polynomial and Trace, Applications of Cayley-Hamilton Theorem.
SUGGESTED READING:
LINEAR ALGEBRA: K. Hoffman and R. Kunze
LINEAR ALGEBRA: S. H. Friedberg, A. J. Insel and L. E. Spence

Course No.: MAM303, Course Title: OPERATIONS RESEARCH
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
[APPLICABLE FROM 2024-25]
UNIT 1
Introduction to general linear programming problems, Geometrical and algebraic analysis of models/solutions. Definitions and Theorems, solution of LPP-graphical, simplex method.
UNIT 2
Two-phases of simplex, Big-M method. Concept of Duality: Weak Duality Theorem, Basic Duality Theorem, Fundamental Theorem on Duality, Complementary Slackness Theorem, Dual-simplex method.
UNIT 3
Post-optimality analysis: Variation in cost vector, resource vector, addition/deletion of constraints/variables. Transportation, Assignment and Travelling-salesman problems.
UNIT 4
Game Theory: Definitions, Maximin and Minimax principles, Two-person zero-sum game, Games with saddle point (Pure strategy), Games without saddle points (Mixed strategy), Graphical method, Dominance principle.
UNIT 5
Inventory Problem: Introduction, Economic Order Quantity, Deterministic inventory with no shortages: The basic EOQ model, EOQ with several production runs of unequal lengths, EOQ with fixed (finite) production (replenishment). Deterministic inventory with shortages.

Course No.: MAM304, Course Title: SEMINAR & GROUP DISCUSSION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26
Seminar and Group Discussion based on MAM301, MAM302 and MAM303 courses.

Course No.: MAW301 Course Title: MATHEMATICAL APPLICATIONS
Class: B.Sc., Status of Course: HALF COURSE, Approved since session: 2023-24
Total Credits:2, Periods(55 mts. each)/week:2(L-2-0+P/S-0), Min.pds./sem:26
[APPLICABLE FROM 2024-25]
UNIT1
Applications in Computer Science: Graph Theory
UNIT 2
Applications in Biology: Golden ratio, Fibonacci Sequence
UNIT 3
Applications in Commerce: Financial Analysis through excel/MATLAB
UNIT 4
Applications in Physics and other areas: Solution of real world problems through systems of linear equations and differential equations, Symmetry in designs and architecture.
UNIT 5
Case Studies: Four colour theorem, Travelling salesman problem, Transportation problem, Scheduling problem

Course No.: MAM401, Course Title: DIFFERENTIAL EQUATIONS I(O.D.EQNS.)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2020-21
Total Credits: 4, Periods (55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem: 52

[APPLICABLE FROM 2024-25]

UNIT 1

Equations of first order and first degree - exact equations. Elementary applications - Newton's law of cooling, orthogonal trajectories. Linear equations with constant coefficients, complementary function, auxilliary equation - distinct roots, repeated roots, imaginary or complex roots, particular integral-the operator D, methods of finding PI of variation of parameters.

UNIT 2

Equations of first order but not of first degree, simultaneous equations dx/P = dy/Q = dz/R, use of multipliers, total differential equations, necessary and sufficient conditions that an equation of the type P dx + Q dy + R dz be integrable, methods of solution.

UNIT 3

Solution in series, linear equations and power series, convergence of power series, ordinary and singular points, validity of the solutions near an ordinary point, solutions near an ordinary point, regular singular point, the indicial equation, form and validity of the solutions near a regular singluar point, indicial equations with difference of roots nonintegral, indicial equations with equal roots with difference of roots a positive integer, non-logarithmic and logarithmic cases.

UNIT 4

Bessel's equation, orthogonal properties and generating function.

UNIT 5

Legendre's equation, generating functions. Introduction to Hypergeometric, Laguerre and Hermite equation.

SUGGESTED READINGS:

Braun M: DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS
ED Rainville& PE Bedient: ELEMENTARY DIFFERENTIAL EQUATIONS
Yoshida: DIFFERENTIAL EQUATIONS AND APPLICATION

Course No.: MAM402, Course Title: STATISTICS II
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

[APPLICABLE FROM 2024-25]

UNIT 1

Bivariate Distributions: Joint Probability Distribution, Joint Density Function, Joint Marginal Distributions, Joint Conditional Distributions, Statistical Independence, Simple Correlation, Karl Pearson Coefficient of Correlation, Spearmans Rank Correlation Coefficient, Linear Regression, Regression Coefficients, Properties of Regression Coefficients, Angle between Two Lines of Regression, Coefficient of Determination, Multiple Correlation Coefficient.

UNIT 2

Probability inequalities (Chebychev’s Inequality, Morkov’s, Jensen), Modes of Convergence, Weak and Strong Laws of Large Numbers, Bernaulli’s Law of Large Numbers, Central Limit Theorem.

UNIT 3

Sampling: Introduction to Sampling: Reasons for Sampling, Reasons for taking a census, Frame, Random Versus Non Random Sampling. Random Sampling Techniques: Simple Random Sampling, Stratified Random Sampling, Systematic Sampling, Cluster or Area Sampling. Non-random Sampling: Convenience Sampling, Judgment Sampling, Quota Sampling, Snowball Sampling, Sampling Distributions: Statistic and Parameter, Sampling Distribution of Means, Sampling Distribution of Proportion, Sampling Distribution of Difference of Means, Sampling Distribution of Difference of Proportion.

UNIT 4

Estimation: Point Estimation, Properties of Point Estimate, Interval Estimation. Estimating the Mean for single sample, Standard Error of Point Estimate, Estimating the Difference Between Two Means for Two Samples, Estimating the Proportion for single sample, Estimating Population Variance, and Sample Size and working problems based on them.

UNIT 5

Hypothesis Testing- Null and Alternative Hypothesis, Level of Significance, One Tailed and Two Tailed Tests, Type I and Type II Errors, z-Test, t-Test, Chi-square test and F-test.

SUGGESTED READING:

MATHEMATICAL STATISTICS: Freund
PROBABILITY & STATISTICS FOR ENGINEERS & SCIENTISTS: Walpole & Myers
PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS: Sheldon Ross
BASIC STATISTICS FOR BUSINESS AND ECONOMICS: Lind Marchal Wathen
ESSENTIAL OF STATISTICS FOR BUSINESS AND ECONOMICS: Anderson, Sweeney, Williams
INTRODUCTION TO MATHEMATICAL STATISTICS: Hogg RV, Craig AL

Course: MAM403, Title: ANALYSIS III (VECTOR CALCULUS)
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Sequences in R^n, Limit and Continuity of Maps from R^n to R, R to R^n and R^m to R^n, Related Sum and Product Theorems, Continuity of Composition, Curves in Plane and Space, Parametric Equations.
UNIT 2
Differentiation of Maps from R^n to R, R to R^n and R^m to R^n, Total Derivative, Partial Derivatives, Jacobian Matrix, Directional Derivative, Chain Rule.
UNIT 3
Mean Value Theorem, Taylor's Formula, Linear and Quadratic Approximation, Local Maxima, Local Minima, Lagrange Multipliers.
UNIT 4
Multiple Integrals: Double Integrals, Double Integrals as Volumes, Fubini's Theorem, Triple Integration, Change of Variable in Multiple Integrals.
UNIT 5
Line Integrals, Surface Integrals, Surface Area, Divergence and Curl Operations, Applications of Gauss Divergence Theorem and Stoke's Theorem.
SUGGESTED READING:
CALCULUS AND ANALYTICAL GEOMETRY: Thomas & Finney
PRINCIPLES OF MATHEMATICAL ANALYSIS: Rudin
INTRODUCTION TO REAL ANALYSIS: Bartle
MATHEMATICAL ANALYSIS: TM Apostol

Course: MAM404, Title: SEMINAR & GROUP DISCUSSION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26
Seminar and Group Discussion based on MAM401, MAM402 and MAM403 courses.

Course No: MAM501, Course Title: METHODS OF APPLIED MATHEMATICS
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1
Laplace transform and its properties, Convolution Theorem. Laplace transform of derivatives and periodic functions. Error and complementary functions and their Laplace transforms.
UNIT 2
Inverse Laplace transforms, Application of Laplace transforms to the solution of ordinary and partial differential equations.
UNIT 3
Fourier series: an expansion theorem, Fourier sine series, cosine series, the one dimensional heat equation, surface temperature varying with time, heat conduction in a sphere, a simple wave equation, Laplace's equation in two dimensions
UNIT 4
Exponential Fourier transform, Fourier Sine and Cosine transforms and their applications in solving partial differential equations.
UNIT 5
Integral Equations: Conversion of Ordinary Differential Equations into Integral equations, Classification of Linear Integral Equations and Introductory methods of their solutions, Eigen functions of integral equations.
SUGGESTED READINGS:
RV Chruchill: OPERATIONAL MATHEMATICS
CJ Tranter: INTEGRAL TRANSFORMS
IN Sneddon: THE USE OF INTEGRAL TRANSFORMS
DV Widder: AN INTRODUCTION TO TRANSFORM THEORY
RM Rao& AS Bopardikar: WAVELET TRANSFORMS

Course: MAM502, Title: DIFFERENTIAL EQUATIONS II (P.D.E.)

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:65

UNIT 1

Linear Partial Differential Equations: Lagrange's method, Working rule for solving Pp+Qq = R by Lagrange's method, geometrical description of Pp+Qq = R. Non-linear Partial Differential Equations of Order 1: Complete Integral, particular integral, singular integral and general integral. Standard form I: only p and q present, standard form II: z = px + qy + f(p,q), standard form III: only p q and z present, standard form IV: equations of the form $f_1(x,p) = f_2(y,p)$, Charpit method, Jacobi method. Cauchy's problem for first order PDE's.

UNIT 2

Second order PDE's, Classification of second order linear PDE's, Canonical forms for Hyperbolic, Parabolic and Elliptic equations.

UNIT 3

Elliptic Differential Equations- Derivation of Laplace equation, solution of Laplace equation in polar, cylindrical and spherical coordinates, separation of variable method, Neumann and Dirichlet problems.

UNIT 4

Parabolic Differential Equations- occurrence and derivation of Diffusion equation, boundary conditions, solution of Diffusion Equation in polar, cylindrical and spherical coordinates, boundary value problems.

UNIT 5

Hyperbolic Differential Equations- occurrence and derivation of Wave equation, Solution of wave equation in polar, cylindrical and spherical coordinates, D'Alembert's Solution, Vibrating String- Variable separable solution, boundary and initial value problems for two-dimensional wave equations- method of eigen function.

SUGGESTED READINGS:

K ShankaraRao: INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS
IN Sneddon: ELEMENTS OF PARTIAL DIFFERENTIAL EQUATIONS
F John: PARTIAL DIFFERENTIAL EQUATIONS

Course: MAM503, Title: METRIC SPACES

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:65

UNIT 1: Metric spaces – Definition and examples, Holder and Minkowski's inequalities, Open balls, Interior points and Interior of a set, Open sets, Closed sets, Diameter of a set, Distance between a point and a set, Distance between two sets.

UNIT 2: Convergent Sequences, Limit and Cluster points, Closure of a set, Cauchy sequences and Completeness, Examples of Complete Metric spaces, Bounded sets, Dense sets, Nowhere dense sets, Boundary of a set.

UNIT 3: Continuous functions, Characterizations of Continuous maps, Limit of a function, Uniform Continuity.

UNIT 4: Compact spaces and their properties, Equivalence of Compactness, Limit point Compactness and Sequential Compactness, Heine Borel Theorem, Continuous maps on compact spaces, Extreme Value Theorem, Uniform Continuity and compactness.

UNIT 5: Baire's Category Theorem, Cantor Intersection Theorem, Banach's Contraction Principle, Ascoli-Arzela Theorem, Inverse Function and Implicit Function theorem,Weirstrass Approximation Theorem.

SUGGESTED READING:

S Kumaresan : TOPOLGY OF METRIC SPACES
TM Apostol: MATHEMATICAL ANALYSIS
W Rudin: PRINCIPLES OF MATHEMATICS ANALYSIS

Course: MAM504, Title: CURVES AND SURFACES
Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:65
UNIT 1
Curves in Space, Arc length, Velocity, Acceleration, Curvature and Torsion, Frenet-Serret formula, Osculating Plane, Normal Plane, Tangent Plane.
UNIT 2
Spherical Curves, Fundamental Theorem of Curves, Co-ordinate Patch, Surfaces, Parametric Curves, First Fundamental Form, Surface of Revolution, Ruled Surface.
UNIT 3
Normal Curvature, Geodesic Curvature, Gauss Formula, Christoffel Symbols, Second Fundamental Form.
UNIT 4
Orientability, Geodesics, Geodesics on a Surface of Revolution, Geodesics on Sphere, Geodesics on Cylinder.
UNIT 5
Weingarten Equations, Principal Directions, Principal Curvatures, Gaussian Curvature, Mean Curvature, Line of Curvature, Asymptotic Curve, Minimal Surface.
SUGGESTED READING:
DIFFERENTIAL GEOMETRY OF CURVES AND SURFACES: M. P. do Carmo
ELEMENTS OF DIFFERENTIAL GEOMETRY:Millman and Parker ELEMENTARY DIFFERENTIAL GEOMETRY: Andrew Pressley

Course: MAM505, Title: INTRODUCTION TO 'C'
Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2024-25
Total Credits: 2, Periods(55 mts. each)/week:2(L-2-0+P/S-0), Min.pds./sem:65
UNIT 1
Introduction to Algorithms, Overview of the C programming Language, literals, variables and data types, type modifiers, type conversion, operators, operator precedence, expressions, conditional expressions, statements and blocks, console I/O.
UNIT 2
Selection (If-Else and Switch), Iteration (while, for and do-while), break and continue.
UNIT 3
Arrays (one, two and multidimensional), pointers, strings.
UNIT 4
Functions: General form, scope rules, function arguments, return statement, recursion; prototypes, preprocessor and directives, macros.
UNIT 5
Structures, unions, enumerations, typedef, File I/O, Time Complexity.
SUGGESTED READING:
1. Brian W. Kernighan and Dennis Ritchie, The C Programming Language, Pearson.
2. Herbert Schildt, C: The Complete Reference, McGraw Hill.
3. R.G. Dromey, How to Solve it by Computer, Pearson.

Course No.: MAM506, Course Title: PROGRAMMING LABORATORY I (C)
Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 2, Periods(55 mts. each)/week:5(L-0+T-0+P/S-5), Min.pds./sem:65
Laboratory based on the course: INTRODUCTION TO 'C' (MAM 505).

Course: MAM507, Title: SEMINAR & GROUP DISCUSSION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26
Seminar and Group Discussion based on MAM501, MAM502, MAM503, MAM504 and MAM505 courses.

Course: MAM601, Title: NUMERICAL ANALYSIS

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2002-03
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Rounding off and truncation of numbers, Errors and propagation of errors in arithematic operations and function evaluation. Solution of Nonlinear equations, Concept of order of convergence and convergence properties. Horner's method of polynomial evaluation.

UNIT 2

Direct and Iterative methods for solving system of Linear equations. Convergence and acceleration of iterative methods. System of non-linear equations.

UNIT 3

Finite differences, Newton's forward and backward formula for interpolation, Gauss and Stirling's formula and Bessel's formula, Lagrange and Hermite Interpolation, Newton's Divided Differences interpolation.

UNIT 4

Numerical Differentiation, Numerical Integration by Newton Cotes methods-Trapezoidal and Simpson's rules, Concept of condition number. Gershgorin's theorem, Power method for computation of largest eigen value (in magnitude) and the corresponding eigen vector and its convergence. The QR method.

UNIT 5

Numerical solution of Ordinary Differential Equations, Single step methods-Taylor's, Euler, Runge-Kutta methods and their stability. Multistep methods and strong stability. Introductory finite difference methods for solving partial differential equations.

SUGGESTED READING:

K Atkinson: AN INTRODUCTION TO NUMERICAL ANALYSIS
MK Jain et al.: NUMERICAL METHODS FOR SCIENTIFIC AND ENGINEERING COMPUTATION
SD Conte & Carl de Boor: ELEMENTARY NUMERICAL ANALYSIS

Course No: MAM602, Course Title: NUMBER THEORY

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2013-14
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:65

UNIT 1 [13 pds]

Number Theoretic Functions-σ, τ, ϕ, Greatest Integer Function, Application to Calendar & Other Applications.

UNIT 2 [13 pds]

Complete Set of residues, Reduced Set of Residues, Linear Congruence, Chinese Remainder Theorem, Fermat's Little Theorem, Wilson's Theorem, Euler's Theorem, Applications.

UNIT 3 [13 pds]

Order of an element modulo n, Primitive Roots, Existence of Primitive Roots, Lagrange's Theorem, Primitive Roots of Primes, Primitive Roots for Composites, Theory of Indices.

UNIT 4 [13 pds]

Quadratic Residue for an Odd Prime, Quadratic Residue for a Power of an Odd Prime, Quadratic Residue for any Integer, Legendre symbol, Gauss' Lemma, Quadratic Reciprocity Law.

UNIT 5 [13 pds]

Pythagorean Triple, Fermat's Last Theorem for n=4, Lagrange's Four-Square Theorem, Finite Continued Fractions, Infinite Continued Fractions, Pell's Equation.

SUGGESTED READING:

David M. Burton: ELEMENTARY NUMBER THEORY, Universal Book Stall, New Delhi, 2002
Gareth A. Jones and J. Mary Jones, ELEMENTARY NUMBER THEORY, Springer-Verlag, London, 2005
I. Niven, H. S. Zuckerman, H. L. Montgomery: AN INTRODUCTION TO THE THEORY OF NUMBERS, John Wiley & Sons, New York, 1991

Course: MAM603, Title: COMPLEX ANALYSIS

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Complex Numbers, Open and Closed sets in the complex plane, Limit and Continuity, Holomorphic functions, Complex power series, Analytic Continuation, Complex Power series.

UNIT 2

Elementary functions, paths, Integration along paths, Cauchy's theorem, Morera's theorem.

UNIT 3

Cauchy's Integral formula, Liouville's theorem, The fundamental theorem of Algebra, Cauchy's formula for derivatives, Taylor's Theorem, Zeros of holomorphic functions, The Identity theorem, The maximum modulus theorem, Schwarz's Lemma.

UNIT 4

Laurent's Theorem, Singularities, Calculation of Residues, Cauchy's Residue Theorem, Problems on Contour integration.

UNIT 5

Conformal mapping, Mobius transformations, Examples on building conformal mappings.

SUGGESTED READING:

Preistley HA: INTRODUCTION TO COMPLEX ANALYSIS
Ahlfors LV: COMPLEX ANALYSIS
Lang S: COMPLEX ANALYSIS
Choudhary B: THE ELEMENTS OF COMPLEX ANALYSIS
Churchill RV: COMPLEX ANALYSIS

Course No.: MAM604, Course Title: ALGEBRA III (SYLOW'S THMS. & I.P.S.)

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 4, Periods(55 mts. each)/week: 4(L-4+T-0+P/S-0), Min.pds./sem:52

UNIT 1: Centre, Centralizer, Conjugacy Class, Class Equation, Cauchy's Theorem, Applications of Sylow's Theorems, Simple Groups, Tests for Non simplicity

UNIT 2: Quaternion Group, Dihedral Group, Permutation Group, Alternating Group, Simple Group, Tests for Non simplicity, Applications of Fundamental Theorem of Finite Abelian Groups, Classification of Groups

UNIT 3: External Direct Product of Groups, Internal Direct Product of Subgroups, Applications of Group and Ring Isomorphism Theorems

UNIT 4: Cardan's method, Subgroup Generated by a Subset, Commutator Subgroup, Normal Series, Solvable Group, Introduction to Solution of Polynomials by Radicals

UNIT 5: Inner Product Spaces, Orthogonal Sets, Orthonormal Basis, Cauchy-Schwarz's Inequality, Orthogonal Complement, Linear Operators on Finite Dimensional Inner Product Spaces, Adjoint of an Operator and its Matrix, Unitary and Orthogonal Operators and their Matrices, Their Eigenvalues, Positive Definite Operators and Matrices.

SUGGESTED READING:

ALGEBRA: Michael Artin ABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
LINEAR ALGEBRA: S. H. Friedberg, A. J. Insel and L. E. Spence CONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian
TOPICS IN ALGEBRA: I. N. HersteinLINEAR ALGEBRA: K. Hoffman and R. Kunze

Course: MAM605, Title: DATA STRUCTURES IN 'C'

Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2002-03
Total Credits: 2, Periods(55 mts. each)/week:2(L-2-0+P/S-0), Min.pds./sem:52

UNIT 1

Analysis of algorithms, ordered list, sequential representation, array representation.

UNIT 2

Stacks, queues, evaluation of expressions, linked representation.

UNIT 3

Trees and tree representation, binary trees, binary tree traversals, binary search tree, heaps and priority queues.

UNIT 4

Graph, graph representation, graph traversals, shortest path algorithms (single source all destinations, all pairs), minimum cost spanning tree algorithms (Kruskal and Prims).

UNIT 5

Searching (Sequential and Binary), Sorting (bubble sort, insertion sort and selection sort), quick sort, merge sort and heap sorting, hashing.

SUGGESTED READING:

Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Universities Press.
Mark Allen Weiss, Data structures and Algorithm Analysis in C, Pearson.
Alfred Aho, John E. Hopcroft and Jeffery D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information.
Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Careermonk Publications.

Course No.: MAM606, Course Title: PROGRAMMING LAB II (DATA STRUCTURES)
Class: B.Sc. Honours, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 2, Periods(55 mts. each)/week:5(L-0+T-0+P/S-5), Min.pds./sem:65
Laboratory based on the course: DATA STRUCTURES IN 'C' (MAM 604).

Course: MAM607, Title: SEMINAR & GROUP DISCUSSION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 1, Periods(55 mts. each)/week:2(L-0-0+P/S-2), Min.pds./sem:26
Seminar and Group Discussion based on MAM601, MAM602, MAM603, MAM604 and MAM605 courses.

Course No.: MAM701, Course Title: MEASURE & INTEGRATION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2024-25
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Lebesgue Outer Measure, its properties, Measurable sets and their properties, Borel sets and their measurability
UNIT 2
Construction of Lebesgue Measure, Measurable Sets and their Properties, Regularity, Measurable Functions and their Properties.
UNIT 3
Lebesgue Integration: Simple Function, Lebesgue integral of a Simple functions, bounded functions and Non-Negative measurable functions. Fatou's Lemma and Lebesgue Monotone Convergence Theorem.
UNIT 4
General Lebesgue Integration and its Properties, Lebesgue Dominated Convergence Theorem, Integration of Series.
UNIT 5
L^p Spaces: L^p space as a vector space and as a metric space, Holder and Minkowski'sinequalities forL^p space, Completeness of L^p spaces.
SUGGESTED READING:
HL Royden: REAL ANALYSIS G.deBarra:MEASURE THEORY AND INTEGRATION

Course: MAM702, Title: TOPOLOGY
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1
Topology, Closed Sets, Basis, Subbasis, Metric Topology, Subspace Topology, Interior Points, Exterior Points, Boundary Points and Limit Points of a Set, Derived set, Interior and Closure of a Set, Dense Sets, Real Line, Sorgenfrey Line
UNIT 2
Continuous Map, Open Map, Closed Map, Projection Map, Homeomorphism
UNIT 3
Product space, Quotient Space, Quotient Map, Introduction to Countability Axioms
UNIT 4
T_1, T_2, Regular, T_3, Completely Regular, $T_{3½}$, Normal and T_4 Spaces, Compact Spaces
UNIT 5
Connected Spaces, Components, Path Connected Spaces, Path Components, Applications of Connectedness

SUGGESTED READING:
TOPOLOGY-A FIRST COURSE: J. R. Munkres
GENERAL TOPOLOGY: J. L. Kelley, Van Nostrand, New York 1955
BASIC TOPOLOGY: M. A. Armstrong

Course: MAM703, Title: THEORY OF DIFFERENTIAL EQUATIONS

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Elementary Concepts about Differential Equations, Lipschitz condition, Gronwall inequality, Existence and Uniqueness of solutions for scalar and systems of equations.

UNIT 2

Linear Differential Equations with Variable Coefficents, Linear Dependence and Independence of Solutions, Concept of Wronskian, Oscillatory and Non-oscillatory Behaviour of Solutions of Second Order Linear Differential Equations, Non-Homogenous Equations, Strum-Liouville Boundary Value Problem, Green's Function.

UNIT 3

Fundamental matrix, Non-homogenous Linear Equations, Linear Systems with constant coefficients, Linear Systems with Periodic Coefficients.

UNIT 4

Stability of Linear Systems, Behaviour of solutions of Linear Differential Equations.

Unit 5

Stability of Nonlinear Differential Equations, Applications of Poincare Bendixon Theorem, Introductory Methods of Solution of Linear Integral Equations.

Course: MAM704, Title: RINGS & CANONONICAL FORMS

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Polynomial Rings, Roots of a Polynomial, Division Algorithm, Irreducibility of a Polynomial, Mod p Irreducibility Test, Eisenstein Criterion, Irreducibility of *p*th Cyclotomic Polynomial

UNIT 2

Quadratic Integer Rings, Euclidean Domain, Principle Ideal Domain, Unique Factorization Domain.

UNIT 3

Geometric and Algebraic Multiplicity, Direct Sum of Subspaces, Direct Sum of Eigenspaces, Diagonalizability of Matrices and Linear Operators.

UNIT 4

Minimal Polynomial, Invariant Subspaces, Conductor, Minimal Polynomial & Diagonalizability, Minimal Polynomial &Triangulability, Cyclic Subspace, Cayley-Hamilton Theorem, Companion Matrix.

UNIT 5

Generalized Eigenspace, Cycle of Generalized Eigenvectors, Direct Sum of Generalized Eigenspaces, Jordan Form, Rational Form.

SUGGESTED READING:

ALGEBRA: Michael Artin
ABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
CONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian
TOPICS IN ALGEBRA: I. N. Herstein
LINEAR ALGEBRA: S. H. Friedberg, A. J. Insel and L. E. Spence

Course No.: MAM705, Title: BASIC RES. METH., SC.COMPUT. & ANAL.
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2013-2014
Total Credits:4

UNIT 1: INTRODUCTION
Meaning of research, types of research, research process, problem formulation and techniques, literature review. Research design, principles and types of experimental designs, controls in an experiment, types of controls.
UNIT 2: MEASUREMENT & DATA COLLECTION
Measurement & Scaling: Measurement in research, scales of measurement, sources of errors, tests of sound measurement, development of measurement tools, scaling, scale construction techniques. Methods of data collection: observation, interviews, questionnaire, rating scales, content analysis, case study, schedules.
UNIT 3: ANALYSIS
Quantitative analysis, Errors in Quantitative analysis- random and systematic errors, handling systematic errors, presentation of results, Quality Control and Quality Assurance, Figures of merit-accuracy, precision, limit of detection, limit of quantification, method of standard additions, internal and external standards, comparison of analytical methods.
UNIT 4: INTERPRETATION & REPORTING
Interpretation, techniques of Interpretation, precautions in Interpretation. Report writing: synopsis, project/dissertation report, abstract; reading and writing a research paper.
UNIT 5: SEARCH, REASONING & IPR
Part A: Patents, copyrights, trademarks, trade secrets, IPR. Ethical, legal and social issues associated with research. Research and the Internet: World Wide Web, search engines, search strategy, subject categories, specialized databases.
Part B: Mathematical and Logical Reasoning.
SUGGESTED READINGS:
Kothari C.R. & Gaurav Garg : RESEARCH METHODOLOGY-METHODS AND TECHNIQUES, 3RD Edition, New Age International
Chawla D. and Neena Sondhi : RESEARCH METHODOLOGY CONCEPTS AND CASES, Vikas Publishing House Pvt. Ltd.
Agarwal A.K.: MODERN APPROACH TO LOGICAL REASONING, 2012, S. Chand & Co. Delhi
R. Panneerselvam : RESEARCH METHODOLOGY, PHI, 2004

Course: MAM706, Title: ANALYTICAL MECHANICS
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Calculus of Variations: Euler-Lagrange equation, Functionals of the form $\int F(x, y_1, y_2, ..., y_n, y_1', ..., y_n')\,dx$, Functionals dependent on higher order derivatives, Functionals dependent on the functions of several independent variables, Variational methods for boundary value problems in ordinary differential equations.
UNIT 2
Generalised co-ordinates. Generalised velocities. Vertual work and genralised forces. Lagrange's equations for a holonomic system. Case of conservative forces. Generalised components of momentum and impulse. Lagrange's equation for impulsive forces. Kinetic energy as a quadratic function of velocities. Equilibrium configuration for conservative holonomic dynamical system. Theory of small oscillations of conservative holonomic dynamical system.
UNIT 3
Variational methods. The Brachistochrone problem. Hamilton's principle. The principle of least action. Distinction between Hamilton's principal and principal of least action.
UNIT 4: Hamilton's equations--the Hamiltonian and the canonical equatios of motion. The passage from the Hamiltonian to the Lagrangian. The Hamilton--Jacobi equation and its complete integral. Phase space. Poisson brackets. Liouville's theorem.
UNIT 5
Motion about a fixed point-Euler's dynamical equations. Motion under no forces about-rotating axes.

Course: MAM707, Title: PRE-DISSERTATION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 1998-1999
Total Credits:4

Course: MAM801, Title: OPTIMIZATION
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2024-25
Total Credits: 4, Periods (55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem: 52
UNIT 1: Queueing Theory: Introduction, Definitions and Notations, Classification of Queueing Models, Distribution of Arrivals (The Poisson Process): Pure Birth Process, Distribution of Inter Arrival Times, Distribution of Departures (Pure Death Process), Distribution of Service Time, Solution of Queueing Models, Poisson Queues- (M/M/1): (∞/FIFO), (M/M/1):(N/FIFO), (M/M/C): (∞/FIFO), (M/M/C): (N/FIFO).
UNIT 2: Non-Linear Programming Problem (NLPP): Introduction, Maxima and minima of functions of several variables and their solutions, Quadratic forms, Concave and convex functions, Unconstrained and constrained optimization.
UNIT 3: Constrained NLPP: Lagrange's method, Kuhn-Tucker conditions, Graphical Method, Concept of Quadratic programming, Frank-Wolfe method. Unconstrained NLPP: Fibonacci and Golden section search, Steepest Descent Method, Conjugate metric method.
UNIT 4: Dynamic Programming: Multistage decision processes, Concept of sub-optimality, Principle of optimality, Calculus method of solution, Tabular method of solution, LPP as a case of dynamic programming.
UNIT 5: Integer programming: Gomory method for pure and mixed LPP, All pure and mixed integer programming, Algorithm and solution of numerical problems, Branch and bound method.

Course: MAM802, Title: FIELD THEORY
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 4, Periods(55 mts. each)/week:5(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Extension of a Field, Quadratic Extensions, Degree, Multiplicativity of Degrees, Finite Extension, Subfield Generated by a Subset, Simple Extension, Roots of a Polynomial in an Extension Field, Fundamental Theorem of Field Theory.
UNIT 2
Algebraic Elements, Finite Simple Extension, Algebraic Extension, Finite and Algebraic Extension, Operations on Algebraic Elements, Applications to Geometric Constructions.
UNIT 3
Multiplicity of Roots of a Polynomial in an Extension Field, Roots of Unity over Q and over Z_n, Separability of Polynomials, Separable Extension, Splitting Field, Cyclotomic Polynomial, Cyclotomic Extension.
UNIT 4
Finite Fields, Classification of Finite Fields,Finite Fields as Simple Extensions and their Degree, Structure of Finite Fields,Subfields of a Finite Field.
UNIT 5
Group of Automorphisms of a Field, Fixed Field, Galois Group, FrobeniusAutomorphism, Applications of Fundamental Theorem of Galois Theory.
SUGGESTED READING:
ALGEBRA: Michael ArtinABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
GALOIS THEORY: Joseph RotmanCONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian

Course: MAM803, Title: FUNCTIONAL ANALYSIS
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem: 52
UNIT 1: Normed Linear Space, Banach Space, Finite Dimensional Normed Linear Space, Compactness and Finite Dimension, Continuity of a Linear Map, Norm of a Continuous Linear Map, Isometric Isomorphism.
UNIT 2: Dual Space, Natural Embedding of a Normed Linear Space in its second Dual Space, Weak Topology, Principle Conjugate of an Operator.
UNIT 3: Hahn-Banach theorem, Open Mapping Theorem, Closed Graph Theorem, Uniform Boundedness principle.
UNIT 4: Hilbert space, Schwarz's inequality, orthogonal complement of a set, orthonormal set, complete orthonormal set, Bessel's inequality, Fourier's expansion, Parseval's equation, Gram Schmidt orthogonalisation process, Dual and second Dual of Hilbert space.
UNIT 5: Adjoint of an Operator, Self Adjoint Operators, Normal Operators, Unitary Operators, Projection on a Linear Space, Banach Space and Hilbert Space, Spectral Theorem.

Course No.: MAM804, Course Title: STOCHASTIC PROC. & STAT. INFERENCE
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1: STOCHASTIC PROCESSES
Stationary processes, Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, Markov processes in continuous time, Poisson process, birth and death process.
UNIT 2: THEORY OF ESTIMATION
Point Estimation, Criterion of unbiasedness, Consistency, sufficiency, Cramer-Rao inequality, Uniformly minimum variance unbiased estimators, Methods of estimation: maximum likelihood moments, minimum chi-square, least square, confidence interval estimation.
UNIT 3: TESTING OF HYPOTHESIS
Basic concepts, types of errors, critical region, power function, most powerful and uniformly most powerful tests, likelihood ratio test, Wald's sequential probability ratio test.
UNIT 4: RELIABILITY THEORY
Definition, Failure, Data Analysis, Hazard, Models, System Reliability Series, Parallel and Mixed Configurations.
UNIT 5: DESIGN OF EXPERIMENTS
Basic principles of experimental design, randomization structure and analysis of completely randomized, randomized block and Latin-square designs. Factorial experiments. Analysis of 2^n factorial experiments in randomized blocks.

Course No.: MAM805, Course Title: TENSOR ANALYSIS
Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Vector, Dual Vector (Covectors), Dual Space and its Basis, Einstein summation convention, Action of a Dual Vector on a Vector, Application to Tangent Space at a point on Surface, Gradient of a Scalar Function as an Example of Dual Vector
UNIT 2
Second Dual Space, Vectors as Linear Maps on Dual Vectors, Relation Between Second Dual Space and Original Vector Space, Transformation Rules for Change of Co-ordinates of Tangent Vectors and their Duals
UNIT 3
Multilinear Maps, Tensors on Vector Spaces, Types of Tensors, Rank of a Tensor, Tensors on Surfaces, Tensor Spaces, Identification Between Tensor Spaces and Vector Space/ Dual Space
UNIT 4
Tensor product, Action of Tensor Product on Basis Elements, Basis for Tensor Spaces, Components of a Tensor, Metric Tensor, Transformation Rules.
UNIT 5
Identification Between Tensor Spaces and Endomorphism Space, Contraction/Trace of a Tensor and its Components, Action of One Tensor on Another Tensor, Alternating Tensors, k-Forms, Wedge Product of 1-Forms, Maps Between Tensor Spaces
SUGGESTED READING
AN INTRODUCTION TO DIFFERENTIABLE MANIFOLDS AND RIEMANNIAN GEOMETRY: W. M. Boothby
RIEMANNIAN MANIFOLDS: John M. Lee

Course No.: MAM806, Course Title: MATHEMATICAL MODELLING

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18

Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1: INTRODUCTION [11 pds]

Mathematical Modelling Process, Types of Models, Modelling with Discrete Dynamical systems: Modelling change with Difference Equations, approximating change with Difference Equations, Systems of Difference Equations.

UNIT 2: POPULATION MODELS [11 pds]

Single Species, Non-age Structured Population Models, Two Species Population Models.

UNIT 3: EPIDEMIC MODELS [10 pds]

Deterministic models without removals, a simple deterministic model, SIS model, SIS model with specific rate of infection as a function of time, SIS models with constant number of carriers, general deterministic models with removal, approximate solution, asymptotic behaviour of the solution, general deterministic model with immigration-steady state solution.

UNIT 4: PROBABILISTIC MODELLING [10 pds]

Models in Genetics, Genetic Matrices, Hardy-Weinberg Law, Correlation between Genetic composition of Siblings, Genotype and Phenotype ratios, Models for genetic improvements-Selection and Mutation.

UNIT 5: OPTIMIZATION MODELS [10 pds]

Role of optimization model in biology and medicine, finding optimal classification schemes, survival of systems, medical diagnosis problem, optimization models for blood testing and patient care, models for optimal control of water pollution, optimal air pollution control models, control models for solid waste disposal.

SUGGESTED READING:

JN Kapur: MATHEMATICAL MODELLING IN BIOLOGY AND MEDICINE
IA Rubinow: INTRODUCTIONS TO MATHEMATICAL BIOLOGY
Giordano, Weir & Fox: A FIRST COURSE IN MATHEMATICAL MODELLING

Course: MAM807, Title: DISSERTATION I

Class: B.Sc., Status of Course: MAJOR COURSE, Approved since session: 1998-1999

Total Credits:8

Course No.: MAM701, Course Title: MEASURE & INTEGRATION

Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Lebesgue Outer Measure, its properties, Measurable sets and their properties, Borel sets and their measurability

UNIT 2

Construction of Lebesgue Measure, Measurable Sets and their Properties, Regularity, Measurable Functions and their Properties.

UNIT 3

Lebesgue Integration: Simple Function, Lebesgue integral of a Simple functions, bounded functions and Non-Negative measurable functions. Fatou's Lemma and Lebesgue Monotone Convergence Theorem.

UNIT 4

General Lebesgue Integration and its Properties, Lebesgue Dominated Convergence Theorem, Integration of Series.

UNIT 5

L^p Spaces: L^p space as a vector space and as a metric space, Holder and Minkowski'sinequalities forL^p space, Completeness of L^p spaces.

SUGGESTED READING:

HL Royden: REAL ANALYSIS G.deBarra:MEASURE THEORY AND INTEGRATION

Course: MAM702, Title: TOPOLOGY

Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Topology, Closed sets, Basis, Sub-basis, Metric topology, Subspace topology, Interior points, Exterior points, Boundary points and limit points of a set, Derived set, Interior and closure of a set, Dense Sets, Real Line, Sorgenfrey Line

UNIT 2

Continuous Map, Open Map, Closed Map, Projection Map, Homeomorphism

UNIT 3

Product space, Quotient space, Quotient map, Introduction to countability axioms

UNIT 4

T1, T2, Regular, T3, Completely Regular, T3½, Normal and T4spaces, Compact spaces.

UNIT 5

Connected spaces, Components, Path connected spaces, Path components, Applications of Connectedness.

SUGGESTED READING:

TOPOLOGY-A FIRST COURSE: J. R. Munkres GENERAL TOPOLOGY: J. L. Kelley, Van Nostrand, New York 1955
BASIC TOPOLOGY: M. A. Armstrong

Course: MAM703, Title: THEORY OF DIFFERENTIAL EQUATIONS

Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Elementary Concepts about Differential Equations, Lipschitz condition, Gronwall inequality, Existence and Uniqueness of solutions for scalar and systems of equations.

UNIT 2

Linear Differential Equations with Variable Coefficents, Linear Dependence and Independence of Solutions, Concept of Wronskian, Oscillatory and Non-oscillatory Behaviour of Solutions of Second Order Linear Differential Equations, Non-Homogenous Equations, Strum-Liouville Boundary Value Problem, Green's Function.

UNIT 3

Fundamental matrix, Non-homogenous Linear Equations, Linear Systems with constant coefficients, Linear Systems with Periodic Coefficients.

UNIT 4

Stability of Linear Systems, Behaviour of solutions of Linear Differential Equations.

Unit 5

Stability of Nonlinear Differential Equations, Applications of Poincare Bendixon Theorem, Introductory Methods of Solution of Linear Integral Equations.

Course: MAM704, Title: ANALYTICAL MECHANICS
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Calculus of Variations: Euler-Lagrange equation, Functionals of the form $\int F(x, y_1, y_2, ..., y_n, y_1', ..., y_n')\, dx$, Functionals dependent on higher order derivatives, Functionals dependent on the functions of several independent variables, Variational methods for boundary value problems in ordinary differential equations.
UNIT 2
Generalised co-ordinates. Generalised velocities. Vertual work and genralised forces. Lagrange's equations for a holonomic system. Case of conservative forces. Generalised components of momentum and impulse. Lagrange's equation for impulsive forces. Kinetic energy as a quadratic function of velocities. Equilibrium configuration for conservative holonomic dynamical system. Theory of small oscillations of conservative holonomic dynamical system.
UNIT 3
Variational methods. The Brachistochrone problem. Hamilton's principle. The principle of least action. Distinction between Hamilton's principal and principal of least action.
UNIT 4: Hamilton's equations--the Hamiltonian and the canonical equatios of motion. The passage from the Hamiltonian to the Lagrangian. The Hamilton--Jacobi equation and its complete integral. Phase space. Poisson brackets. Liouville's theorem.
UNIT 5
Motion about a fixed point-Euler's dynamical equations. Motion under no forces about-rotating axes.

Course: MAM705, Title: RINGS & CANONONICAL FORMS
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Polynomial Rings, Roots of a Polynomial, Division Algorithm, Irreducibility of a Polynomial, Mod p Irreducibility Test, Eisenstein Criterion, Irreducibility of *p*th Cyclotomic Polynomial
UNIT II
Quadratic Integer Rings, Euclidean Domain, Principle Ideal Domain, Unique Factorization Domain.
UNIT III
Geometric and Algebraic Multiplicity, Direct Sum of Subspaces, Direct Sum of Eigenspaces, Diagonalizability of Matrices and Linear Operators.
UNIT IV
Minimal Polynomial, Invariant Subspaces, Conductor, Minimal Polynomial & Diagonalizability, Minimal Polynomial &Triangulability, Cyclic Subspace, Cayley-Hamilton Theorem, Companion Matrix.
UNIT V
Generalized Eigenspace, Cycle of Generalized Eigenvectors, Direct Sum of Generalized Eigenspaces, Jordan Form, Rational Form.

SUGGESTED READING:
ALGEBRA: Michael Artin
ABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
CONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian
TOPICS IN ALGEBRA: I. N. Herstein
LINEAR ALGEBRA: S. H. Friedberg, A. J. Insel and L. E. Spence

Course: MAM706, Title: OOP AND MATHEMATICAL SOFTWARE LAB
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2021-22
Total Credits: 2, Periods(55 mts. each)/week:4(L-0-0+P/S-4), Min.pds./sem:52

1. Introduction to and exercise on object-oriented programming concepts with modern programming languages such as Python/Java or any modern object-oriented programming language.
2. Introduction to working with Mathematical Software such as MATLAB/R/Python packages.

Course No. MAM707, Course Title: COMPUTER SYSTEMS ARCHITECTURE
Class: M.Sc., Status of the Course: MAJOR, Approved Since Session: 2009-10
Credits: 4, Periods (55 mts.) per week:4(L:4 + T:0 + P:0), Min. periods per semester: 52
UNIT 1: Review of Digital Systems, General purposemachine, history, programming-architecture-logic design view points, machine classification, instruction formats, computer instruction sets (data movement, ALU, branch instructions), address in gmodes, Simple RISC Computer (SRC), formal description using Register Transfer Notation (RTN), data path, control path.
UNIT 2: Processor design, register transfers, single bus SRC micro architecture, data path implementation, logic design, control sequences, control unit, clocks, timing, multi-bus micro architecture, exceptions.
UNIT 3: Pipelining basics, hazards, instruction level parallelism, micro programming, examples of CISC/RISC processors.
UNIT 4: Memory system design, RAM structure, SRAM, DRAM, ROM, memory hierarchy, cache design, cache policies, Virtual memory, I/O, programmed I/O, interrupts, DMA, error control, peripheral devices.
UNIT 5: Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.
SUGGESTED READINGS:
HeuringV.P.andJordan,H.F.,ComputerSystemsDesignandArchitecture,AddisonWesley,2001.
Stallings,W.,ComputerOrganizationandArchitecture,PHI.,9thedition,2013
Mano,M.,ComputerSystemArchitecture,Prentice HallofIndia,3rd edition, 2017
J.L.Hennessey,D.A.Patterson.ComputerArchitecture:AQuantitativeApproach,Elsevier,6th edition, 2017

Course No. MAM708, Course Title: DATA MANAGEMENT, VISUALIZATION & R
Class: M.Sc Status of the Course: MAJOR, Approved Since Session: 2023-24
Credits: 4, Periods (55 mts.) per week:4(L:3 + T:1 + P:0), Min. periods per semester: 52
UNIT 1
Basic concepts: Database systems, data models, schemas, database systems architecture, ER modelling.
UNIT 2
Relational model: Domains, relations, keys, normalization, relational algebra, calculus.
UNIT 3
SQL: Select statements, displaying data from single and multiple tables, Creating and managing tables, controlling access, advanced subqueries: Multiple column subqueries, Subqueries in FROM clause, Scalar and correlated subqueries.
UNIT 4
Visualization: Value of Visualization, Visual Display of Quantitative Information, Visualization Design, Narrative, Text Visualization, Visual Analytics.
UNIT 5
An Introduction to R, Visualizing and Manipulating Data, Introduction to Programming and Modelling with R.
SUGGESTED READING:
Elmasri&Navathe: FUNDAMENTALS OF DATABASE SYSTEMS, 3/e. Addison Wesley.
Soren V: SQL AND RELATIONAL DATABASE, Galgotia.
E. Tufte:The Visual Display of Quantitative Information (2nd Edition). Graphics Press, 2001
Zuur, Alain, Ieno, Elena N., Meesters, Erik: A Beginners Guide to R, Springer SQL Reference, Oracle Press

Course: MAM801, Title: OPTIMIZATION
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods (55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem: 52
UNIT 1: Queueing Theory: Introduction, Definitions and Notations, Classification of Queueing Models, Distribution of Arrivals (The Poisson Process): Pure Birth Process, Distribution of Inter Arrival Times, Distribution of Departures (Pure Death Process), Distribution of Service Time, Solution of Queueing Models, Poisson Queues- (M/M/1): (∞/FIFO), (M/M/1):(N/FIFO), (M/M/C): (∞/FIFO), (M/M/C): (N/FIFO).
UNIT 2: Non-Linear Programming Problem (NLPP): Introduction, Maxima and minima of functions of several variables and their solutions, Quadratic forms, Concave and convex functions, Unconstrained and constrained optimization.
UNIT 3: Constrained NLPP: Lagrange's method, Kuhn-Tucker conditions, Graphical Method, Concept of Quadratic programming, Frank-Wolfe method. Unconstrained NLPP: Fibonacci and Golden section search, Steepest Descent Method, Conjugate metric method.
UNIT 4: Dynamic Programming: Multistage decision processes, Concept of sub-optimality, Principle of optimality, Calculus method of solution, Tabular method of solution, LPP as a case of dynamic programming.
UNIT 5: Integer programming: Gomory method for pure and mixed LPP, All pure and mixed integer

programming, Algorithm and solution of numerical problems, Branch and bound method.

Course: MAM802, Title: FIELD THEORY
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 4, Periods(55 mts. each)/week:5(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1
Extension of a Field, Quadratic extensions, Degree, Multiplicativity of Degrees, Finite Extension, Subfield Generated by a Subset, Simple Extension, Roots of a Polynomial in an Extension Field, Fundamental Theorem of Field Theory.
UNIT 2
Algebraic Elements, Finite Simple Extension, Algebraic Extension, Finite and Algebraic Extension, Operations on Algebraic Elements, Applications to Geometric Constructions.
UNIT 3
Multiplicity of Roots of a Polynomial in an Extension Field,Roots of Unity over Q and over Zn, Separability of Polynomials, Separable Extension, Splitting Field, Cyclotomic Polynomial, Cyclotomic Extension.
UNIT 4
Finite Fields, Classification of Finite Fields, Finite Fields as Simple Extensions and their Degree, Structure of Finite Fields,Subfields of a Finite Field.
UNIT 5
Group of Automorphisms of a Field, Fixed Field, Galois Group, FrobeniusAutomorphism, Applications of Fundamental Theorem of Galois Theory.
SUGGESTED READING
ALGEBRA: Michael ArtinABSTRACT ALGEBRA: D. S. Dummit and R. M. Foote
GALOIS THEORY: Joseph RotmanCONTEMPORARY ABSTRACT ALGEBRA: J. A. Gallian

Course: MAM803, Title: FUNCTIONAL ANALYSIS
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem: 52
UNIT 1: Normed Linear Space, Banach Space, Finite Dimensional Normed Linear Space, Compactness and Finite Dimension, Continuity of a Linear Map, Norm of a Continuous Linear Map, Isometric Isomorphism.
UNIT 2: Dual Space, Natural Embedding of a Normed Linear Space in its second Dual Space, Weak Topology, Principle Conjugate of an Operator.
UNIT 3: Hahn-Banach theorem, Open Mapping Theorem, Closed Graph Theorem, Uniform Boundedness principle.
UNIT 4: Hilbert space, Schwarz's inequality, orthogonal complement of a set, orthonormal set, complete orthonormal set, Bessel's inequality, Fourier's expansion, Parseval's equation, Gram Schmidt orthogonalisation process, Dual and second Dual of Hilbert space.
UNIT 5: Adjoint of an Operator, Self Adjoint Operators, Normal Operators, Unitary Operators, Projection on a Linear Space, Banach Space and Hilbert Space, Spectral Theorem.

Course: MAM804, Title: FLUID DYNAMICS
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-2018
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem: 52
UNIT 1: The Equation of Continuity in Cartesian, Polar and Spherical coordinates, Boundary Surface, Eulerian and Lagrangian forms of equation of continuity. Symmetrical form of equation of continuity, Equation of Motion, Pressure equation, Lagrangian equation of motion, Helmholtz vorticity equation, Cauchy’s integral.
UNIT 2 [10 pds]
Viscosity, The Navier-Stokes equations of motion, Euler's Equation, Bernoulli's Equation, steady motion between parallel planes, steady flow through a cylindrical pipe, steady flow between concentric rotating cylinders.
UNIT 3 [10 pds]
Meaning of two-dimensional flow, velocity potential and Stream function, Complex potential for irrotational, incompressible flow, complex potentials for line source, sinks and doublets, two dimensional image systems, circle theorem, the theorem of Blasius.
UNIT 4 [10 pds]
Vortex filaments, complex potential due to a vortex of strength +k, motion due to m vortices, two vortex filaments, image of vortex w.r.t. a plane, image of vortex w.r.t. a cylinder, complex potential due to vortex doublet, vortex sheet, infinite single row of vortices of equal strength, two infinite rows of vortices, Karman's vortex sheet.
UNIT 5 [10 pds]

Non dimensional numbers, Prandtl's boundary layer theory, Karman's integral equation.

Course No.: MAM805, Course Title: STOCHASTIC PROC. & STAT. INFERENCE
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1: STOCHASTIC PROCESSES
Stationary processes, Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, Markov processes in continuous time, Poisson process, birth and death process.
UNIT 2: THEORY OF ESTIMATION
Point Estimation, Criterion of unbiasedness, Consistency, sufficiency, Cramer-Rao inequality, Uniformly minimum variance unbiased estimators, Methods of estimation: maximum likelihood moments, minimum chi-square, least square, confidence interval estimation.
UNIT 3: TESTING OF HYPOTHESIS
Basic concepts, types of errors, critical region, power function, most powerful and uniformly most powerful tests, likelihood ratio test, Wald's sequential probability ratio test.
UNIT 4: RELIABILITY THEORY
Definition, Failure, Data Analysis, Hazard, Models, System Reliability Series, Parallel and Mixed Configurations.
UNIT 5: DESIGN OF EXPERIMENTS
Basic principles of experimental design, randomization structure and analysis of completely randomized, randomized block and Latin-square designs. Factorial experiments. Analysis of 2^n factorial experiments in randomized blocks.

Course: MAM806, Title: SOFTWARE LAB II
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 2, Periods(55 mts. each)/week:4(L-0-0+P/S-4), Min.pds./sem:52
MATLAB exercises on MAM801- Optimization.

Course No.: MAM812, Course Title: GRAPH THEORY
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week: 4(L-4-0+P/S-0), Min.pds./sem:52
UNIT1:Introduction
Basicnotationandterminology,graph-theoreticdatastructures:incidence,adjacency, and matrix representation, Types of graphs, Degree of vertex, Trails and Circuits, Paths and Cycles, Connectivity, Coverings, Isomorphism, CutSet&CutVertices, Applicationsofgraph theory.
UNIT2: TreesandForest
Definitionoftree,distance,eccentricity,center,radius and diameter,types of trees and their properties, countinglabeled trees, spanningtreeand Kirchoff's Theorem.
UNIT3: GraphColoring and matching
Coloringanditsexample, chromatic number, chromatic polynomial,bipartite graphs, matching in bipartite graphs.
UNIT4: NetworkFlow and Planar graph
Basicnotationandterminology,flowsandcuts,augmentingpaths,theford-fulkersonlabeling algorithm.
Planargraphs:basicsofplanargraphs,Euler'sformula,Kuratowski'sTheorem.
UNIT5: Graph Algorithms
Reachability: Warshall'sAlgorithm , Depth-First and Breadth-First Searches, The Lightest Path: Dijkstra's Algorithm , Floyd's Algorithm ,The Lightest Spanning Tree: Kruskal's and Prim's Algorithms, TheLightest Hamiltonian Circuit (TravellingSalesman's Problem): The Annealing Algorithm and the Karp–Held Heuristics , Maximum Matching in Bipartite Graphs: The Hungarian Algorithm, Maximum FlowinaTransport Network: TheFord–Fulkerson Algorithm.Casestudies.
SUGGESTED READINGS:

1. DouglasWest.IntroductiontographtheoryPrenticehall,2000.
2. N.Hartsfield&G.Ringel.Pearlsingraphtheory:acomprehensiveintroduction.Courier Corporation, 2013.
3. R.Sedgewick.AlgorithmsinC++,PearsonEducationIndia,2002.
4. V.Zverovich.ModernapplicationsofgraphtheoryOxfordUniversityPress,2021.
5. Benjamin,G.Chartrand&P.Zhang.ThefascinatingworldofgraphtheoryPrincetonUniversity Press, 2017.

Course No.: MAM001, Title: BASIC RES. METH., SC.COMPUT. & ANAL.
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2013-2014
Total Credits:4

UNIT 1: INTRODUCTION
Meaning of research, types of research, research process, problem formulation and techniques, literature review. Research design, principles and types of experimental designs, controls in an experiment, types of controls.
UNIT 2: MEASUREMENT & DATA COLLECTION
Measurement & Scaling: Measurement in research, scales of measurement, sources of errors, tests of sound measurement, development of measurement tools, scaling, scale construction techniques. Methods of data collection: observation, interviews, questionnaire, rating scales, content analysis, case study, schedules.
UNIT 3: ANALYSIS
Quantitative analysis, Errors in Quantitative analysis- random and systematic errors, handling systematic errors, presentation of results, Quality Control and Quality Assurance, Figures of merit-accuracy, precision, limit of detection, limit of quantification, method of standard additions, internal and external standards, comparison of analytical methods.
UNIT 4: INTERPRETATION & REPORTING
Interpretation, techniques of Interpretation, precautions in Interpretation. Report writing: synopsis, project/dissertation report, abstract; reading and writing a research paper.
UNIT 5: SEARCH, REASONING & IPR
Part A: Patents, copyrights, trademarks, trade secrets, IPR. Ethical, legal and social issues associated with research. Research and the Internet: World Wide Web, search engines, search strategy, subject categories, specialized databases.
Part B: Mathematical and Logical Reasoning.
SUGGESTED READINGS:
Kothari C.R. & Gaurav Garg : RESEARCH METHODOLOGY-METHODS AND TECHNIQUES, 3RD Edition, New Age International
Chawla D. and Neena Sondhi : RESEARCH METHODOLOGY CONCEPTS AND CASES, Vikas Publishing House Pvt. Ltd.
Agarwal A.K.: MODERN APPROACH TO LOGICAL REASONING, 2012, S. Chand & Co. Delhi
R. Panneerselvam : RESEARCH METHODOLOGY, PHI, 2004

Course Number: MAM002, Title: PRE-DISSERTATION
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 1998-1999
Total Credits:4
Preparation of Bibliography, Summaries of Related Studies, Preparation of Synopsis of the Research Project.

Course: MAM901, Title: DISSERTATION
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 1998-1999
Total Credits:12
Dissertation on any given topic. Every Candidate will submit Dissertation before 30 November every year.

Course No.: MAM902, Course Title: MATHEMATICAL MODELLING
Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52
UNIT 1: INTRODUCTION [11 pds]
Mathematical Modelling Process, Types of Models, Modelling with Discrete Dynamical systems: Modelling change with Difference Equations, approximating change with Difference Equations, Systems of Difference Equations.
UNIT 2: POPULATION MODELS [11 pds]
Single Species, Non-age Structured Population Models, Two Species Population Models.
UNIT 3: EPIDEMIC MODELS [10 pds]
Deterministic models without removals, a simple deterministic model, SIS model, SIS model with specific rate of infection as a function of time, SIS models with constant number of carriers, general deterministic models with removal, approximate solution, asymptotic behaviour of the solution, general deterministic model with immigration-steady state solution.
UNIT 4: PROBABILISTIC MODELLING [10 pds]
Models in Genetics, Genetic Matrices, Hardy-Weinberg Law, Correlation between Genetic composition of Siblings, Genotype and Phenotype ratios, Models for genetic improvements-Selection and Mutation.
UNIT 5: OPTIMIZATION MODELS [10 pds]
Role of optimization model in biology and medicine, finding optimal classification schemes, survival of systems, medical diagnosis problem, optimization models for blood testing and patient care, models for optimal control of water pollution, optimal air pollution control models, control models for solid waste disposal.
SUGGESTED READING:
JN Kapur: MATHEMATICAL MODELLING IN BIOLOGY AND MEDICINE IA Rubinow: INTRODUCTIONS TO MATHEMATICAL BIOLOGY

Giordano, Weir & Fox: A FIRST COURSE IN MATHEMATICAL MODELLING

Course: MAM903, Title: INTRODUCTION TO RIEMANNIAN GEOMETRY

Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 4, Periods (55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1

Charts, Atlas, Complete atlas, Equivalent atlases, Differentiable Manifolds, Product, Real Projective Space, Grassman Manifolds.

UNIT 2

Induced Topology on a Manifold, Manifold Structure on a topological space, Open submanifold, Properties of the induced topology, Partitions of unity.

UNIT 3

Differentiable Functions between manifolds, Diffeomorphisms, Tangent Space, Differential, Basis Theorem, Inverse Function Theorem for Manifolds.

UNIT 4

Rank of a Differentiable Function,Immersion, Submanifold, Regular Submanifold, Submersion, Quotient Manifold, Whitney Embedding Theorem.

UNIT 5

Vector Field, Lie Bracket, Lie Algebra of Vector Fields, Riemannian Manifold, Covariant Derivative, Geodesics, Normal Neighbourhood Theorem.

SUGGESTED READING:

AN INTRODUCTION TO DIFFERENTIABLE MANIF OLDS AND RIEMANNIAN GEOMETRY: William M. Boothby
DIFFERENTIABLE MANIFOLDS: C. Brickell A COURSE IN DIFFERENTIAL GEOMETRY AND LIE GROUPS: S. Kumaresan
RIEMANNIAN MANIFOLDS (AN INTRODUCTION TO CURVATURE): John M. Lee

Course: MAM904, Title: FUZZY SETS & SYSTEMS

Class: M.Sc., Status of Course: MAJOR COURSE, Approved since session: 1998-1999
Total Credits:4, Periods(55 mts. each)/week:4(L-4-0+P/S-0), Min.pds./sem:52

UNIT 1 [11 pds]

Fuzzy Sets, Convex fuzzy set & Basic theorems, Basic Concepts, Fuzzy Set Operations, Properties Of Fuzzy Sets, Alpha Cuts, Extension Principle, Features Of Membership Functions, Fuzzification, Membership Value Assignments: Intuition, Inference.

UNIT 2 [11 pds]

Fuzzy Arithmetic. Fuzzy Numbers, Fuzzy Operations On Fuzzy Numbers, Interval Analysis In Arithmetic, Fuzzy Vectors. Defuzzification & Arithmetic operations on fuzzy numbers.

UNIT 3 [10 pds]

Fuzzy Relations. Crisp Vs Fuzzy Relations, Operations On Fuzzy Relations, Properties Of Fuzzy Relations, Fuzzy Cartesian Product And Compositions, Fuzzy Tolerance And Equivalence Relations, Fuzzy Ordering Relations, Fuzzy Compatibility.

UNIT 4 [10 pds]

Fuzzy Logic. Bivalued And Multivalued Logic, Fuzzy Tautologies, Implication And Composition Operations, Decomposition of canonical form and canonical form, Fuzzy Propositions, Fuzzy Quantifiers, Linguistic Hedges, Inferencing from Various Propositions.

UNIT 5 [10 pds]

Applications. Fuzzy Expert Systems, Fuzzy Systems, Aggregation of fuzzy rules & graphical method of inference, Fuzzy Controllers.

SUGGESTED READING

J Klir & Bo Yuan: FUZZY SETS AND FUZZY LOGIC T J Ross: FUZZY LOGIC WITH ENGINEERING APPLICATIONS

Course: MAM951, Title: DISSERTATION I

Class: Ph.D. Course Work, Status of Course: MAJOR COURSE, Approved since session: 2007-08
Total Credits: 8

Dissertation on any given topic.

Course: MAM953, Title: SELF STUDY COURSE

Class: Ph.D. Course Work, Status of Course: MAJOR COURSE, Approved since session: 2007-08
Total Credits: 4

Self Study Course.

Course No.: MAM954, Course Title: ADV. SCIENTIFIC METHODOLOGY& ANALYSIS
Class: Ph.D. Course Work, Status of Course: Major Course, Approved since session: 2013-14
Total Credits: 4, Periods(55 mts. each)/week:4(L-4+T-0+P/S-0), Min.pds./sem.:52
[SAME AS PHM954]
UNIT 1
Part A: Introduction, matrix-vector approach (MATLAB), vectors and plotting, vectorization of scalar computations, evaluation of functions, scaling and superposition, approximations and error, floating point numbers, properties of floating point systems, machine precision, subnormals and underflow, floating point arithmetic, condition number, stability, writing MATLAB functions, examples.
Part B: Mathematical and Logical Reasoning to Cover Part I of UGC NET Syllabus. Literature review, report writing and ethics in research.
UNIT 2
The polynomial interpolation problem, Vandermonde approach, special and general case, piecewise interpolation – Hermit, cubic and spline, nested multiplication, Newton representation, properties, accuracy, MATLAB implementations.
UNIT 3
Newton-Cotes integration and implementation, error, composite rules, Composite quadrature, adaptive quadrature, Gauss quadrature, MATLAB implementation examples.
UNIT 4
Matrix computations, simple i-j recipes, band and block structures, matrix-vector multiplications, matrix-matrix multiplications, errors and norms, recursive matrix operations, distributed memory matrix multiplication, discrete Fourier transform, fast Fourier transform, Introduction to MPI.
UNIT 5
Triangular problems, banded problems, full problems, stability, error, sensitivity, QR and Cholesky factorizations, system of linear equations, LU decomposition.
SUGGESTED READINGS:
Michael Heath, Scientific Computing: An Introductory Survey, McGraw Hill.
CF Van Loan, Introduction to Scientific Computing: A Matrix-Vector Approach Using MATLAB, 2nd Edition.

Course: MAM955, Title: SPECIAL TOPICS IN MATHEMATICS
Class: Ph.D. Course Work, Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 4, Periods (55 mts. each)/week: 4(L:4+T:0+P/S-0), Min.pds./sem:52
UNIT 1
Spectral radius, spread, singular values. Properties of Normal Matrices, Schur's Theorem, Diagonalizability of Normal and Self-adjoint Operators, The singular value decomposition and the pseudoinverse.
UNIT 2
Bilinear Forms: Matrix Representation, Diagonalizability of a Bilinear Form, Quadratic Forms and their Reduction.
UNIT 3
Rigid Motion, Translation, Rotation, Reflection, Orthogonal Operators on R^2 and R^3.
UNIT 4
Classical Linear Groups: Algebraic and Topological Structures on Matrix Groups, Dimension as a Vector Space, Topological Properties.
UNIT 5
Partial Differential Equations of Second Order: Introduction, Equation Reducible to Linear Form, Equation Integrable by Lagrange's method, solution of Equations under given Geometrical conditions, Monge's Method to solve $Rr+Ss+Tt+U(rt-s^2)=V$, Canonical Forms, Special Forms of II order Equation.
SUGGESTED READING:
ALGEBRA: Michael Artin LINEAR ALGEBRA: S. H. Friedberg, A. J. Insel and L.E. Spence

Course: MAM181, Title: ENGINEERING MATHEMATICS I

Class: B. Tech., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55 mts. each)/week:3(L-3-0+P/S-0), Min pds./sem:39

UNIT 1

Linear independence of vectors, Rank of a matrix, Solution of system of linear simultaneous equations, Eigen values and vectors, LU decomposition, Cayley-Hamilton theorem.

UNIT 2

Functions of one variable: $\epsilon - \delta$ definition of limit, continuity and differentiability, Mean value theorems, indeterminate forms, successive differentiation, Leibnitz theorem.

UNIT 3

Functions of several variables: Limit of real valued functions of several variables, Partial, directional and total derivative, Euler's theorem, Taylor Series (in one and two variables), Maxima and Minima, Jacobians.

UNIT 4

Limit of vector valued functions of one variable, Differentiation and Integration of vector valued functions, arc length, Double and Triple Integrals and their applications to area and volume.

UNIT 5

Gradient, Divergence and curl. Line and Surface Integrals, Gauss, Green's and Stroke's Theorem (without proof). Simple Applications.

SUGGESTED READINGS:

THOMAS & FINNEY: Calculus and Analytical Geometry E KREYSZIG: ADVANCED ENGINEERING MATHEMATICS
B S GREWAL: ENGINEERINGMATHEMATICS

Course: MAM281, Title: ENGINEERING MATHEMATICS II

Class: B. Tech., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55 mts. each)/week:3(L-3-0+P/S-0), Min pds./sem:39

UNIT 1: DIFFERENTIAL EQUATIONS

Equations of first order (linear and non-linear), higher order linear equations with constant coefficients, Singular solutions, Orthogonal trajectories.

UNIT 2: DIFFERENTIAL EQUATIONS OF SECOND ORDER

Ordinary Linear Differential Equations of Second Order: When one integral belonging to C.F. is known, Method of Removal of the first derivative, Transformation of the equations by changing the independent variable, Cauchy's equation, Euler's equation, Method of variation of parameters.

UNIT 3: PARTIAL DIFFERENTIAL EQUATIONS

Elementary partial differential equations of first order, Homogenous and non-homogenous partial differential equations with constant coefficients, Solution of one-dimensional diffusion equation, first and second order one-dimensional wave equation and two-dimensional Laplace equations.

UNIT 4: COMPLEX ANALYSIS

Analytic Function, Cauchy-Reimann Equation, Conjugate harmonic functions, Integration, Cauchy's Theorem, Cauchy's Integral Formulae.

UNIT 5: SINGULARITIES AND CAUCHY RESIDUES THEOREM

Taylor's and Laurent's expansions, Zeros, poles and essential singularities, Residues, Cauchy Residues Theorem.

SUGGESTED READINGS:

Ray and Sharma: Differential Equations Gorakh Prasad: Text Book of Differential Calculus
Chadda GC, Dwivedi D S and Tripathi S M: : Text Book of Differential Calculus

Course: MAM381, Title: ENGINEERING MATHEMATICS III

Class: B. Tech., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55 mts. each)/week:3(L-3-0+P/S-0), Min pds./sem:39

UNIT 1: FOURIER SERIES- Dirichlet's conditions, Half range series, Harmonic analysis.

UNIT 2: FOURIER TRANSFORMS

Finite and Infinite Fourier Transforms, Fourier Integral Theorem, Inversion Theorem, Applications of Fourier Transforms.

UNIT 3: LAPLACE TRANSFORMS

Standard Forms, Shifting and Convolution Theorems, Transforms of derivatives. Inverse Laplace Transforms, Laplace transforms of error function, Heavyside Direct Delta Functions.

UNIT 4: Z TRANSFORMS

Standard Forms of Z- Transform, Shifting and Convolution Theorems, Transforms of derivatives. Inverse of Z-Transforms, Z- transforms of standard Functions.

UNIT 5: APPLICATIONS OF LAPLACE AND Z-TRANSFROMS

Solutions of ODE's and PDE's, Solve initial and boundary value problems, Solution of one-dimensional diffusion equation, first and second order one-dimensional wave equation and two-dimensional Laplace equations.

SUGGESTED READINGS:

Course No.: MAM481, Course Title: ENGINEERING MATHEMATICS IV
Class: B.Tech., Status of Course: Major Course, Approved since session: 2023-24
Total Credits: 3, Periods(55mts. each)/week:3), Min.pds./sem: 39
UNIT 1:
Conditional Probability, Baye's Theorem; Measure of central Tendency and dispersion in terms of moments. Mathematical expectations.
UNIT 2
Random Variables: Discrete and continuous, Probability mass/ density function, cumulative mass/ density function. Binomial, Poisson and Normal distributions and their applications.
UNIT 3: Stochastic Processes
Stationary processes, Markov process, Memoryless random variable, Markov chains with finite and countable state space, classification of states, Markov processes in continuous time.
UNIT 4: Theory of Estimation
Point and Interval Estimation, Criterion of unbiasedness, Consistency, Efficiency, sufficiency, Methods of estimation: maximum likelihood moments
UNIT- 5
Curve fitting (Method of least square) correlation analysis. Linear regression analysis.
SUGGESTED READING:
Walpole, R.E., Mayers, R.L., Myers, S.L., and Ye K., 'Probability and Statistics for engineers and scientists', Pearson Education.
Johnson, R.A., Probability and statistics for Engineers, PHI.
Kapoor and Saxena, Mathematical Statistics, S. Chand

Course No.: MAM581, Course Title: DISCRETE MATHEMATICS
Class: B.Tech., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55mts. each)/week: 3, Min pds./sem: 39

UNIT 1
Mathematical Logic: Truth tables, equivalence of formulas, tautological implications, normal forms: disjunctive and conjunctive; Theory of inference for propositional calculus; Predicate calculus: predicates, variables and quantifiers, free and bound variables, universe of discourse, nested quantifiers, rules of inference for predicate calculus. Proof strategy and methods.
UNIT 2
Equivalence relation, Partition of a Set, Finite sets, Countable and uncountable sets, Axiom of choice, Partially Ordered Set, Ordered Set, Upper Bound/ Lower Bound, Maximal/Minimal Element, Supremum, Infimum, Lattice, Zorn's Lemma, Well-ordering principle.
UNIT 3
Groupoid, Monoid, Semigroups, Groups, Subgroups, graphs: connectivity, matching, coloring, Boolean Algebra: combinational and sequential circuits. Minimization. Number representations and computer arithmetic's (fixed and floating points)
UNIT 4
Combinatorics: Fundamental laws of counting, pigeonhole principle, permutations, combinations, binomial theorem, multinomial theorem, principle of exclusion and inclusion.
UNIT 5
Discrete numeric functions, Generating functions, Recurrence relations.
SUGGESTED READINGS:
JP Tremblay, R Manohar: DISCRETE MATHEMATICAL STRUCTURES WITH APPLICATIONS TO COMPUTER SCIENCE, McGraw Hill Publication
CL Lee: DISCRETE MATHEMATICS
Kolman, Busby, Ross: DISCRETE MATHEMATICAL STRUCTURES, Prentice Hall Publication
Leach Malvino : Digital principles and applications, Mc Graw Hill

Course No.: MAM582, Course Title: PROBABILITY AND STATISTICS
Class: B.Tech., Status of Course: MAJOR COURSE, Approved since session: 2017-18
Total Credits: 3, Periods (55mts. each)/week: 3, Min pds./sem: 39
[Apply only session 2024-25]

UNIT 1
Conditional Probability, Baye's Theorem; Measure of central Tendency and dispersion in terms of moments. Mathematical expectations.
UNIT 2
Random Variables: Discrete and continuous, Probability mass/ density function, cumulative mass/ density function. Binomial, Poisson and Normal distributions and their applications.
UNIT-3
Sampling distribution, central limit theorem, Estimation; Point and internal estimation using z and t distribution.
UNIT-4
Two types of error, confidence and significance level (small and large samples). Testing of Hypothesis based on means proportions. X^2 – test as the test of independence and goodness of fit. Test based on variance; F-distribution; one way ANOVA.
UNIT- 5
Curve fitting (Method of least square) correlation analysis. Linear regression analysis.
SUGGESTED READING:
Walpole, R.E., Mayers, R.L., Myers, S.L., and Ye K., 'Probability and Statistics for engineers and scientists', Pearson Education.
Johnson, R.A., Probability and statistics for Engineers, PHI.
Kapoor and Saxena, Mathematical Statistics, S. Chand.

Course No.: MAM582, Course Title: NUMERICAL ANALYSIS
Class: B.Tech., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits: 3, Periods (55mts. each)/week: 3, Min pds./sem: 39
[Applicable from 2025-26]
UNIT 1: ALGEBRAIC AND TRANScenDENTAL EQUATION
Numerical solution, Method of bisection, Newton-Raphson Iteration, Acceleration of Convergence by Aitken Triangle Square Process.
UNIT 2: Linear simultanEous algebraic equation
Solution by Cholesky's, Jacobi's and Gauss-Seidel methods. Largest Eigen Value and corresponding Eigen Vector.Power method
UNIT 3: INTERPOLATION
Difference Table. Forward, Backward, Central and Shift operators. Gregory-Newton, Sterling, Everett's and Bessel's Formulae. Lagrange's formula. Inverse interpolation.
UNIT 4: numerical differentiation and integration
Newton-Cotes Formula. Gaussian Quadrature Formula, Extension of trapezoidal and Simpsons rule to multiple integrals.
UNIT 5: ORDINARY DIFFERENTIAL EQUATIONS &Partial Differential Equations
Numerical Solution, Methods of Taylor, Picard, Euler, Range-Kutta, Adams-Bashforth and Milne's method. Simultaneous differential equations.
Numerical Solution. Laplace and one-dimensional heat conduction equation.

SUGGESTED READINGS:
SS Sastry: NUMERICAL ANALYSIS Conte DeBoor: NUMERICAL ANALYSIS
Hildebrand: NUMERICAL ANALYSIS RG
Stanton: NUMERICA

Course: MAM681, Title: ADVANCED OPTIMIZATION TECHNIQUES
Class: B.Sc. Engg., Status of Course: MAJOR COURSE, Approved since session: 2023-24
Total Credits:3, Periods(55 mts. each)/week:3(L:3-0+P:0+S:0), Min.pds./sem:39

UNIT 1 [8 pds]
Introduction to mathematical programming problems and models, Geometry and Analysis of models/solutions. Convex polyhedron, Concave and convex functions, Related theorems, Linear Models and representations, Definitions and Theorems, solution of l.p.p. graphical, simplex, two-phases of simplex, Big-M method.
UNIT 2 [8 pds]
Concept of Duality, Theorems, Dual-simplex, Transportation problem.
UNIT 3 [8 pds]
Non-linear programming problems: Single and multi variable optimization problems (with and without constraints)-Definitions and related theorems. Lagrange's method, KKT conditions. Unimodal function, Fibonacci and Golden section search, Steepest descent method, Conjugate metric method.
UNIT 4 [8 pds]
Dynamic Programming: Multistage decision processes, Concept of sub-optimality, Principle optimality, Calculus method of solution, Tabular method of solution, L.p.p. as a case of Dynamic programming.
UNIT 5 [7 pds]
Quadratic Programming, use of optimization toolbox in Matlab and CPLEX solver in optimization.
SUGGESTED READINGS:
G Hadley: LINEAR PROGRAMMING SI Gass: LINEAR PROGRAMMING
SS Rao: OPTIMIZATION TECHNIQUES
NS Kambo: MATHEMATICAL PROGRAMMING TECHNIQUES

Course: PMA101, Title: COMPUTATIONAL METHODS
Class: M. Tech, Status of Course: Major Course, Approved since session: 2009-10
Total Credits:4, Periods(55 mts. each)/week:4(L-3+T-1+P-0+S-0), Min pds./sem: 52

UNIT 1: PARTIAL EQUATIONS OF SECOND ORDER
Equation that can be integrated by inspection, equation reducible to linear form, equation integrable by Lagrange's method, solution of equation under given geometrical conditions, Monge's method to solve the equation of the type $Rr+Ss+Tt=v$ and $Rr+Ss+Tt+U(rt-s^2)=v,$ canonical forms.
UNIT 2: TRANSFORMS
Standard forms, Shifting and convolution theorems, Transforms of derivatives, inverse Laplace transforms, Applications to the solution of linear and simultaneous differential equations, Finite and infinite Fourier transforms, Applications to boundary value problems.
UNIT 3: INTEGRAL EQUATIONS
Conversion of ordinary differential equations into integral equation, classification of linear integral equation and methods of their solution using Laplace transforms.
UNIT 4: STATISTICS
Correlation and Regression, Binomial, Poisson and Normal distributions. Theory of testing of Hypothesis: Null and alternate hypotheses, simple and composite hypotheses, Type I & Type II errors, Critical region, Most powerful Critical region, Analysis of Variance.
UNIT 5: LINEAR PROGRAMMING
Graphical Method, Simplex method.

SUGGESTED READINGS:
Raddick & Miller: ADVANCED MATHEMATICS FOR ENGINEERS
C J Tranter: INTEGRAL TRANSFORMS IN MATHEMATICAL PHYSICS
B S Grewal: HIGHER ENGINEERING MATHEMATICS
S S Rao: OPTIMIZATION TECHNIQUES
R P Kanwal: LINEAR INTEGRAL EQUATIONS
Peter Collins: DIFFERENTIAL & INTEGRAL EQUATIONS

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