R.K.D.F. UNIVERSITY, BHOPAL

M.Sc. (Mathematics)

REVISIED SYLLABUS 2019-2020

SCHEME

Semester – I

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MMM 511	ANALYSIS-I	20	8	80	32	-	-	100
2	MMM 512	ORDINARY DIFFERENTIAL EQUATIONS	20	8	80	32	-	-	100
3	MMM 513	CLASSICAL MECHANICS	20	8	80	32	-	-	100
4	MMM 514	ALGEBRA	20	8	80	32	-	-	100
Total			**80**	**32**	**320**	**128**	**-**	**-**	**400**

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M.Sc. (Mathematics)

Syllabus

Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	ANALYSIS- I	MMM 511

UNIT I

Brief review of sets, relations and functions. Finite and infinite sets, countable anduncountable sets, Schröder-Bernstein theorem, Ordered fields, least upper bound property,the field of real numbers, Archimedean property, density of rational numbers, existence of n_{th} root of positive real numbers, exponential and logarithm, the extended real number system, the complex field.

UNIT II

Numerical sequences and their convergence, bounded sequences, Cauchy sequences, construction of real numbers using Cauchy sequences; series of complex numbers, convergence of series, series of nonnegative terms, the number e, the root and ratio tests, limit supremum and limit infimum, power series, summation by parts, absolute convergence, addition and multiplication of series, rearrangements (statement only).

UNIT III

Euclidean spaces, metric spaces, open and closed sets, limit points, interior points,compact spaces; statements only of the following: nested interval theorem, Heine-Borel theorem, and Bolzano-Weierstrass' threorem.

UNIT IV

Limit and continuity of functions of two variables in details, Introduction of Partial differentiation, Euler's Theorem on homogeneous function, Jacobians, Differentiability of real-valued functions of twovariables, Taylor's theorem for functions of two variables, Double and triple integrals, Dirichlet's integrals.

UNIT-V

Differentiation of real-valued functions and its elementary properties; mean value theorem; Taylor's theorem; differentiation of vector-valued functions; elementary properties of Riemann integral (brief review); integration of vector-valued functions.

Textbooks:

1. Principles of Mathematical Analysis (5_{th} edition) – W. Rudin, McGraw Hll

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Syllabus

Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	ORDINARY DIFFERENTIAL EQUATIONS	MMM 512

UNIT I

Linear equations with constant coefficients; the second and higher order homogeneous equation; initial value problems for second order equations; existence theorem; uniqueness theorem; linear dependence and independence of solutions; the Wronskian and linear independence; a formula for the Wronskian; the non-homogeneous equation of order two.

UNIT II

Linear Differential equations and equations reducible to the linear form, solutions of homogeneous equations, Exact differential equation, the theorem on n linearly independent solutions; the Wronskian and linear independence, First order and higher degree equations Solvable for x, y and p, Clairaut's form and singular solutions, linear differential equations withconstant coefficients

UNIT III

Existence and uniqueness of solutions – introduction; equations with variable separated; exact equations, Lipschitz condition; non-local existence of solutions; uniqueness of solutions; existence and uniqueness theorem for first order equations; statement of existence and uniqueness theorem for the solutions of ordinary differential equation of order n.

UNIT IV

Initial value problems for the homogeneous equations; solutions of homogeneous equations; Wronskian and linear independence; non-homogeneous equations; homogeneous equations with analytic coefficients; Legendre equation, justification of power series method; Legendre polynomials and Rodrigues' formulae.

UNIT V

Linear equations with regular singular points – introduction; Euler equation; second order equations with regular singular points – example and the general case, convergence proof, exceptional cases; Bessel equation; regular singular points at infinity.

Reference books:

1. Elementary Differential Equations (3rd Edition) – W. T. Martain and E. Relssner

2. Theory of Ordinary Differential Equations – E. A. Codington and N. Levinson, TMH

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M.Sc. (Mathematics)

Syllabus

Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	CLASSICAL MECHANICS	MMM 513

UNIT I

Generalized coordinates; holonomic & non-holonomic systems; D'Alembert's principle; Lagrange's equations; calculus of variations.

UNIT II

Hamilton's principle, Lagrange's equations from Hamilton's principle, extension of Hamilton's principle to non-conservative and non-holonomic systems, conservation theorems and symmetry properties.

UNIT III

Eulerian angles; Euler's theorem on the motion of a rigid body; infinitesimal rotations; rate of change of a vector; coriolis force; Euler's equations of motion; force free motion of a rigid body; heavy symmetrical top with one point fixed.

UNIT IV

Hamilton's equations of motion, conservation theorems and physical significance of Hamiltonian, Hamilton's equations from variational principle, principle of least action. Hamilton's canonical equation of motion, relation with Lagrange's equation, cyclic coordinate, Routhian procedure, variational principle approach to Hamilton's equation of motion, examples.

UNIT V

Equations of canonical transformation; integral invariants of Poincare'; Lagrange and Poisson brackets as canonical invariants, equations of motion in Poisson bracket notation; infinitesimal contact transformations; constants of motion and symmetry properties. Canonical transformations, generating functions, symplectic condition, infintesimal canonical transformations, examples. Poisson bracket, Lagrange bracket, formal solution of equations of motion in terms of Poisson brackets. Examples

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Syllabus

Semester – I

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	ALGEBRA	MMM 514

UNIT I

A brief review of groups, their elementary properties and examples, subgroups, cyclic groups, homomorphism of groups and Lagrange's theorem; permutation groups, permutations as products of cycles, even and odd permutations, normal subgroups, quotient groups; isomorphism theorems, correspondence theorem;

UNIT II

Group Theory – Basic Group Theory: Definition of group, Subgroups, Cayley's Theorem, Lagrange's Theorem, Key examples of groups. – Quotient Groups: Cosets, Normal Subgroups, Isomorphism Theorems – Group Actions: Action of a group on itself, Conjugacy classes, the class equation – Sylow Theorems: Proofs using group actions, applications to groups of small order

UNIT III

Applications of Sylow's theorems, conjugacy classes in S_n and A_n, simplicity of A_n. Direct product; structure theorem for finite abelian groups; invariants of a finite abelian group (Statements only)

UNIT IV

Basic properties and examples of ring, domain, division ring and field; direct products of rings; characteristic of a domain; field of fractions of an integral domain; ring homomorphisms (always unitary); ideals; factor rings; prime and maximal ideals, principal ideal domain; Euclidean domain; unique factorization domain.

UNIT V

A brief review of polynomial rings over a field; reducible and irreducible polynomials, Gauss' theorem for reducibility of $f(x) \in \mathbf{Z}[x]$; Eisenstein's criterion for irreducibility of $f(x) \in \mathbf{Z}[x]$ over $\mathbf{Q}$, roots of polynomials; finite fields of orders 4, 8, 9 and 27 using irreducible polynomials over $\mathbf{Z}_2$ and $\mathbf{Z}_3$.

Textbooks:

4. Basic Abstract Algebra (3rd edition) – P.B. Bhattacharya, S. K. Jain .

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SCHEME

Semester – II

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MMM 521-(a) / MMM 521 –(b) / MMM 521 –(c)	LINEAR ALGEBRA / Advanced Abstract algebra –II / Lebasque measure & integration	20	8	80	32	-	-	100
2	MMM 522	ANALYSIS-II	20	8	80	32	-	-	100
3	MMM 523	PARTIAL DIFFERENTIAL EQUATIONS	20	8	80	32	-	-	100
4	MMM 524	PROGRAMMING IN C AND APPLICATIONS	20	8	80	32	-	-	100
Total			**80**	**32**	**320**	**128**	**-**	**-**	**400**

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Syllabus

Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	LINEAR ALGEBRA	MMM 521(a)

UNIT-I

Linear Algebra:-Rank of a Matrix, Eigen values, Eigen vectors, matrix representation of a linear transformation; , isomorphism between the algebra of linear transformations and that of matrices; Characteristics equation of a matrix,

UNIT-II

Similarity of matrices and linear transformations; trace of matrices and linear transformations, characteristic roots and characteristic vectors, characteristic polynomials, relation between characteristic polynomial and minimal polynomial; Cayley Hamilton theorem and its use in finding inverse of matrix, Application of matrix to a system of linear(both homogenous and non- homogenous) equations, theorems on consistency and inconsistency of a system of linear equations, Solving the linear equations with three unknowns.

;

UNIT-III

Projections and their relation with direct sum decomposition of vector spaces; invariant subspaces; primary decomposition theorem, cyclic subspaces; companion matrices; a proof of Cayley-Hamilton theorem; triangulability; canonical forms of nilpotent transformations; Jordan canonical forms; rational canonical forms.

UNIT-IV

Inner product spaces, properties of inner products and norms, Cauchy-Schwarz inequality; orthogonality and orthogonal complements, orthonormal basis, Gram-Schmidt process; adjoint of a linear transformation; Hermitian, unitary and normal transformations and their diagonalizations.

UNIT-V

Forms on inner product spaces and their matrix representations; bilinear forms; Hermitian forms; symmetric bilinear forms; orthogonal diagonalization of real quadratic forms.

Textbooks:

1. Linear Algebra – P. B. Bhattacharya, S. K. Jain and S. R. Nagpal,

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Syllabus

Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	Advanced Abstract algebra –II	MMM 521(b)

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Unit 1

Introduction to Modules, examples, submodules, quotient modules, Modules homomorphism, isomorphism, Finitely generated modules, cyclic modules.

Unit 2

Simple modules, Semisimple modules, Free modules, Schur's lemma.

Unit 3

Noetherian & Artinian modules and rings, Hilbert basis theorem. Wedderburn - Artin theorem.

Unit 4

Uniform modules, primary modules, Noether-Laskar theorem, Fundamental structure theorem of modules over a principal ideal domain.

Unit 5

Algebra of Linear Transformation, characteristic roots, Matrices, Matrix of Linear Transformations, similarity of Linear Transformation, Invariant space , Reduction to triangular forms.

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Syllabus
Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	Lebasque measure & integration	MMM 521(c)

Unit 1

Lebesgue outer measure,Measurable sets, Regularity, Measurable functions,Borel and Lebesgue measurability, Non – measurable sets.

Unit 2

Integration of Non – negative functions. The General integral. Integration of Series, Reimann and Lebesgue Integrals.

Unit 3

The Four derivatives. Functions of bounded variation, Lebesgue Differential Theorem , Differention and Integration.

Unit 4

The LP–space , Convex function, Jensen's inequality, Holder and Minkowski inequalities Completeness of Lp.

Unit 5

Dual of space when $1 < p < \infty$, Convergence in measure, Uniform convergence and almost uniform convergence.

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Syllabus

Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	ANALYSIS-II	MMM 522

UNIT-I

Sequences of functions, pointwise and uniform convergence; uniform convergence and continuity; uniform convergence and integration; uniform convergence and differentiation; nowhere differentiable functions; Statement of Stone-Weierstrass' theorem for a real and complex-valued functions on an interval.

UNIT-II

Directional derivatives; Partial derivatives measure the rate of change of a function in the directions of the standard basis vectors. Directional derivatives measure the rate of change in any given direction. derivatives of functions of several variables and their interrelationship; chain rule; mean value theorem; higher order partial derivatives; equality of mixed partial derivatives, Schwarz lemma; Taylor's theorem.

UNIT-III

Injective mapping theorem, surjective mapping theorem, inverse function theorem and implicit function theorem of functions of two and three (for analogy) variables; extremum problems with and without constraints of functions of two and three (for analogy) variables.

UNIT-IV

o rings of sets, additive, countably additive, regular set functions, outer measures on power set of reals, measurable spaces, Lebesgue measure, measurable functions and their properties.

UNIT-V

Lebesgue integral, Lebesgue integrable functions, properties of integrals, Fatou's lemma, integration of complex valued functions, functions of class L_2 , Fourier series, Riesz-Fischer theorem. Lebesgue General (Dominated) convergence theorem. Differential of an integral Lp space. Completeness of Lp-space.

Textbooks:

1. Principles of Mathematical Analysis – W. Rudin, McGraw Hill

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Syllabus

Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	PARTIAL DIFFERENTIAL EQUATIONS	MMM 523

UNIT I

Definition of PDE, origin of first-order PDE; determination of integral surfaces of linear first order partial differential equations passing through a given curve; surfaces orthogonal to given system of surfaces; non-linear PDE of first order, Cauchy's method of characteristic; compatible system of first order PDE; Charpit's method of solution, solutions satisfying given conditions, Jacobi's method of solution

.

UNIT II

Origin of second order PDE, linear second order PDE with constant coefficients, linear second order PDE with variable coefficients; characteristic curves of the second order PDE; Monge's method of solution of non-linear PDE of second order.

UNIT III

Separation of variables in a PDE; Laplace's equation, elementary solutions of Laplace's equations; families of equipotential surfaces.

UNIT IV

The Wave Equation – Solution of initial/boundary value problems – Characteristic coordinates and a general solution – D'Alembert's solution of the initial value problem – Energy integrals and uniqueness of solution for the wave equation.

UNIT V

Diffusion equation, resolution of boundary value problems for diffusion equation, elementary solutions of diffusion equation, separation of variables.

Text Book:

1. Elements of Partial Differential Equation (3rd edition) – I. N. Sneddon, McGraw Hill

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Syllabus

Semester – II

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	PROGRAMMING IN C AND APPLICATIONS	MMM 524

UNIT I

C Language Fundamentals- Character set, Identifiers, keyword, data types, Constants and variables, statements, expression, operators, precedence of operators, Input-output. Assignments, control structures, decision making and looping, decision making and branching.

UNIT II

Logical IF statements in C; switch, break, continue GOTO statements in C; WHILE, FOR, DO WHILE loops in C.

UNIT III

Subscripted variables and arrays in C; array variables, syntax rules, use of multiple subscripts in arrays, reading and writing multi-dimensional arrays, for loops, for arrays in C; format specifications in C.

UNIT IV

Some algorithms and programs on theory of matrices and numbers like Sieve method for primality test, generation of twin primes, solution of congruence using complete residue system, addition, subtraction and multiplication of matrices. transpose, determinant .

UNIT V

Function definition, function prototypes, arguments, call by value, call by reference, pointers, character arrays, automatic variables in C; external variables and scopes in C; some applications of C; operations with strings and sorting; file processing commands

Textbooks:

1. Computer Programming in C – V. Rajaraman, Prentice-Hall of India Pvt. Ltd.,

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SCHEME

Semester – III

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MMM 531	TOPOLOGY	20	8	80	32	-	-	100
2	MMM 532	COMPLEX FUNCTION THEORY	20	8	80	32	-	-	100
3	MMM 533	NUMERICAL ANALYSIS	20	8	80	32	-	-	100
4	MMM 534	APPLICATION OF MATHEMATICS IN ENVIRONMENTAL	20	8	80	32	-	-	100
Total			**80**	**32**	**320**	**128**	**-**	**-**	**400**

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Syllabus

Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	TOPOLOGY	MMM 531

UNIT I

Definition and examples of topological spaces, closed sets and closure, dense subsets. Neighbourhoods interior Exterior and boundary operations, Accumulation points and Derived sets. Bases and subbase. Subspaces and relative topology. Alternative method of defining a topology in terms of Kuratowski closure operator and neighbourhood systems. Continuous functions and homoemorphisms

UNIT II

Continuity and related concepts; product topology; quotient topology; a brief introduction to minimal uncountable well ordered set S_Ω; countability axioms; Lindelof spaces and separable spaces.

UNIT III

Connected spaces, generation of connected sets; component, path component; local connectedness, local path-connectedness.

UNIT IV

Compact spaces; limit point compact and sequentially compact spaces; locally compact spaces; one point compactification; finite product of compact spaces, statement of Tychonoff's theorem.

UNIT V

Separation axioms; Urysohn's lemma; Tietze's extension theorem; statement of Urysohn's metrization theorem.

Textbooks:

1. General Topology – J. L. Kelley, Springer Verlag, New York, 1990.

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Syllabus

Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	COMPLEX FUNCTION THEORY	MMM 532

UNIT I

Holomorphic Functions, Cauchy-Riemman equations and its applications, Formal power series, radius of convergence of power series, exponential, cosine and sine, logarithm functions introduced as power series, their elementary properties.

UNIT II

Integration of complex-valued functions and differential 1-forms along a piecewise differentiable path, primitive , local primitive and primitive along a path of a differential 1- form, homotopic pats, simply connected domains, index of a closed path, holomorphic functions, Cauchy's theorem and its corollaries.

UNIT III

Cauchy's integral formula, Taylor's expansion of holomorphic functions, Cauchy's estimate; Liouville's theorem; fundamental theorem of algebra; zeros of an analytic function and related results; maximum modulus theorem; Schwarz' lemma.

UNIT IV

Laurents's expansion of a holomorphic function in an annulus, singularitiesof a function, removable singularities, poles and essential singularities; extended plane nd stereographic projection, residues, calculus of residues; evaluation of definite integrals; argument principle; Rouche's Theorem.

UNIT V

Complex form of equations of straight lines, half planes, circles, etc., analytic (holomorphic) function as mappings; conformal maps; Mobius transformation; cross ratio; symmetry and orientation principle; examples of images of regions under elementary analytic function.

Textbooks:

1. An Introduction To Complex Analysis – A. R. Shastri, Macmillan India Ltd., 2003.

2. Complex Variables and Applications – S. Ponnusamy, and H. Silverman

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Syllabus

Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	NUMERICAL ANALYSIS	MMM 533

UNIT I

A brief introduction to algebraic and transcendental equations and their roots; direct and iterative methods for determination of roots of these equations; initial approximations; bisection method, secant method, Regula-Falsi method, Newton-Raphson method for determination of roots of algebraic and transcendental equations; error analysis, rate of convergence and algorithm for each of these methods. System of non-linear equations: Fixed point iteration method for the system $x = g(x)$, sufficient condition for convergence, Newton's method for nonlinear systems

UNIT II

A brief introduction to systems of linear algebraic equations and their solutions, eigenvalue problem and its solution; direct and iterative methods; forward and backward substitution method; Cramer's rule; Gauss elimination method; Gauss-Jordan elimination method; Gauss-Jacobi iteration method; Gauss-Seidel iteration method; power method for eigenvalue problem; iterative method for matrix inversion; error analysis, rate of convergence and algorithm for each of these methods.

UNIT III

Lagrange and Newton interpolation; Lagrange interpolating polynomial and Newton divided differences interpolating polynomial; linear interpolation; Newton's divided difference interpolation and its generalizations; finite difference operators; relation between differences and derivatives; Gregory-Newton forward and backward difference interpolation; truncation error bounds and algorithm for each of these interpolations.

UNIT IV

Differentiation and integration; numerical differentiation; methods based on linear and quadratic interpolation with error of approximation; methods based on finite differences; optimum choice of step length; numerical integration; methods based on interpolation; determination of the error term; trapezoidal rule; Simpson's rule; error of integration; algorithms for numerical differentiation and integration.

UNIT V

Ordinary differential equations and their numerical solutions; initial value problems; error estimates; Euler-Richardson method, Runge-Kutta methods and Predictor- Corrector method; error analysis and algorithm for each of these methods; partial differential equations; finite-difference method with error analysis and algorithm.

Textbooks:

1. Numerical Methods for scientific and Engineering computation – M. K. Jain, S. R.
2. Computer Oriented Numerical Analysis – V. Rajaraman, Prentice-Hall of India Pvt

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YEAR - I

Semester – III

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	APPLICATION OF MATHEMATICS IN ENVIRONMENTAL	MMM 534

UNIT 1

Linear Equations: Direct Methods for Solving Systems of Linear Equations, Gauss elimination, Gauss Jordan Method, LUDecomposition, Cholesky Decomposition, Iterative Methods: Jacobi Method , Gauss - Seidel Method, Relaxation Method, Methods Based on Numerical Differentiation., matrix form, row reduction; row rank and column rank, row equivalence, row reducedechelon matrices, various methods to find solutions of a system of linear equations, linear inequalities.

UNIT II

Introduction to ecology and environment; linear programming problem –introduction, graphical solution method, some exceptional cases; general linear8 programming problem, duality, simplex method; problems related to ecology and environment.

UNIT III

Integral equations of convolution type and their solutions by Laplace transform, Fredholm's theorems; integral equations with symmetric kernel; eigenvalues and eigenfunctions of integral equations and their simple properties. Multiple integrals, repeated integrals, interchange of order of integrations, change of variable theorem, mean-value theorems for multiple integrals, line integral and Green's theorem, Convergence of improper integrals

UNIT IV

Generalized functions; Minusinkski's operational calculus of one variable (algebra of addition and convolution of functions, ordered pairs of functions, convolution quotients of a function with a nonzero function), Dirac delta function

.

UNIT V

Eigenvalue problem; ordinary differential equations of the Sturm-Liouville type; eigenvalues and eigenfunctions; expansion theorem; extrema properties of the eigenvalues of linear differential operators, formulation of the eigenvalue problem of a differential operator as a problem of integral equation.

Textbook:

1. Linear Algebra (2nd edition) – K. Hoffman and R. Kunze, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.

2. Introduction to Matrices and Linear Transformations (3rd edition) – D. T. Finkbeiner, D.B. Taraporevala, Bombay, 1990.

3. Operations Research (for Group B) – K. Swarup, P. K. Gupt and Man Mohan, Sultan Chand & Sons, New Delhi, 2000.

4.Laplace Transform Theory – M. G. Smith

Reference books:

4. Applied Operation Research: A Survey (for Group B) – G. E. Whitehouse and B. L. Wechsler, John Wiley & Sons, 1975.

5. Ecology: The Experimental Analysis of Distribution and Abundance (2nd edition) (for Group B) – C. J. Krebs, Harper and Row Publishers, 1978.

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SCHEME

Semester – IV

No	Subject Code	Subject Title	Marks Allotted						
			Assignment Marks		Theory Marks		Practical Marks		Total Marks
			Max	Min	Max	Min	Max	Min	
1	MMM 541-(a) / MMM 541 – (b) / MMM 541 – (c)	MATHEMATICAL METHODS / Functional Analysis II / Advanced Graph Theory- II	20	8	80	32	-	-	100
2	MMM 542	ELEMENTARY NUMBER THEORY	20	8	80	32	-	-	100
3	MMM 543	DISSERTATION	-	-	-	-	300	150	300
Total			**40**	**16**	**160**	**64**	**300**	**150**	**400**

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M.Sc. (Mathematics)

Syllabus

Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	MATHEMATICAL METHODS	MMM 541(a)

UNIT I

Laplace transformations: Laplace transformations, Linearity of the Laplace transformation, Existence theorem of Laplace transforms, Laplace transforms of derivatives and integrals, Shifting theorem, Differentiation and integration of transforms, Inverse Laplace transforms, Convolution theorem, Applications of Laplace, transformation in solving linear differential equations with constant coefficients

UNIT II

Formulation of integral equations, integral equations of Fredholm and Volterra type, solution by successive substitution and successive approximation; integral equations with degenerate kernels.

UNIT III

Integral equations of convolution type and their solutions by Laplace transform, Fredholm's theorems; integral equations with symmetric kernel; eigenvalues and eigenfunctions of integral equations and their simple properties.

UNIT IV

Generalized functions; Minusinkski's operational calculus of one variable (algebra of addition and convolution of functions, ordered pairs of functions, convolution quotients of a function with a nonzero function), Dirac delta function

.

UNIT V

Eigenvalue problem; ordinary differential equations of the Sturm-Liouville type; eigenvalues and eigenfunctions; expansion theorem; extrema properties of the eigenvalues of linear differential operators, formulation of the eigenvalue problem of a differential
operator as a problem of integral equation.

Textbooks:

1. Laplace Transform Theory – M. G. Smith

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M.Sc. (Mathematics)

Syllabus
Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	Functional Analysis II	MMM 541(b)

Unit 1

Hilbert adjoint operator and its properties, self adjoint, unitary and normal operators ,positive operator.

Unit 2

Zorn's lemma, Hahn- Banach theorem for real linear spaces, Hahn- Banach theorem for complex linear spaces and normed linear spaces.

Unit 3

Adjoint operators on normed spaces, relation between adjoint operator and Hilbert adjoint operator ,Reflexive spaces, Reflexivity of Hilbert spaces.

Unit 4

Category theorem-Baire's Category theorem ,uniform boundedness theorem and some of its application, strong and weak convergence in normed spaces.

Unit 5

Convergence of sequences of operators and functionals ,open mapping theorem, closed graph theorem, contraction theorem.

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Syllabus
Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	Advanced Graph Theory- II	MMM 541(c)

Unit 1

Matrix representation of graphs, Incidence matrix, sub matrices of A(G),Circuit matrix, Fundamental circuit matrix and rank of B ,an application to a switching network.

Unit 2

Cut set matrix, relationships among Af, Bf, and Cf path matrix ,Adjacency matrix.

Unit 3

Chromatic Number, Chromatic Partitioning, Chromatic Polynomial , coverings, matching's.

Unit4

The four color problem, directed graph ,some types of Digraphs, digraphs and binary relations, Euler digraphs ,Directed paths and connectedness.

Unit 5

Trees with directed graphs, Arboreocence, Fundamental circuits in diagraphs, Matrix A,B,and C of digraphs, Adjacency matrix of a digraph.

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Syllabus
Semester – IV

BRANCH	SUBJECT TITLE	SUBJECT CODE
M.Sc (Mathematics)	ELEMENTARY NUMBER THEORY	MMM 542

UNIT I

Divisibility; Euclidean algorithm; primes; congruences; Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's quotients and their elementary consequences; solutions of congruences; Chinese remainder theorem; Euler's phi-function.

UNIT II

Congruence modulo powers of prime; power residues; primitive roots and their existence; quadratic residues; Legendre symbol, Gauss' lemma about Legendre symbol; quadratic reciprocity law; proofs of various formulations; Jacobi symbol.

UNIT III

Greatest integer function; arithmetic functions, multiplicative arithmetic functions (elementary ones); Mobius inversion formula; convolution of arithmetic functions, group properties of arithmetic functions; recurrence functions; Fibonacci numbers and their elementary properties.

UNIT IV

Diophantine equations – solutions of $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^2$; properties of Pythagorean triples; sums of two , four and five squares; assorted examples of diophantine equations.

UNIT V

Simple continued fractions, finite and infinite continued fractions, uniqueness, representation of rational and irrational numbers as simple continued fractions, rational approximation to irrational numbers, Hurwitz theorem, basic facts of periodic continued fractions and their illustrations (without proofs); Pell's equation. Generating Function Models, Calculating coefficient of generating functions, Partitions, Exponential Generating Functions, A Summation Method. Recurrence Relations: Recurrence Relation Models, Divide and conquer Relations, Solution of Linear, Recurrence Relations, Solution of Inhomogeneous Recurrence Relations, Solutions with Generating Functions.