St Aloysius College (Autonomous)

Mangalore

Re-accredited by NAAC "A" Grade

B.Sc Mathematics

CREDIT BASED SEMESTER SYSTEM

(2014 –15 ONWARDS)

ಸಂತ ಅಲೋಶಿಯಸ್ ಕಾಲೇಜು
(ಸ್ವಾಯತ್ತ)
ಮಂಗಳೂರು- 575 003

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Re-accredited by NAAC with 'A' Grade
Recognized by UGC as "College with Potential for Excellence"

No: SAC 40/Syllabus 2014-15 Date: 13 – 06 - 2014

NOTIFICATION

Sub: Syllabus of B.Sc. Mathematics Under Credit Based Semester System.

Ref: 1. Academic Council decision dated 28-09-2013

2. Office Notification dated 12-06-2014

Pursuant to the Notification cited under reference (2) above, the Syllabus of B.Sc. Mathematics under Credit Based Semester System is hereby notified for implementation with effect from the academic year 2014-15.

PRINCIPAL

ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar
3. Library

PREAMBLE

SCOPE OF THE SYLLABUS

This syllabus is framed in such a way that the students learn Calculus and Differential Equations and their applications, which help them to learn allied subjects like Physics, Computer Science, in a better way. Also, the students learn Number Theory and Algebra which can motivate the students to go for higher studies in Mathematics. A variety of optional papers are given so that the students can learn the subjects of their interest.

Course Pattern and Scheme of Examinations

Group II: Optional III B.Sc. Mathematics

Semester	Paper	Hours per week	Duration of the Exam(hrs)	Semester Exams	Marks Internal Assessment*	Total
I	Paper1	6	3	100	50	150
II	Paper2	6	3	100	50	150
III	Paper3	6	3	100	50	150
IV	Paper4	6	3	100	50	150
V	Paper5(a)	5	3	100	50	150
	Paper5(b) Elective*	5	3	100	50	150
VI	Paper6(a)	5	3	100	50	150
	Paper6(b) Elective*	5	3	100	50	150
					Total	1200

*For each paper Internal Assessment marks shall be awarded based on the marks scored in two tests and projects/assignment/Surprise tests.

*During the V & VI semester, a student can opt for any one of the special papers offered in the syllabus, except that a student studying statistics in B. Sc. cannot opt for the paper ‘distribution theory’.

Semester	Paper	Paper Code	Title of the Paper
I	Paper1	G 503.1	Calculus
II	Paper 2	G 503.2	Calculus, Number Theory And Differential Equations
III	Paper 3	G 503.3	Number Theory, Group Theory & Multivariate Calculus
IV	Paper 4	G 503.4	Functions Of A Complex Variable, Number Theory, Group Theory And Real Analysis
V	Paper5(a)	G 503.5(a)	Differential Equations, Laplace transform and Algebra
	Paper5(b) Special Paper	G 503.5(b)i G 503.5(b)ii G 503.5(b)iii G 503.5(b)iv G 503.5(b)v G 503.5(b)vi	5(b)i Discrete Mathematics 5(b)ii Numerical Methods 5(b)iii Graph Theory 5(b)iv Linear programming 5(b)v Mathematical Modeling 5(b)vi Distribution Theory
VI	Paper6(a)	G 503.6(a)	Partial Differential Equations, Fourier Series and linear algebra.
	Paper6(b) Special Paper	G 503.6(b)i G 503.6(b)ii G 503.6(b)iii G 503.6(b)iv G 503.6(b)v G 503.6(b)vi	6(b)i Discrete Mathematics 6(b)ii Numerical Methods 6(b)iii Graph Theory 6(b)iv Linear programming 6(b)v Mathematical Modeling 6(b)vi Distribution Theory

A Student has to opt a special paper in paper 6(b) which is different from what was opted earlier in paper 5(b).

QUESTION PAPER PATTERN FOR B.SC. MATHEMATICS

(Credit based Semester Scheme for End Semester Examination)

Each Question Paper shall consist of two parts: PART A and PART B.

The number of Questions in each part is tabulated below for different papers.

Papers	Part A Short Answer Questions No. of Questions	Part B Long Answer Questions No. of full Questions
Paper 1	15	5
Paper 2	15	5
Paper 3	15	5

THIRD SEMESTER
G 503.3-PAPER 3
NUMBER THEORY, GROUP THEORY
AND MULTIVARIATE CALCULUS

Unit I:

Congruences: Basic properties of congruences , Primary and decimal representation of integers. Linear congruences and their incongruent solution. Chinese Remainder Theorem. Fermat's Little theorem. Pseudo primes. Wilson's theorem.

Unit II:

Group Theory: Binary operations, commutative law, associative law, identity, Groups, abelian groups.

Subgroups – Definition of subgroups, intersection of sub groups, finite subgroups, Center of a group, centralizer of an element, normalizer of a subset, Finding order of HK for finite subgroups H and K.

Cyclic groups – subgroup generated by a single element, Generator of a cyclic subgroup, subgroups of cyclic group, subgroups of Z, infinite cyclic groups and their subgroups, finite cyclic groups and their subgroups, generators for infinite cyclic groups, generator for a finite cyclic group, cyclic group of prime order, order of an element in a group, properties of $\theta(a)$, order of the product of two elements.

Lagrange's theorem – Right and left cosets, symmetric group of order 3, Lagrange's Theorem- order of a group, number of distinct left cosets, index of a subgroup, groups of prime order, Euler's theorem, Fermat's theorem.

Unit: III:

Differential calculus of functions of more than one variable: Domain and range of a function of n-variables. Composite function. Level curves limits of functions of more than one variable . Accumulation point, Continuity of functions of more than one variable. Removable and essential discontinuity . Partial derivatives. Differentiability and the total differential. The chain rule. The general chain rule. Higher order partial derivatives.

Unit: IV

Directional derivatives an gradients. Normal Vector. Tangent plane. Tangent line. Extreme of functions two variables. Absolute extreme value Lagrange's multipliers.

Unit: V

Double integral: Evaluation of double integrals and to iterated integrals. Double integrals in polar co-ordinates. Area of surface. Then triple integral. The triple integral in cylindrical and spherical co-ordinates.

Text Books:

(1) The calculus with analytical geometry – Louis Leithold – 6th edition, Harper & Row, Publishers, New York.

(2) Number Theory by David M. Burton 6Th edition – Tata McGraw-Hill Edition.

(3) University Algebra by N. S. Gopalakrishnan- revised 2nd edition.

Reference Books:

1. Calculus by Lipman Bers, Holt, Rienehart and Winstion, 1969
2. First course in Calculus by Serge Lang, Addision – Wesley,1966
3. Differential and Integral Caluclus – N. Pisknov Vol I and Vol II, Tata Mcgraw-Hill, 1980
4. Thomas' Calculus, 11th edition by Maurice D. Weir, Joel Hass and Frank R. Giordano (Pearson Publications)
5. Topics from the theory of numbers by Grosswald Brikhauser, 1984
6. Algebra, T.K.M.Pillay and Natarajan, publishers S. Vishwanathan1985
7. A first course in Algebra: J.B.Fraleigh, Addision- Wesley 1982.
8. Topics of Algebra – Mukhopadhyaya, M.K.Sen & S. Ghosh, University press 2004.

FOURTH SEMESTER

G 503.4 - PAPER-4

FUNCTIONS OF A COMPLEX VARIABLE, NUMBER THEORY, GROUP THEORY AND REAL ANALYSIS.

Unit I

Complex variables

Recapitulation- Algebra of Complex numbers. Demoivre's Theorem, Polar and exponential form, nth roots of a complex number.

Functions of a Complex variable, Limits, Continuity, Differentiability, Cauchy Riemann Equations, Analytic functions, Harmonic Functions.

Unit II

Number of divisors and sum of a divisors.

Euler's phi-function, Euler's theorem, properties of Euler's Phi-function. Perfect numbers, Mersenne primes, Fermat numbers. Solutions of the Pythagoras equation. Fermat's last theorem. Properties of Pythagorean triangle. Fibonacci sequence, gcd of two Fibonacci numbers, Finite continued fractions- convergents of a continued fraction

Unit III

Group Homomorphism: – Definition examples homomorphic image of abelian group, Homomorphic image of cyclic groups.

Group Isomorphism :- Definition of isomorphic groups), Groups of roots of unity, Isomorphism of finite and infinite cyclic groups, Cyclic groups of same order, groups of prime order, Klein-4 Group, groups of order 4, Automorphism, inner automorphism.

Kernel of a homomorphism, normal subgroups, simple groups, necessary and sufficient condition for normal subgroups, subgroup of index 2 .

Quotient groups: - Definition, Examples, The First Isomorphism Theorem, isomorphism of G/Z onto G'.

Permutation Groups :- Definition of permutation, Symmetric group, Transpositions, cycles, Signature, Odd and even permutations, Alternating Group.

Unit IV

Real Analysis (Sequences and Series)

Sequences, monotonic and bounded Sequences, least upper bound and greatest lower bound, the axiom of completeness, infinite series of constant terms, partial sums, infinite series of positive terms, Comparison test, Limit Comparison Test, Hyper harmonic series, Integral test.

Unit V

Infinite Series.

Alternating series, Liebniz's test, absolute convergence and conditional convergence, ratio test and root test for absolute convergence of an infinite series of nonzero terms.

Text Book:

(1) Complex Variables-Theory and applications Second Edition– H. S. Kasana, PHI Learning Private Limited.
(2) University Algebra by N. S. Gopalakrishnan- revised 2^{nd} edition.
(3) The calculus with analytical geometry – Louis Leithold – 6^{th} edition, Harper & Row, Publishers, New York.
(4) Number Theory by David M. Burton 6^{Th} edition – Tata McGraw-Hill Edition.

Reference Books:

1. Calculus by Lipman Bers, Holt, Rienehart and Winstion, 1969
2. First course in Calculus by Serge Lang, Addision – Wesley,1966
3. Thomas' Calculus, 11^{th} edition by Maurice D. Weir, Joel Hass and Frank R. Giordano (Pearson Publications)
4. Topics from the theory of numbers by Grosswald Brikhauser, 1984
5. Algebra, T.K.M.Pillay and Natarajan, publishers S. Vishwanathan1985
6. A first course in Algebra: J.B.Fraleigh, Addision- Wesley 1982.
7. Topics of Algebra – Mukhopadhyaya, M.K.Sen & S. Ghosh, University press 2004.

FIFTH SEMESTER

G 503.5(A) - PAPER 5(A)

DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORM AND ALGEBRA

60 hours; 5hrs/ week: 150MARKS

Unit I

Ring Theory: - Definition of Rings , Unit Element , Commutative Ring.

Integral domains :- Zero divisors , Integral domain , Field, Division ring (Skew field), regular elements , Finite Integral domains , Center of a ring .

Ring Homomorphisms: - Homomorphism and Kernel of a ring homomorphism .

Isomorphism: - isomorphism, Embedding

Ideals: Definition of ideals, Simple Rings, Left and right ideals, Sum and Product of two ideals .

Quotient rings : Definition, First Isomorphism Theorem .

Unit II

Prime and Maximal Ideals: Prime Ideals , Prime ideals in Z, Maximal Ideals

Factorization : Divisibility , associates, Irreducible elements , Prime elements , g.c.d., relatively prime elements .

Euclidian Domain :- Definition . Examples, existence of g.c.d., Factorization Theorem.

Polynomial Rings: Polynomials, Polynomial rings, Degree of a polynomial, Constant polynomial, Irreducible polynomials

UNIT III

Higher order linear differential equations (with constant coefficients) : Solving Homogeneous Equations, Auxiliary Equations, real , distinct, repeated, complex roots, Non Homogeneous equations, D-operators, Particular integral with $f(x) = e^{ax}$, sinax, cosax, x^n, $e^{ax}v(x)$, Non homogeneous differential equations of higher order.

Unit IV

Higher order differential equations with variable coefficients: Cauchy Euler Differential Equations, Second order differential equations with variable coefficients- when a part of the complementary function is known, variations of parameters, changing independent variable.

UNIT V

Laplace Transforms (L.T): Sufficient conditions for existence of Laplace Transforms, Properties of Laplace Transforms, Laplace transforms of some common functions, Laplace transforms of Derivatives and integrals, Further properties of L. T., L.T. of periodic functions, L.T. of step functions, Inverse Laplace Transforms, Convolution theorem, Applications to D. E.

Text books: 1) University Algebra by N. S. Gopalakrishnan- revised 2nd edition.

2) A short course in Differential Equations by

Earl D Rainville and Phillip EBadient, IBH Publishing Company

3) A Text book of B.Sc. Mathematics Vol 2by G K Ranganath, S Chand and Company Ltd.

Reference Books:

1. Laplace Transform – Murray R. Speigal.
2. Differential Equations – S.B.Rao and H.R.Anuradha .
3. Differential Equations with applications and Historical notes – G.F.Simmons, Mcgrw- Hill 1972
4. Introductory Course in Differential Equations – D.A.Murray,1924.
5. Differential Equations (Schaum series)
6. Higher Engineering Mathematics – B.S. Grewal, Khanna publisher New Delhi.
7. Algebra, T.K.M.Pillay and Natarajan, publishers S. Vishwanathan1985
8. A first course in Algebra: J.B.Fraleigh, Addision- Wesley 1982.
9. Topics of Algebra – Mukhopadhyaya, M.K.Sen & S. Ghosh, University press 2004.
10. The calculus with analytical geometry – Louis Leithold – 5th edition.
11. Differential Equations with Applications and programs by S. Balachandra Rao and H. R. Anuradha-University Press

V SEMESTER – PAPER 5(b)

G 503.5(b)i Discrete Mathematics

G 503.5(b)ii Numerical Methods

G 503.5(b)iii Graph Theory

G 503.5(b)iv Linear programming

G 503.5(b)v Mathematical Modeling

G 503.5(b)vi Distribution Theory

SIXTH SEMESTER

G 503.6(A) - PAPER 6(A)

PARTIAL DIFFERENTIAL EQUATIONS, FOURIER SERIES AND LINEAR ALGEBRA

UNIT I

Total Differential equations : Conditions for integrebility of Pdx + Qdy + Rdz =0, methods of solving Pdx + Qdy + Rdz=0 by (1) inspection method , (2) One variable regarded as constant , (3) Method of Auxiliary Equations , (4) Homogeneous Equations, Solutions of Simultaneous total Differential equations.

UNIT II

Fourier Series:

Introduction, Periodic functions, Euler's Formulae, Definite integrals.

Dirichlet's conditions for a Fourier Series expansion, Even and Odd functions, Half Range Series Complex Fourier Coefficients, Finite Fourier Transforms.

Unit III

Linear Algebra:-

Vector Spaces , properties , Subspaces intersection of subspaces, (L(S)- subspace generated by a subset, nature of elements of L(S) , Sum of subspaces, Direct sum of two subspaces , Characterization of direct sum , direct sum of n subspaces.

Linear Dependence, Independence and Bases **:** basis, generating set , linear independence, minimal generating set , dimension , dimensions of subspaces, dimension of a sum of subspaces .

Inner Product Spaces **:** Inner product, norm, Schwarz inequality , orthogonal vectors, normal vectors , orthonormal basis and set independence of orthonormal sets , existence of orthonormal basis in an inner product space, (Orthogonal complements .

Unit IV

Linear Transformations: -

Linear transformation , kernel , isomorphism , isomorphism of $f^{(n)}$ with any n-dimensional space, quotient space , first Isomorphism Theorem , dimension of a quotient space , non singular transformation , (L(V, V')), dimension of L(V,V') .

Matrices: identity, idempotent, nilpotent, non singular, diagonal, triangular and block matrices .

Matrices and Linear transformations:

matrix associated with a linear transformation ,isomorphism of l(V,V') with $M_{mn}(F)$) , matrix of a product of linear transformations , Relation between matrices of a L.T. with respect to different bases , similar matrices .

Rank : row rank, column rank, rank, rank of a linear transformation , rank of a composition of linear transformations , rank of a product of matrices,.

Unit V

Elementary Row Operations : Elementary matrices, non singularity of elementary matrices , inverse of an elementary matrix, inverse of a matrix as a product of elementary matrices , equivalent matrices .

Linear Equations**:** Homogeneous linear Equations, condition for existence of non trivial solutions, Non Homogeneous Equations, condition for existence of solutions) and 5 condition for existence of unique solution.

Minimal polynomial: existence, minimal polynomial, Uniqueness, (Min. poly. of non singular matrices, min. poly. of similar matrices, Min. poly. of a transformation.

Characteristic roots**:** Ch. roots of f(A) for a polynomial f and matrix A , number of distinct Characteristic Roots, Characteristic polynomial of a matrix, Characteristic polynomial of similar matrices , Characteristic polynomial of a linear transformation , Cayley Hamilton theorem, Characteristic polynomial of the transpose.

Text books:

1) University Algebra by Gopalakrisnan – 2nd revised edition
2) A Text book of B.Sc. Mathematics Vol 2by G K Ranganath, S Chand and Company Ltd.

Reference:

1. Advanced Engineering Mathematics (8th Edition) – E.Kreyszig, John Wiley and Sons.
2. Algebra T.K.M. Pilay & Natarajan, publishers S.Kumerasan.
3. Topics in algebra by – I. N. Herstein Wiley student Edition – 2nd edition.
4. A brief survey of modern algebra – Birkoff and MacLane, Macmilan - 1965

VI SEMESTER – PAPER 6(b)

G 503.6(b)i Discrete Mathematics

G 503.6(b)ii Numerical Methods

G 503.6(b)iii Graph Theory

G 503.6(b)iv Linear programming

G 503.6(b)v Mathematical Modeling

G 503.6(b)vi Distribution Theory

DISCRETE MATHEMATICS

60 hours; 5hrs/week; 150marks

UNIT 1: (12 hours)

Introduction: Sets Countability, Mathematical induction, Principles of inclusion and exclusion, propositions, computability and formal languages: Russel's phrase structures, grammars and Languages. Permutations, combinations and discrete probability, conditional probability.

Relations and functions : Introduction, a relational model for data bases, properties of binary relations, equivalence relations and partitions, partial orderings relations and lattices, chains and anti – chains. A job scheduling problem, functions and Pigeon – hole principle.

UNIT 2 :(12 hours)

Graphs and planar graphs: introduction, basic terminology, multigraphs and weighted graphs, paths and circuits, shortest paths in weighted graphs.

Eulerian paths and circuits, Hamiltonian paths and circuits, factors of a graph, planar graphs.

UNIT 3: (12 hours)

Trees, paths, length in rooted trees. Prefix codes, Binary search trees, spanning trees and cutsets, minimum spanning trees, Transport Networks.

UNIT 4 (12hours)

Finite state Machines: Introduction, Finite State Machines, Finite State Machines as models of physical systems. Equivalent machines.

Finite State Machines language recognisers. Analysis algorithms; Introduction, time complexity of algorithms a shortest path algorithm, Complexity of problems, Tractable and intractable problems.

UNIT 5: (12hours)

Discrete numeric functions and generating functions: Introduction numeric functions, Asymptotic behavior of Numeric functions.

Generating functions. Combinatorial problems. Revenue relations and recursive algorithms: recurrence relations, linear recurrence relations with constant coefficients.

Text Book: Elements of Discrete Mathematics (second edition), C.L.Liu, Mcgraw-Hill 1985, ch.1 to 10 – Relavant Sections.

Reference Books:

1. Discrete Mathematical structures with applications to computer science by J.P.Tremblay R.Manohar.
2. Discrete Mathematics structures by Besnard Kolman, Robert C. Bushy, Sharan Ross (third edition).

NUMERICAL METHODS

60 hours; 5hrs/week; 150marks

UNIT 1 (12 hours)

Errors in numerical calculations, absolute, relative and percentage errors, a general error formula, errors in series approximation.

Solution of Algebraic and transcendental equations : Bisection method, iteration method, acceleration of convergence : Aitken's process, the method of false position, Newton Raphson method, Generalized Newton's method, solution of system of nonlinear equations, the method of iteration and Newton Raphson method.

UNIT 2: (12 hours)

Interpolation: Errors in polynomial interpolation, finite differences: forward differences, backward differences, symbolic relations, detection of errors by use of difference tables, differences of a polynomial, Newton's formulae for interpolation, interpolation with unevenly spaced points: Lagrange's interpolating formula.

UNIT 3: (12hours)

Divided difference and their properties, Newton's general interpolation formula, Interpolation by iteration, inverse interpolation, Numerical differentiation, Max. and min. values of a tabulated function.

Numerical integration; Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

UNIT 4 :(12hours)

Matrices and linear system of equations: Basic definitions: Matrix operations, transposes, inverse, rank of a matrix, consistency of a linear system of equations, vector and matrix norms.

Direct methods of solving linear systems: matrix inversion method, Gauss elimination method, modification Gauss elimination method to compute the inverse.

Iterative methods of solving Linear systems: Jacobi's method, Gauss – Seidal method.

UNIT 5 :(12 hours)

Numerical solution of ordinary differential equations: Solution by Taylor series, Picards method of successive approximation.
Euler's method, Runge Kutta Method, Predictor corrector methods, Adams- Bashforth method, Adams Moulton method.

Text Book: Introductory methods of Numerical Analysis by S.S.Sastry. Third Edition. Prentice Hall of India.
Relevant sections from the Text Book

Reference Book: Numerical Methods for scientists and Engineers, M.K.Jain, S.B.W.Publishers, Delhi 1971.

GRAPH THEORY

60 hours; 5hrs/week; 150marks

UNIT 1: (12hours)

Definition of a graph, Konigsberg bridge problem. Finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, sub graphs, walks, paths, circuits, connected graphs, components. Euler graphs, operation on graphs. Hamiltonian paths and circuits. Trees: properties, pendent vertices, Distance and center, rooted and binary tree. Spanning trees, Fundamental circuits.

UNIT 2: (12hours)

Cut sets, properties, cutsets in a graph. Fundamental cut sets and circuits. Connectivity and seperability.

Kuratowski's two graphs, Different representation of planar graphs, Detection of planarity, Geometrical dual.

UNIT 3: (12hours)

Incidence matrix, submatrices of A(G), Circuit matrix. Fundamental circuit matrix and rank. Cutest matrix. Pathmatrix, Adjacency matrix. Chromatic number, Chromatic partitioning, Chromatic polynomial coverings.

UNIT 4: (12hours) Directed graphs, Definition, types of digraph, binary relations and Directed paths and connectedness. Euler digraphs, trees and digraphs. Fundamental circuits in digraphs, matrices A, B, C of digraphs, adjacency matrix of a graph

UNIT 5: (12hours)

Enumeration of Graphs, labeled graphs, Counting labeled graphs, Rooted Labeled graphs, Counting unlabeled graphs, Rooted unlabeled Trees, Counting Series for U_n. Free Unlabeled trees. Polya's counting theorem.

.**Text Book:** Graph Theory with application to Engineering and Computer science –Narsingh Deo, Prenticehall India.

Chap 1 to 9-Relevant Sections

LINEAR PROGRAMMING

60 hours; 5hrs/week; 150marks

UNIT 1: (12hours)

Geometric linear programming: Polyhedral convex sets, Geometric method – Simplex Algorithms: Canonical slack forms for linear programming problems – Tucker Tableaus, The Pivot transformation, The simplex algorithm for maximum basic feasible tableaus, Simplex algorithm for maximum tableaus.

UNIT 2: (12hours)

Negative Transposition: The Simplex Algorithm for minimum Tableaus, Cycling, Noncanonical Linear Programming problems: Introduction, Unconstrained variables, Equations of constraint. Duality theory: Introduction, Duality in Canonical Tableaus, The Dual Simplex Algorithm, matrix Formulation of canonical Tableaus, The Duality Equation.

UNIT 3: (12hours)

The Duality Theorem, Duality in Noncanonical Tableaus.

Matrix Games: Introduction, An Example: Two Person Zero – Sum Matrix Games, Linear Programming Formulation of Matrix Games, The Von Neumann Minimax Theorem, concluding remarks.

UNIT 4: (12hours)

Transportation and Assignment problems: Introduction. The Balanced Transportation problem, The Vogel Advanced Start method (VAM). The transportation algorithm, Unbalanced transportation problems, the assignment problems.

UNIT 5: (12hours)

Network – Flow problems: Introduction, Graph Theoretic preliminaries, The Maximal flow network problem. The Max – flow Min- cut theorem: The maximal – flow Algorithm, The shortest path network problem. Dijkstra's Algorithm Only.

Text Book: Linear Programming and its Applications – James K.Strayer, Narosa publishing House – Relevant Sections.

MATHEMATICAL MODELING

60 hours, 5hrs/week; 150marks

UNIT 1: (12hours)

Scope of Mathematical Modeling;

Models, mathematical and otherwise, steps in building a mathematical model, Approximate and limited models – Gravity, Rockets and raindrops, Macro and Micro population models I – exponential growth.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 1: Sections 1,2,3,4.

UNIT 2: (12 hours)

Macro and Micro population models II - The Leslie Matrix;

Macro and Micro population models I - Family planning models;

Descriptive and prescriptive models - Inventory policy;

The relation of models to data: Sources of error – Underground exploration of the Earth;

Adjusting data I (the easy way) – The mean the maximum likelihood.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 1: Section 5, 6, 7.

Chapter 2: Section 1, 2.

UNIT 3: (12 hours)

Adjusting data II (The hard way) – miscellaneous methods and examples. Evaluation of Mathematical models: A birds eye view of evaluation – college enrollment; Descriptive realism – Simple linear regression; Descriptive realism – correlation is not causation; Accuracy – Multiple linear regression ;

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 2: Section 3

Chapter 3: Section 1,2,3,4.

UNIT 4: (12hours)

Precession – Maltus and the Dismal theorem;

Robustness – The ups and downs of ancient astronomy.

Optimization – Classical optimization; Linear programming. Formulation and graphical solution; An outline of the simplex method.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 3: Section 5, 7.

Chapter 4: Section 1, 2, 3.

UNIT 5: (12hours)

Inter Programming – The Knapsack and Traveling salesman problem;

The Transportation problem; Combinatorial Optimization. The Chinese Postman Problem. Discrete verses continuous models; and introduction to difference equations. Exponential population growth difference and differential equation;

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 4: Section 4, 5, 6;

Chapter 4: Section 2, 2A, 2B.

Reference Book: Mathematical Modeling by J.N.Kapur.

Distribution Theory

60 hours, 5hrs/week; 150marks

Unit I: Definition of discrete and continuous random variables, cumulative distribution function (c.d.f.) and its properties (with proof), probability mass function (p.m.f) and probability density function (p.d.f.), Expectation, correlation, Properties of expectation, Theorems on sum and product of expectations of random variables.

12 hours

Unit II: Univariate Discrete distributions: uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric distributions, properties, mean, variance, MGF and mode of Binomial and Poisson distribution (with proof). Genesis and Applications.

12 hours

Unit III: Univariate Continuous Distributions: Rectangular distribution: Mean, variance and moments, Median, Normal distribution: Normal approximation to Binomial and Poisson distribution, Median, Mode, moments and additive property of Normal distribution, Exponential, Gamma, Beta distribution of first and second kind, Distribution function, Mean and variance. Genesis and Applications.

12 hours

Unit IV: Bivariate Normal distribution and its properties, marginal and conditional distribution.

12 hours

Unit V: Markov's inequality (statement only), Central Limit Theorem, Sequence of random variables, Convergence in probability, Basic results (without proof), WLLN for i.i.d. random variables and applications, Convergence in distribution.

12 hours

Reference books

1. S.C. Gupta and V.K. Kapoor (2011): Fundamentals of Mathematical Statistics, Sultan Chand and sons.
2. Goon A.M. Gupta and Das Gupta (2008): Fundamentals of Statistics, vol. II World Press, Kolkata.
3. Parimal Mukhopadhyay (2011): Mathematical Statistics, Books and Allied (p) Ltd. Kolkata.
4. R.V. Hogy and E.A. Tansis (2001): Probability and Statistics, Pearson Education Asia.

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