MANGALORE UNIVERSITY

Mathematics Syllabus for B. Sc. (Credit Based Semester System) (Revised Syllabus)

PREAMBLE

The Mathematics syllabus for B. Sc. in use at present was introduced from the academic year 2006-2007, which was the first syllabus introduced under Credit Based Semester System. The U.G.B.O.S. decided to update the syllabus to keep pace with recent developments in the subject. The Board observed that new text books and reference books giving modern approach to different branches of Mathematics, at undergraduate level, are readily available now and their introduction to the course is desirable. Apart from this fact, the following revised syllabus for B. Sc. Mathematics (Credit Based Semester System) of Mangalore University, framed by the U.G.B.O.S., has also taken into consideration the syllabus recommended by the UGC curriculum development committee and syllabi of other Universities of Karnataka. The syllabus is meant to be introduced from the academic year 2012-2013 and it is framed as per the prevailing guidelines of the Credit Based Semester System.

Course Pattern and Scheme of Examinations

Group II : Optional III : B.Sc. Mathematics

Semester	Paper	Hours per week	Duration of the Uni. Exam (hrs)	Marks		
				University Exams	Internal Assessment*	Total
I	MT 101 : Paper 1	6	3	120	30	150
II	MT 151 : Paper 2	6	3	120	30	150
III	MT 201 : Paper 3	6	3	120	30	150
IV	MT 251 : Paper 4	6	3	120	30	150
V	MT 301 : Paper 5	5	3	120	30	150
	MT 302 : Paper 6 (Special Paper)**	5	3	120	30	150
VI	MT 351 : Paper 7	5	3	120	30	150
	MT 352 : Paper 8 (Special Paper)**	5	3	120	30	150
				Total		**1200**

* For each paper, the internal assessment marks shall be awarded based on two tests conducted for the purpose.

** During the Vth & VIth Semesters, a student can opt for any one of the special papers offered in the syllabus.

Semester	**Paper**	**Title of the papers**
I	MT 101 : Paper 1	Calculus and Number Theory
II	MT 151 : Paper 2	Number theory, Calculus and Solid Geometry
III	MT 201 : Paper 3	Differential Equations, Complex Variables and Functions of Several Variables
IV	MT 251 : Paper 4	Multiple Integrals, Infinite Sequences and Series and Group Theory
V	MT 301 : Paper 5	Ring Theory and Higher Order Differential Equations
	MT 302 : Paper 6 (Special paper)	6 a) Discrete Mathematics 6 b) Numerical Analysis
VI	MT 351 : Paper 7	Partial Differential Equations, Fourier Series and Linear Algebra
	MT 352 : Paper 8 (Special paper)	8 a) Graph Theory 8 b) Linear Programming and its Applications

QUESTION PAPER PATTERN FOR B.Sc. MATHEMATICS (CREDIT BASED SEMESTER SYSTEM) FOR UNIVERSITY EXAMINATION

- Each Question Paper, for Paper 1 to Paper 8, shall consist of two parts : Part A and Part B.

- The number of Questions in each part shall be as tabulated below for different papers:

Papers	Part A Short Answer Questions No. of Questions	Part B Long Answer Questions No. of Questions
Paper 1	15	10
Paper 2	15	10
Paper 3	15	10
Paper 4	15	10
Paper 5	15	10
Paper 6	15	10
Paper 7	15	10
Paper 8	15	10

Note 1 : Fifteen Questions in Part A shall equally cover all the units of the syllabus. Any ten questions shall be answered. Each question in Part A carries three marks for Paper 1 to Paper 8.

Note 2 : In Part B, all papers shall have two questions from each of the five units. Five full questions shall be answered, choosing one full question from each unit. Each question in Part B carries 18 marks for Paper 1 to Paper 8.

B.Sc. MATHEMATICS SYLLABUS
(CREDIT BASED SEMESTER SYSTEM)
(Revised Syllabus)

I SEMESTER

MT 101 : PAPER 1
CALCULUS AND NUMBER THEORY
72 hours; 6 hrs/week; 120 marks

UNIT 1 : (15 hours)

Limits and Continuity: Limits of function values, Limit laws and Sandwich Theorem – recapitulation.
One sided limits and limits at ∞ : One sided limits –recapitulation, Limits at infinity, Finite limits at ± ∞, Limits at infinity for rational functions, Horizontal asymptotes, Oblique asymptotes.
Infinite Limits and vertical Asymptotes: Formal Definitions of infinite limits, and Definitions of ∞ and -∞ as limits, Vertical asymptotes, Dominant terms.
Continuity : Continuity and intermediate value theorem - recapitulation.
Applications of derivatives : Extreme values of a function, Absolute maximum and minimum, Extreme Value Theorem, Local maximum and minimum, Finding extrema, First Derivative test for Local extreme values, Critical point, Finding absolute extrema.
Mean value theorem : Rolle's Theorem, Mean Value Theorem.

Text Book **[1]** : Selected topics from,
Chapter 2 : Sections 2.4, 2.5, 2.6.
Chapter 4 : Sections 4.1, 4.2 .

UNIT 2 : (15 hours)

Monotonic Functions and the First Derivative Test : Definitions of increasing and decreasing functions, First Derivative test for monotonic functions, First Derivative test for local extrema.
Concavity and Curve Sketching : Definitions of concavity, Second Derivative Test for Concavity, Points of Inflection, Second Derivative Test for Local extrema, Learning about functions from derivatives, Tracing curves.
Applied Optimization problems

Text Book **[1]** : Chapter 4 : Selected topics from Sections 4.3, 4.4, 4.5.

UNIT 3 : (14 hours)

Indeterminate Forms and L'Hospital's Rule : Indeterminate form 0/0, L' Hospital's Rule (First Form), L' Hospital's Rule (Stronger Form), Cauchy's Mean Value Theorem, Indeterminate forms ∞/∞, $\infty.0$, $\infty - \infty$.
Polar Coordinates : Definition of polar coordinates, Relating Polar and Cartesian co-ordinates, Converting Cartesian to polar and polar to Cartesian - recapitulation. Polar coordinates with negative r-values, Polar Equations and Graphs.
Graphing in Polar coordinates : Symmetry, Tests for symmetry, Slope of curves, tracing curves, Finding points where graphs intersect.
Areas and lengths in Polar Coordinates : Area in the plane, Area between curves, Length of a polar curve.

Text Book **[1]** : Selected topics from,
Chapter 4 : Section 4.6.
Chapter 10 : Sections 10.5, 10.6, 10.7.

UNIT 4 : (14 hours)

Integration : Sigma notation and finite sums : Limits of finite sums, Definitions of lower and upper sums, Riemann sums.
The Definite Integral : Definite integral as a limit of Riemann sums, Existence of Definite integrals, Integrable and nonintegrable functions, Area under the graph of a non-negative function, Average value of a continuous function, average or mean value.
The fundamental theorem of calculus : The mean value Theorem for Definite Integrals, Fundamental theorem –Part 1, Fundamental Theorem Part 2 (The Evaluation Theorem), Total area.

Text Book **[1]** ; Chapter 5: Selected topics from Sections 5.2, 5.3, 5.4 .

UNIT 5: (14 hours)

Number Theory
Recapitulation of Division Algorithm, G.C.D. and Euclidean Algorithm.
The Diophantine Equation, The Fundamental Theorem of arithmetic, The theory of congruences, Recapitulation of basic properties of congruences, Binary and decimal representation of integers, Linear Congruences and the Chinese Remainder theorem.

Text Book **[2]** : Selected topics from
Chapter 2 : Sections 2.2, 2.3 and 2.4 –Recapitulation, Section 2.5.
Chapter 3 : Section 3.1 ,
Chapter 4. : Sections 4.2, 4.3, 4.4.

Text Books :

[1] Thomas' Calculus, by Maurice D. Weir, Joel Hass and Frank R. Giordano, 11th edition, Pearson Publications, 2008
[2] Number Theory by David M. Burton, 6th edition – UBS Publications, 2009

Reference books :

(1) Calculus with Analytical Geometry by Louis Leithold, 5th edition, Harper and Row publishers, New York, 1986
(2) Number Theory by H. S. Hall, S.R. Knight, Maxford Books.

II SEMESTER

MT 151 : PAPER 2
NUMBER THEORY, CALCULUS AND SOLID GEOMETRY
72 hours; 6 hrs/week; 120 marks

UNIT 1 : (14 hours)

Number theory

Fermat's Theorem, Wilson's Theorem, Euler's Φ function, Euler's Theorem, Some properties of Euler's Function, Finite continued fractions.

Text book **[2]**: Selected Topics from
Chapter 5 : Sections 5.2, 5.3.
Chapter 7 : Sections 7.2, 7.3, 7.4.
Chapter 15 : Section 15.2

UNIT 2 : (14 hours)

Techniques of Integration

Integration by parts : Reduction formulae, Substitution and integration by parts.
Trigonometric Integrals- Products of powers of sines and cosines, Integrals of powers of tan x and sec x .
Reduction formulas : for $\int \tan^n x\,dx$, $\int (\ln x)^n dx$ and $\int \sin^n x \cos^m x\,dx$.
Numerical Integration : Trapezoidal approximations- The trapezoidal rule, Simpson's rule .

Text Book **[1] :** Chapter 8 : Selected Topics from Sections 8.2, 8.4, 8.6, 8.7

UNIT 3 : (15 hours)

Applications of Definite Integrals

Volumes by Slicing and Rotation about an axis- Definition of volume, Calculating the volume of a solid , Volume of a pyramid , Volume of a wedge , Solids of revolution : The disk method, Washer method.

Volume by cylindrical shell method : Finding volumes by using shells, The shell method : Rotation about y-axis and x- axis.
Lengths of plane curves Length of a parametrically defined curve- Definition and Derivation of a Formula for the length of $y = f(x)$, Dealing with discontinuities in dy/dx.

Text Book **[1]** : Chapter 6 : Selected topics from Sections 6.1, 6.2, 6.3 .

UNIT 4 : (15 hours)

Vectors & the Geometry of Space : Three Dimensional coordinate system, Distance and spheres in space, Standard Equation of the sphere.
[Recapitulation : Vectors : The dot product , cross product and related results]
Direction cosines.
Lines and planes in space: Lines and line segments in space , Vector equation of the line, Parametric equation of a line : Parametrizing a line through a point and parallel to a vector, Parametrizing a line through two points, Parametrizing a line segment, Distance from a point to a line in space, Equation for a plane in space, Lines of intersection, Distance from a point to a plane, Angles between planes. .

Text Book **[1]** : Chapter 12 : Selected Topics from Section 12.1, [Recapitulation of Sections 12.2, 12.,3 and 12.4.], Selected topics from Section 12.5

UNIT 5 : (14 hours)

Vector valued Functions and Motion in Space
Vector Functions: Path, curve, component functions, Parametrization, Position vector, Definition of limit and continuity, , Derivatives and Motion – Definition of derivatives, Differentiable Vector function, Smooth curve, Tangent line, Piecewise smooth curve, Differentiation Rules.
Arc Length and Unit Tangent Vector : Arc length along a space curve , Length of a smooth curve, Arc length parameter with a given base point , Speed on a smooth curve, Unit Tangent vector .
Curvature and the Unit Normal Vector : Curvature of a plane curve , Formula for calculating curvature, Principal normal vector, Circle of curvature for plane curves, Curvature and normal vectors for space curves.

Text book **[1]** : Chapter 13 : Selected topics from Sections 13.1, 13.3, 13.4

Text Books :

[1] Thomas' Calculus, by Maurice D. Weir, Joel Hass and Frank R. Giordano,11th edition, Pearson Publications, 2008
[2] Number Theory by David M. Burton, 6th edition – UBS Publications, 2009

Reference Books :

(1) Calculus with Analytical Geometry by Louis Leithold, 5th edition, Harper and Row publishers, New York, 1986
(2) Number Theory by H. S. Hall, S.R. Knight, Maxford Books.

III SEMESTER

MT 201 : PAPER 3
DIFFERENTIAL EQUATIONS, COMPLEX VARIABLES AND FUNCTIONS OF SEVERAL VARIABLES

72 hours; 6 hrs/week; 120 marks

UNIT 1 : (14 hours)

Differential Equations : Formation of a Differential equation, Separation of variables, Homogeneous Equations, Method of Solving Homogeneous Equations, Linear Differential Equations, Bernoulli's Equation, Exact Differential Equations, Equations Reducible to the exact form.

Text book **[1]** : Selected topics from
Chapter 1: Section 1.5
Chapter 2: Sections 2.2, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9.

UNIT 2 : (14 hours)

Differential Equations : Differential equations of the First Order and Higher Degree, Equations Solvable for p, Equations Solvable for x, Equations Solvable for y, Clairaut's Equation.
Orthogonal Trajectories: Family of curves and trajectories, Orthogonal trajectories in Cartesian form and Polar form.

Text Book **[1]** : Selected topics from,
Chapter 3: Sections 3.1, 3.2, 3.3, 3.4.
Chapter 4 : Sections 4.1, 4.2, 4.3.

UNIT 3 : (14 hrs)

Complex variables
Algebra of Complex numbers – Recapitulation.
Analytic Functions :
Functions of a Complex variable , Limits, Continuity, Differentiability, Cauchy Riemann Equations, Analytic functions, Harmonic Functions.

Text Book **[2]**:
Chapter 1 : Recapitulation
Chapter 2: Selected topics from Sections 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7.

UNIT 4 : (15 hours)

Partial Derivatives

Functions of several variables: Definition of function of n independent variables, Domains and ranges, Functions of two variables, Definition of interior and boundary points, Definitions of open, closed, bounded and unbounded regions in a plane.

Graphs, Level curves and contours of functions of two variables; Functions of three variables, Level surface, Interior and boundary points for space regions, Open and closed regions.

Limits and continuity in higher dimensions : Limits, Continuity, Two path test for non existence of limit, Continuity of composites, Functions of more than two variables, Extreme values of continuous functions on closed and bounded sets.

Partial derivatives: Partial Derivative of a function of two variables, Implicit partial differentiation, Finding slope of a surface in the y-direction, Functions of more than two variables, Partial derivatives and continuity, Second Order partial derivatives, Mixed Derivative theorem, Partial Derivatives of still higher order, Differentiability : Increment theorem for functions of two variables, Differentiable function.

Chain Rule: Chain rule for functions of two and three independent variables- Functions defined on surfaces, Implicit differentiation.

Text Book **[3]** : Selected topics from Sections 14.1, 14.2, 14.3, 14.4,

UNIT 5 : (15 hours)

Directional Derivatives and Gradient Vectors : Directional derivatives in the plane, Interpretation of the directional derivative, Gradient vector , Properties of the directional derivatives, Gradients and tangents to level curves, Rules for gradients, Gradients of functions of three variables.

Tangent Planes and Differentials : Tangent planes and normal lines, Equation of a plane tangent to a surface, Linearization of a function of two variables, Definition of standard linear approximations, Differentials: Total differentials, Linearization and total differentials of functions of more than two variables.

Extreme values and saddle points: Derivative tests for Local Extreme values : Local maxima and minima, First Derivative test for local extreme values, Critical and saddle points, Absolute Maxima and Minima and closed bounded regions,

Constrained Maxima and Minima.

Text Book **[3]** : Selected topics from Sections 14. 5, 14. 6, 14.7, 14.8

Text Books :

[1] Differential Equations with Applications and programs by S. Balachandra Rao and H. R. Anuradha, Universities Press, 2009

[2] Complex Variables , Theory and Applications by H. S. Kasana , Second Edition, PHI Learning Private Limited, 2008

[3] Thomas' Calculus, by Maurice D. Weir, Joel Hass and Frank R. Giordano,11th edition, Pearson Publications, 2008

Reference Books :

(1) A short Course in Differential Equations by Earl D. Rainvelle and Philip E. Bedient, 4th Edition , Macmillan, 1969

(2) Complex Variables and Applications by James Ward Brown and Ruel V. Churchill, 7th Edition, Mc Graw Hill publications, 2003

(3) Calculus with Analytical Geometry by Louis Leithold, 5th edition, Harper and Row publishers, New York, 1986

IV SEMESTER

MT 251 : PAPER 4
MULTIPLE INTEGRALS, INFINITE SEQUENCES AND SERIES AND GROUP THEORY

72 hours; 6 hrs/week; 120 marks

UNIT 1 : (14 hours)

Multiple Integrals

Double integrals: Double Integrals over rectangles, Double Integrals as volume, The Fubini's Theorem (First Form), Double Integrals over bounded non – rectangular Regions, Fubini's Theorem (Stronger Form), Finding Limits of integration, Properties of double integrals.

Reversing the order of integration, Volume beneath a surface.

Areas of bounded regions in plane : Definition of area, examples

Double integrals in Polar form : Integrals in Polar coordinates, Finding limits of Integration, Changing Cartesian Integrals into Polar Integrals.

Triple Integrals in Rectangular Coordinates : Volume of a region in space, Finding limits of integration, Properties of Triple Integrals .

Text Book **[1]** : Chapter 15 : Selected topics from Sections 15.1, 15.2, 15.3, 15.4

UNIT 2 : (14 hours)

Infinite Sequences and Series: Infinite Sequences : Convergence and Divergence, Limit, Definition of Divergence to Infinity, Calculating limits of sequences, Sandwich theorem for sequences, The Continuous Function Theorem for Sequences,

Convergence of a sequence using L'Hospital's Rule, Bounded nondecreasing sequences, Bounded sequences, Upper bound, Least upper bound.
Infinite Series : Partial sum, Convergence and sum of the series, Geometric series, nth term test for divergence, Combining Series.
Taylor and Maclaurin Series : Series representations, Taylor and Maclaurin series, Taylor Polynomial of order n.
Taylor's Theorem : Taylor's formula.

Text Book **[1]** : Chapter 11 : Selected topics from Sections 11.1, 11.2, 11.8, 11.9

UNIT 3 : (14 hours)
Convergence/ Divergence tests for infinite series.
The integral Test: Non decreasing Partial sums: The Integral Test .
Comparison test : Limit Comparison test , The Ratio and Root Tests
Alternating series , absolute and conditional convergence: The Alternating Series Test : Leibnitz's Theorem, Absolute and conditional convergence, The Absolute Convergence Test- The Rearrangement Theorem for Absolutely Convergent series.

Text Book **[1]** : Chapter 11: Selected topics from Sections : 11. 3, 11.4, 11.5, 11.6

UNIT 4 : (15 hours)
Group Theory [Recapitulation of basic concepts]
Subgroups – Definition of a subgroup, Intersection of subgroups, Finite subgroups, Center of a group, Centraliser of an element, Normaliser 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 .

Text Book **[2]** : Chapter 1 : Selected topics from Sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.6.

UNIT 5 : (15 hours)
Group Homomorphism : Definition and examples, Homomorphic image of abelian groups, 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, Subgroups of index 2.

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

Text Book **[2]** : Chapter 1 : Selected topics from Sections 1.7, 1.8, 1.9

Text books :

[1] Thomas' Calculus, by Maurice D. Weir, Joel Hass and Frank R. Giordano,11th edition, Pearson Publications, 2008

[2] University Algebra by N. S. Gopalakrishnan – Revised 2nd Edition, New Age International, 2009

Reference books :

(1) Calculus with Analytical Geometry by Louis Leithold, 5th edition, Harper and Row publishers, New York, 1986

(2) Topics in algebra by I. N. Herstien, 2nd edition, John Wily & Sons, 2007

V SEMESTER

MT 301 : PAPER 5
RING THEORY AND HIGHER ORDER DIFFERENTIAL EQUATIONS

60 hours; 5 hrs/week; 120 marks

UNIT 1: (12 hours)

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 Homorphisms :- 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 .

Text Book **[1] :** Chapter 2 : Selected topics from Sections 2.2, 2.3, 2.4, 2.5, 2.7, 2.8

UNIT 2 : (12 hours)

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.

Text Book **[1]** :Chapter 2 : Selected topics from Sections 2.9, 2.10, 2.11, 2.14

UNIT 3 : (12 hours)

Higher order linear differential equations with constant coefficients : Solving Homogeneous Equations, Auxillary 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.

Text Book **[2]** : Chapter 5. Selected topics from Sections 5.1, 5.2, 5.3, 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6, 5.4.

UNIT 4 : (12 hours)

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.

Text Book **[2]** : Selected topics from Chapter 6.
Chapter 8 : Sections 8.1, 8.2, 8.3, 8.4.

UNIT 5 : (12 hours)

Laplace Transforms : 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 Laplace transforms. Laplace transforms of periodic functions, Laplace transforms of step functions, Inverse Laplace Transforms, Convolution theorem, Applications to Differential Equations.

Text Book **[2]** : Chapter 14 : Selected topics from Sections 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, 14.9, 14.11, 14.12, 14.13.

Text books :

[1] University Algebra by N. S. Gopalakrishnan – Revised 2nd Edition, New Age International, 2009

[2] Differential Equations with Applications and programs by S. Balachandra Rao and H. R. Anuradha, Universities Press, 2009

Reference Books :

(1) Topics in algebra by I. N. Herstien, 2nd edition, John Wily & Sons, 2007

(2) A short Course in Differential Equations by Earl D. Rainvelle and Philip E. Bedient, 4th Edition, Macmillan, 1969

V SEMESTER

MT 302 : PAPER 6
(Special Paper – 6a)
DISCRETE MATHEMATICS

60 hours; 5 hrs/week; 120 marks

UNIT 1 : (12 hours)

Partially Ordered Sets & Lattices : Definition and examples of partially ordered sets. Lattices : Set theoretic & Algebraic definitions, Examples for lattices, Duality principle, Sublattices & Convex sublattices, Ideals of lattices, Complements & Relative complements, Homomorphism & Isomorphism, distributive and modular lattices, Characterization of distributive and modular lattices in terms of sublattices.

UNIT 2 : (12 hours)

Graphs and Planar Graphs: Introduction, Basic terminology, Multigraphs and Weighted graphs, Digraphs and relations, Representation of graphs, Operations on graphs, Paths and circuits, Graph traversals, Eulerian paths and circuits, Hamiltonian paths and circuits, Factor of a graph, Planar graphs, Graph colouring.

UNIT 3 : (12 hours)

Trees and Cut-sets : Trees, Rooted trees, Path lengths in rooted trees, Prefix codes, Spanning trees and cut-sets, Minimum spanning trees; Kruskal's Algorithm, Prim's Algorithm.

UNIT 4 : (12 hours)

Modeling Computation: Introduction, Russell's Paradox and Noncomputability, ordered sets, Languages, Phrase structure grammars, Types of grammars and languages, Basic concepts of Information processing machine, finite state machines, Finite state machines as models of physical systems, Equivalent machines, Finite state machines as language recognizers.

Analysis of Algorithms: Introduction, Algorithms LARGEST1, LARGEST2 , BUBBLESORT and LARGESMALL algorithms, Time complexity of algorithms, Tractable and Intractable problems.

UNIT 5 : (12 hours)

Discrete numeric functions and Generating functions : Introduction, Manipulation of numeric functions, Asymptotic behaviour of numeric functions, Generating functions.

Recurrence relations and Recursive Algorithms: Introduction, Recurrence relations, Linear recurrence relation with constant coefficients, Homogeneous solutions, particular solutions.

Text Books :

[1] Elements of Discrete Mathematics by C.L. Liu, 3rd edition, Tata Macgraw - Hill Publishers, 2008

[2] Introduction to Lattice Theory by Gabor Szasz, Academic Press, New York and London, 1963.

Reference books:

(1) Discrete Mathematical Structures with Applications to Computer Science by J. P. Trembley and R. Manohar - Tata Macgraw - Hill Publishers

(2) Discrete Mathematics for Computer Scientists by J. K. Truss - Pearson Education, Asia.

V SEMESTER

MT 302 : PAPER 6
(Special Paper - 6b)
NUMERICAL ANALYSIS

60 hours; 5 hrs/week; 120 marks

UNIT 1 : (12 hours)

Applications and Errors in Computation:

Introduction, accuracy of numbers, errors, useful rules for estimating errors , error propagations , error in the approximation of a function. Errors in a series approximation.

Solutions of Algebraic and Transcendental Equations:

Introduction : Initial approximation, rate of convergence, Bisection method, method of false position or Regula falsi method, Iteration method, Newton Raphson method.

Chapter 1 : Section 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7.
Chapter 2 : Section 2.1, 2.5(1), 2.6, 2.7, 2.8, 2.10.2.11

UNIT 2 : (12 hours)

Solution of Simultaneous Algebraic Equations:

Introduction to matrices - Definition, Special matrices, Operation on matrices, Related matrices, Rank of a matrix, Elementary transformations of a matrix, Equivalent matrix, Consistency of a system of linear equation, System of linear homogeneous equations.

Solution of linear homogeneous equations, Direct methods of solution – matrix inversion method, Gauss elimination method, Gauss-Jordan method.

Iterative methods of solution- Jacobi's iteration method, Gauss-Seidel iteration method.

Chapter 3 : Sections 3.2 , 3.3 , 3.4 , 3.5.

UNIT 3 : (12 hours)
Finite differences:
Introduction, Finite differences, differences of a polynomial, to find one or more Missing terms.
Interpolation: Introduction, Newton's forward interpolation formula, Newton's backward interpolation formula, Interpolation with unequal intervals, Lagrange's interpolation formula.

Chapter 6 : Sections 6.1, 6.2, 6.3 , 6.8.
Chapter 7 : Sections 7.1, 7.2, 7.3, 7.11, 7.12.

UNIT 4 : (12 hours)
Divided differences : Newton's divided difference formula, Inverse interpolation, Lagrange's method.

Numerical differentiation and integration:
Numerical differentiation, Formulae for derivatives- Derivatives using forward difference formulae, Derivatives using backward difference formulae. Maxima and minima of a tabulated function.

Numerical integration: Newton cotes quadrature formulae, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule

Chapter 7 : Sections 7.13, 7.14, 7.19, 7.20
Chapter 8 : Sections 8.1, 8.2, 8.3, 8.4, 8.5,

UNIT 5 (12 hours)
Numerical Solution of Ordinary Differential Equations :
Introduction, Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge-kutta method, Predictor-corrector methods.
Adams-Bashforth method.

Chapter 10 : Sections 10.1, 10.2, 10.3, 10.4, 10.5, 10.7, 10.8, 10.10.

Text Book: Numerical methods in Engineering and Science with programs in C, C++ by Dr. B. S. GREWAL, Ninth edition, Khanna publications, New Delhi, April 2010

Reference Book: Introductory Methods of Numerical Analysis by S. S. Sastri, 3rd Edition, Prentice Hall of India, 2008

VI SEMESTER

MT 351 : PAPER 7
PARTIAL DIFFERENTIAL EQUATIONS, FOURIER SERIES AND LINEAR ALGEBRA

60 hours; 5 hrs/week; 120 marks

UNIT 1 : (12 hours)
Differential Equations
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 Auxillary Equations, (4) Homogenous Equations, Solutions of Simultaneous Total Differential equations.

Text book **[2] :**
Chapter 12 : Selected topics from Sections 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, 12.8.
Chapter 13 : Selected topics from Sections 13.1, 13.2.

UNIT 2 : (12 hours)
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 .

Text Book **[2]** : Chapter 15 : Selected topics from 15.2, 15.3, 15.4, 15.5, 15.6, 15.8.

UNIT 3 : (12 hours)
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 linear independence of orthonormal sets, Existence of orthonormal basis in an inner product space, Orthogonal complements .

Text Book **[1]** : Chapter 3: Selected topics from Sections 3.2, 3.3, and 3.4.
Chapter 5: Selected topics from Section 5.11

UNIT 4 : (12 hours)

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 Linear Transformation with respect to different bases, Similar matrices .

Rank : Row rank, Column rank, Rank of a matrix, Rank of a linear transformation, Rank of a composition of linear transformations, Rank of a product of matrices.

Text Book **[1] :** Chapter 3 : Selected topics from section 3.5.
Chapter 5 : Selected topics from section 5.2, 5.3 and 5.5.

UNIT 5 : (12 hours)

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 five conditions for the existence of a unique solution.

Minimal polynomial: Definition and existence of Minimal polynomial, Uniqueness, Minimal polynomial of non singular matrices, minimum polynomial of similar matrices , Minimal polynomial of a transformation.

Characteristic roots : Characteristic 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 book **[1]** : Chapter 5: Selected topics from Sections 5.5, 5.6, 5.8 and 5.9.

Text books :

[1] University Algebra by N. S. Gopalakrishnan – Revised 2nd Edition, New Age International, 2009

[2] Differential Equations with Applications and programs by S. Balachandra Rao and H. R. Anuradha, Universities Press, 2009

Reference Books :

(1) Topics in algebra by I. N. Herstien, 2nd edition, John Wily & Sons, 2007

(2) A short Course in Differential Equations by Earl D. Rainvelle and Philip E. Bedient, 4th Edition , Macmillan, 1969

VI SEMESTER

MT 352 : PAPER 8
(Special Paper – 8a)
GRAPH THEORY

60 hours; 5 hrs/week; 120 marks

UNIT 1 : (12 hours)

Graphs, finite, Infinite graphs, Incidence and degree, Isolated vertex, Pendant vertex, Null graph, Isomorphism, Subgraphs, Walks, Paths, Circuits, Connected and disconnected graphs, Components, Euler graphs, Operations on graphs, Hamiltonian paths, Circuits, Trees and some properties of trees, Rooted and binary tree, Spanning tree and fundamental circuits.

Sections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4, 2.5,2 .6, 2.7, 2.8, 2.9, 3 .1, 3.2, 3.3, 3.4, 3.5, 3.7, 3.8 of the Text book

UNIT 2: (12 hours)

Cutsets, Properties, Fundamental cutsets, Connectivity, Separability, Planar graphs, Kuratowski's graphs, Different representations of planar graphs, Geometric dual.

Sections 4.1, 4.2, 4.3, 4.4, 4.5 , 5.2, 5.3, 5.4, 5.6 of the Text book

UNIT 3 : (12 hours)

Ring sum of two circuits, Subspace, Orthogonal vectors, Matrix representation, Incidence matrix, Cutset matrix, Circuit matrix, Adjacency matrix.

Sections 6.1, 6.4 , 6.5, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, 7.6 ,7.9 of the Text book

UNIT 4 : (12 hours)

Chromatic number : Chromatic number of a tree, bipartite graph, complete graph and cycles. Chromatic polynomial: Chromatic polynomial of a tree, complete graph and cycles, the chromatic polynomial of a graph as a combination of chromatic polynomials of complete graphs.

Sections: 8.1, 8.3 of the Text book

UNIT 5 : (12 hours)
Directed graphs, Types, Matrices in graphs, Enumeration of graphs, Counting labelled trees.

Sections 9.1, 9.2, 9.4, 9.8, 10.1, 10.2 of the Text book

Text book : Graph theory With Applications to Engineering and Computer Science by Narsingh Deo, PHI Learning Private Limited, 2009

Reference Book: College Graph Theory by V. R. Kulli, Vishwa International Publications, 2011.

VI SEMESTER

PAPER 8
(Special Paper – 8b)
LINEAR PROGRAMMING AND ITS APPLICATIONS
60 hours; 5 hrs/week; 120 marks

UNIT 1 : (12 hours)
Geometric Linear Programming : Profit Maximization and cost Minimization, Cost Minimization, Canonical forms for Linear Programming Problems, Polyhedral Convex sets.
The Simplex Algorithm : Canonical stack forms for Linear Programming Problems, Tucker Tableaus, Pivot Transformation, Pivot Transformation for Maximum and Minimum Tableaus, Simplex Algorithm for Maximum Basic Feasible Tableaus., Simplex Algorithm for Maximum Tableau.

Chapter 1, Sections 1, 2, 3.
Chapter 2, Sections 1, 3, 5,

UNIT 2 : (12 hours)
Negative Transposition : The Simplex Algorithm for Minimum tableaus,.
Non Canonical Linear Programming problems : Unconstrained variables, Equations of Constraint .
Duality Theory : Duality in Canonical Tableaus, Dual Simplex Algorithm, Matrix formulation of Canonical Tableaus, The Duality Equation.

Chapter 2, Section 7
Chapter 3, Sections 1, 2
Chapter 4, Sections 1, 2, 3, 4.

UNIT 3 : (12 hours)
The Duality Theorem : Duality in Non Canonical Tableaus.
Matrix Games : Two Persons Zero Sum Matrix Game, Linear Programming Formulation of Matrix Games, The Von Neumann Minimax Theorem .

Chapter 4, Sections 5, 6.
Chapter 5, Sections 1, 2, 3.

UNIT 4 : (12 hours)
Transportation and Assignment Problem : The Balanced Transportation Problem, The Vogel Advanced Start Method (VAM), The Transportation Algorithm, Unbalanced Transportation Problems, The Assignment Problem, The Hungarian Algorithm.

Chapter 6, Sections 1, 2, 3 , 5, 6.

UNIT 5 : (12 hours)
Network- Flow Problems: Graph Theoretic Preliminaries, The Maximal Flow Network Problems, The Max-Flow Min-Cut Theorem, The Maximal Flow Algorithm, The Shortest Path Network Problem - The Shortest Path Algorithm I.

Chapter 7, Sections 1, 2, 3, 4

Text Book: Linear Programming and its Applications by James K Strayer, Narosa Publishing House, Springer International Student Edition, 1992

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