Syllabi for M. Sc. in Mathematics:

FIRST SEMESTER:

MATH HC 01	Algebra I

Unit I

Number theory - Congruences, residue classes, theorems of Fermat, Euler and Wilson, linear congruences, elementary arithmetical functions, primitive roots, quadratic residues and the law of quadratic reciprocity.

Unit II

Groups - Lagrange's Theorem, homomorphism and isomorphism, normal subgroups and factor groups.

Unit III

The fundamental theorem of homomorphism, two laws of isomorphism.

Unit IV

Permutation groups and Cayley's theorem, Sylow's theorems.

Books for Reference:

1. D. M. Burton – Elementary Number Theory, Tata McGraw-Hill, New Delhi, 6th Ed.,

2. I. Niven, H. S. Zuckerman and H. L. Montgomery – An Introduction to the Theory of Numbers, New York, John Wiley and Sons, Inc., 2004, 5th Ed.,

3. G. A. Jones and J. M. Jones – Elementary Number Theory, Springer, 1998.

4. Thomas W. Hungerford – Algebra, Springer International Edition, New York.

5. Michael Artin – Algebra, Prentice-Hall of India, New Delhi.

6. J. A. Gallian – Contemporary Abstract Algebra, Narosa Publishing House, 4th Ed.,

7. D. S. Dummit and R. M. Foote – Abstract Algebra, John Wiley and Sons, 1999.

8. I. N. Herstein – Topics in Algebra, Vikas Publishing House, New Delhi.

9. J. B. Fraleigh – A First course in Abstract Algebra, Addison-Wesley,

10. N. S. Gopalakrishnan – University Algebra, New Age International, 2nd E

MATH HC 02	Real Analysis I

Unit I

The extended real number system, the n-dimensional Euclidean space, the binomial inequality, the inequality of the arithmetic and geometric means, the inequality of the power means, Cauchy's, Holder's inequality and Minkowski's inequality.

Unit II

Numerical sequences, convergent sequences, Cauchy sequences, upper and lower limits.

Unit III

Series of real numbers series of non-negative terms, the number `e', tests of convergence.

Unit IV

Multiplications of series, re-arrangements. Double series, infinite products.

Books for Reference:

1. W. Rudin – Principles of Mathematical Analysis, International Student edition, McGraw Hill, 3rd Ed.

2. T. M. Apostal – Mathematical Analysis, Addison Wesley, Narosa, New Delhi, 2nd Ed.

3. R. R. Goldberg – Methods of real Analysis, Oxford and IBH, New Delhi.

4. Torence Tao – Analysis I, Hindustan Book Agency, India, 2006.

5. Torence Tao – Analysis II, Hindustan Book Agency, India, 2006.

6. Kenneth A. Ross – Elementary Analysis: The Theory of Calculus, Springer International Edition, 2004.

MATH HC 03	**Real Analysis II**

Unit I

Finite, countable and uncountable sets, the topology of the real line.

Unit II

Continuity, uniform continuity, properties of continuous functions, discontinuities, monotonic functions.

Unit III

Differentiability, mean value theorems, L' Hospital rule, Taylor's theorem, maxima and minima, Functions of bounded variation.

Unit IV

The Riemann-Stieltje's integral, criterion for integrability. Properties of the integral, classes of integrable functions. The integral as the limit of a sum. First and second mean value theorems. Integration and differentiation.

Books for Reference:

1. W. Rudin – Principles of Mathematical Analysis, International Student edition, McGraw-Hill, 3rd Ed..

2. Torence Tao – Analysis I, Hindustan Book Agency, India, 2006.

3. Torence Tao – Analysis II, Hindustan Book Agency, India, 2006.

4. T. M. Apostal – Mathematical Analysis, Addison Wesley, Narosa, 2nd Ed.,

5. R. R. Goldberg – Methods of real Analysis, Oxford and IBH Publishing Company, New Delhi.

6. Kenneth A. Ross – Elementary Analysis: The Theory of Calculus, Springer International Edition, 2004.

MATH HC 04	Complex Analysis I

Unit I

Algebra of complex numbers, geometric representation of complex numbers. Riemann sphere and Stereographic projection, Lines, Circles. Limits and Continuity.

Unit II

Analytic functions, Cauchy-Riemann equations, Harmonic functions, Polynomials and Rational functions. Elementary theory of power series - sequences, series, uniform convergence of power series, Abel's limit theorem, The elementary functions.

Unit III

Topology of the complex plane. Linear fractional transformations, Cross-ratio, Symmetry, Elementary conformal mappings. Complex integration – Line integrals, Rectifiable arcs.

Unit IV

Cauchy's theorem for a rectangle. Cauchy's theorem in a Circular disk, Cauchy's integral formula. Local properties of analytic functions.

Books for Reference:

1. L. V. Ahlfors – Complex Analysis, McGraw-Hill, Kogakusha, 1979.

2. J. B. Conway – Functions of one complex variable, Narosa, New Delhi.

3. R. P. Boas – Invitation to Complex Analysis, The Random House, 1987

4. B. C. Palka – An Introduction to Complex Function Theory, Springer, 1991.

5. S. Ponnusamy – Foundations of Complex Analysis, Narosa, 1995.

MATH SC 01	Linear Algebra

Unit I

Vector Spaces, Subspaces, Linear Combinations and Systems of Linear Equations, Linear Dependence and Linear Independence, Bases and Dimension, Maximal Linearly Independent Subsets;

Linear Transformations, Null Spaces, and Ranges, The Matrix Representation of a Linear Transformation, Composition of Linear Transformations and Matrix Multiplication, Invertibility and Isomorphisms, The Change of Coordinate Matrix, The Dual Space;

Elementary Matrix Operations and Elementary Matrices, The Rank of a Matrix and Matrix Inverses, Systems of Linear Equations.

Unit II

Properties of Determinants, Cofactor Expansions, Elementary Operations and Cramer's Rule;

Eigenvalues and Eigenvectors, Diagonalizability, Invariant Subspaces and the Cayley-Hamilton Theorem;

Inner Products and Norms, The Gram-Schmidt Orthogonalization Process and Orthogonal Complements.

Unit III

The Adjoint of a Linear Operator, Normal and Self-Adjoint Operators, Unitary and Orthogonal Operators and Their Matrices, Orthogonal Projections and the Spectral Theorem;

Bilinear and Quadratic Forms;

Unit IV

The Diagonal form, The Triangular form; The Jordan Canonical Form; The Minimal Polynomial;

The Rational Canonical Form.

Books for Reference:

1. S. Friedberg, A. Insel, and L. Spence - Linear Algebra, Fourth Edition, PHI, 2009.

2. Jimmie Gilbert and Linda Gilbert – Linear Algebra and Matrix Theory, Academic Press, An imprint of Elsevier.

3. I. N. Herstein – Topics in Algebra, Vikas Publishing House, New Delhi.

4. Hoffman and Kunze – Linear Algebra, Prentice-Hall of India, 1978, 2nd Ed.,

5. P. R. Halmos – Finite Dimensional Vector Space, D. Van Nostrand, 1958.

6. S. Kumeresan – Linear Algebra, A Geometric approach, Prentice Hall India, 2000.

MATH SC 02	Combinatorics and Graph Theory

Unit I

Partially ordered sets, Lattices, Complete lattices, Distributive lattices, Complements, Boolean Algebra, Boolean expressions, Application to switching circuits.

Unit II

Permutations and Combinations, Pigeon-hole principle, Principle of inclusion and exclusion.

Unit III

Graphs, Vertices of graphs, Walks and connectedness, Degrees, Operations on graphs, Blocks - Cutpoints, bridges Block graphs and Cutpoint graphs.

Unit IV

Trees - Elementary properties of trees, Center, Connectivity, Connectivity and line connectivity, Menger's theorem, Partitions, Coverings, Coverings and independence number.

Books for Reference:

1. C. L. Liu – Elements of Discrete Mathematics, McGraw-Hill, 1986.

2. Kenneth H. Rosen – Discrete Mathematics and its Applications, McGraw-Hill, 2002.

3. F. Harary – Graph Theory, Addition Wesley Reading Mass, 1969.

4. N. Deo – Graph Theory With Applications to Engineering and Computer Science, Prentice Hall of India, 1987.

5. K. R. Parthasarathy – Basic Graph Theory, Tata McGraw-Hill, New Delhi, 1994.

6. G. Chartand and L. Lesniak – Graphs and Diagraphs, wadsworth and Brooks, 2nd Ed.,

7. Clark and D. A. Holton – A First Look at Graph Theory, Allied publishers.

8. D. B. West – Introduction to Graph Theory, Pearson Education Inc.,2001, 2nd Ed.,

9. J. A. Bondy and U. S. R. Murthy – Graph Theory with applications, Elsevier, 1976.

MATH SC 03	Graph Theory

Unit I

Graphs – Vertex degrees - Sub-graphs - Paths and cycles - Connected graphs - Connected components

Unit II

Acyclic graphs – Trees - Cut edges - Cut vertices – Spanning Tree .

Unit III

Euler tours - Euler graphs - Hamiltonian paths - Hamiltonian graphs - Closure of a graph.

Unit IV

Planar graphs - Euler's formula- Vertex colouring - Chromatic number - Chromatic polynomial – R - Critical graphs.

Books for Reference:

1. F. Harary – Graph Theory, Addition Wesley Reading Mass, 1969.

2. N. Deo – Graph Theory With Applications to Engineering and Computer Science, Prentice Hall of India, 1987.

3. K. R. Parthasarathy – Basic Graph Theory, Tata McGraw-Hill, New Delhi, 1994.

4. G. Chartand and L. Lesniak – Graphs and Diagraphs, Qwadsworth and Brooks, 2nd Ed.,

5. Clark and D. A. Holton – A First Look at Graph Theory, Allied publishers.

6. D. B. West – Introduction to Graph Theory, Pearson Education Inc., 2001, 2nd Ed.,

7. J. A. Bondy and U. S. R. Murthy – Graph Theory with applications, Elsevier, 1976.

SECOND SEMESTER

MATH HC 05	Algebra II

Unit I

Rings, Integral domains and Fields, Homomorphisms, Ideals and Quotient Rings, Prime and Maximal ideals.

Unit II

Euclidean and principal ideal rings, Polynomials, Zeros of a polynomial, Factorization, Irreducibility criterion.

Unit III

Adjunction of roots, algebraic and transcendental extensions, Finite fields.

Unit IV

Separable and inseparable extensions, Perfect and imperfect fields. Theorem on the primitive element.

Books for Reference:

1. Thomas W. Hungerford – Algebra, Springer International Edition, New York.

2. Michael Artin – Algebra, Prentice-Hall of India, New Delhi.

3. Joseph A. Gallian – Contemporary Abstract Algebra, Narosa, 4th Ed.,

4. D. S. Dummit and R. M. Foote – Abstract Algebra, John Wiley and Sons,1999, 2nd Ed.,

5. I. N. Herstein – Topics in Algebra, Vikas Publishing House, New Delhi.

6. J. B. Fraleigh – A First course in Abstract Algebra, Addison-Wesley,

7. N. S. Gopalakrishnan – University Algebra, New Age International, 2nd ed.,

MATH HC 06	**Real Analysis III**

Unit I

Sequences and series of functions, Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation.

Unit II

Power series, The exponential and logarithmic functions, The trigonometric functions. Improper integrals and their convergence.

Unit III

Functions of several variables, partial derivatives, continuity and differentiability, the chain rule, Jacobians.

Unit IV

The Implicit function theorem, Taylor's theorem, the Maxima and Minima, Lagrange's multipliers.

Books for Reference:

1. W. Rudin – Principles of Mathematical Analysis, International Student edition, McGraw-Hill, 3rd Ed.,

2. T.M. Apostal – Mathematical Analysis, Addison Wesley, Narosa, 2nd Ed.,

3. R.R. Goldberg – Methods of Real Analysis, Oxford and IBH, New Delhi.

4. D.V. Widder – Advanced Calculus, Prentice Hall of India, New Delhi, 2nd Ed.,

5. Torence Tao – Analysis I, Hindustan Book Agency, India, 2006.

6. Torence Tao – Analysis II, Hindustan Book Agency, India, 2006.

7. Kenneth A. Ross – Elementary Analysis: The Theory of Calculus, Springer International Edition, 2004.

MATH HC 07	Complex Analysis II

Unit I

The Calculus of Residues – The residue theorem, argument principle, Evaluation of definite integrals.

Unit II

Harmonic functions – Definition and basic properties, mean value property, Poisson's formula, Schwarz's theorem, reflection principle.

Unit III

Power series expansions – The Weierstrass theorem, The Taylor series, The Laurent series.

Unit IV

Partial fractions and factorization – Partial fractions, Mittag - Leffer's theorem, Infinite products, Canonical products, The Gamma and Beta functions, Sterling's formula.
Entire functions – Jensen's formula, Hadamard's theorem.

Books for Reference:

1. L. V. Ahlfors – Complex Analysis, McGraw-Hill, Kogakusha, 1979.

2. J. B. Conway – Functions of one complex variable, Narosa, New Delhi.

3. R. P. Boas – Invitation to Complex Analysis, The Random House, 1987.

4. B. C. Palka – An Introduction to the Complex Function Theory, Springer, 1991.

5. S. Ponnusamy – Foundations of Complex Analysis, Narosa, 1995.

MATH SC 04	Ordinary and Partial Differential Equations

Unit I

Linear Second Order Equations - Initial value problem, Existence and Uniqueness by Picard's Theorem, Wronskian, separation and comparison theorems, Poincare phase plane, variation of parameters.

Unit II

Power series solutions - Solution near ordinary and regular singular point. Convergence of the formal power series, applications to Legendre, Bessel, Hermite, Laguerre and hypergeometric differential equations with their properties.

Unit III

Partial differential equations - Cauchy problems and characteristics, Classification of Second order PDE's, reduction to canonical forms, derivation of the equations of mathematical physics and their solutions by separation of variables.

Unit IV

Boundary value problems - Transforming Boundary value problem of PDE and ODE, Sturm - Liouvile system, eigen values and eigen functions, simple properties, expansion in eigen functions, Parseval's identity, Green's function method.

Books for Reference:

1. E. A. Coddington and N. Levinson – Theory of Ordinary Differential equations, Tata McGraw-Hill, New Delhi.

2. R. Courant and D. Hilbert – Methods of Mathermatical Physics, Vol. I. & II, Tata McGraw-Hill, New Delhi, 1975.

3. G. F. Simmons – Differential Equations with applications and Historical Notes, Tata McGraw-Hill, New Delhi, 1991.

4. I. N. Sneddon – Theory of Partial differential equations, McGraw-Hill, International Student Edition.

5. S. G. Deo and V. Raghavendra – Ordinary Differential Equations and Stability Theory, Tata McGraw-Hill, New Delhi.

MATH SC 05	Representation Theory of Finite Groups

Unit I

Classical Groups: General linear group, Orthogonal group, Symplectic group, Unitary group.

Unit II

Group representation, Conjugate representation, G-invariant spaces – irreducible representations – Schur's lemma.

Unit III

The Group Algebra – Maschke's theorem – characters. Orthogonality relations for characters – Number of irreducible representations.

Unit IV

Permutation representations – Regular representation. Representations of Symmetric groups. Representation of Finite abelian groups – Dihedral groups.

Books for Reference:

1. Alperin, J. L.; Bell R. B., "Groups and Representations", Graduate Texts in Mathematics, 162, Springer-Verlag, New York, 1995.

2. Curtis C. W.; Reiner I., "Representation theory of finite groups and associative algebras", Pure and Applied Mathematics, Vol. XI Interscience Publishers, a division of John Wiley & Sons, New York-London 1962.

3. Dummit D. S.; Foote R. M. "Abstract algebra", Third edition, John Wiley & Sons, Inc., Hoboken, NJ, 2004.

4. Fulton; Harris, "Representation theory: A first course" Graduate Texts in Mathematics, 129, Readings in Mathematics, Springer-Verlag, New York, 1991.

5. James, Gordon; Liebeck, Martin, "Representations and characters of groups", Second edition, Cambridge University Press, New York, 2001.

6. Musili C. S., "Representations of finite groups" Texts and Readings in Mathematics, Hindustan Book Agency, Delhi, 1993.

MATH OE 01	Discrete Mathematics

Unit I

Mathematical Logic: Connection – Normal Forms – Theory of Inferences –Predicate Calculus.

Unit II

Set Theory: Operations on Sets – Basic Set Identities – Relations and Orderings.

Unit III

Recursion: Functions – Recursive Functions – Partial Recursive Functions.

Unit IV

Graph Theory: Basic Concepts of Graph Theory- Paths – Connectedness – Matrix Representation of Graphs – Trees – List structures and Graphs

Books for Reference:

1. C. L. Liu – Elements of Discrete Mathematics, McGraw-Hill, 1986.

2. Kenneth H. Rosen – Discrete Mathematics and its Applications, McGraw-Hill, 2002.

3. F. Harary – Graph Theory, Addition Wesley Reading Mass, 1969.

4. N. Deo – Graph Theory With Applications to Engineering and Computer Science, Prentice Hall of India, 1987.

5. K. R. Parthasarathy – Basic Graph Theory, Tata McGraw-Hill, New Delhi, 1994.

6. G. Chartand and L. Lesniak – Graphs and Diagraphs, wadsworth and Brooks, 2nd Ed.,

7. Clark and D. A. Holton – A First Look at Graph Theory, Allied publishers.

8. D. B. West – Introduction to Graph Theory, Pearson Education Inc.,2001, 2nd Ed.,

9. J. A. Bondy and U. S. R. Murthy – Graph Theory with applications, Elsevier, 1976

THIRD SEMESTER

MATH HC 08	Elements of Functional Analysis

Unit I

Metric completion. Banach's contraction mapping theorem and applications, Baire' category theorem, Ascoli - Arzela theorem.

Unit II

Linear spaces and linear operators, Norm of a bounded operator, The Hahn – Banach extension theorem, Stone - Weirstrass theorem.

Unit III

Open mapping and Closed Graph theorems. The Banach - Steinhaus Principle of Uniform Boundedness.

Unit IV

Hilbert spaces- The orthogonal projection, Nearly orthogonal elements, Riesz's lemma, Riesz's representation theorem.

Books for Reference:

1. G. F. Simmons – Introduction to Topology and Modern Analysis, Tata McGraw-Hill, New Delhi.

2. A. E. Taylor – Introduction to Functional Analysis, Wiley, New York, 1958.

3. A. Page and A. L. Brown – Elements of Functional Analysis.

4. George Bachman and Lawrence Narici – Functional Analysis, Dover Publications, Inc., Mineola, New York.

5. J. B. Conway – A Course in Functional Analysis, GTM, Vol. 96., Springer, 1985.

MATH HC 09	Topology I

Unit I

Set theoretic preliminaries.
Topological spaces and continuous maps - topological spaces, basis for a topology, the order topology, the product topology on X x X, the subspace topology.

Unit II

Closed sets and limit points, continuous functions, the product topology, the metric topology, the quotient topology.

Unit III

Connectedness - connected spaces, connected sets on the real line, path connectedness.

Unit IV

Compactness - compact spaces, compact sets on the line, limit point compactness, local compactness.

Books for Reference:

1. J. R. Munkres – A First Course in Topology, Prentice Hall India, 2000, 2nd Ed.,

2. G. F. Simmons – Introduction to Topology and Modern Analysis, McGraw-Hill, Kogakusha, 1968.

3. S. Willard – General Topology, Addison Wesley, New York, 1968.

4. J. Dugundji – Topology, Allyn and Bacon, Boston, 1966.

5. J. L. Kelley – General Topology, Van Nostrand and Reinhold Co., New York, 1955.

MATH SC 06	Commutative Algebra

Unit I

Rings and ideals - Rings and ring homomorphisms, Ideals, Quotient rings, zero-divisors, nilpotent elements, units, prime ideals and maximal ideals.

Unit II

The prime spectrum of a ring, the nil radical and Jacobson radical, operation on ideals, extension and contraction.

Unit III

Modules - Modules and modules homomorphisms, submodules and quotient modules, Direct sums, Free modules Finitely generated modules, Nakayama Lemma, Simple modules, Exact sequences of modules.

Unit IV

Modules with chain conditions - Artinian and Noetherian modules, modules of finite length, Artnian rings, Noetherian rings, Hilbert basis theorem.

Books for Reference:

1. M. F. Atiyah and I. G. Macdonald – Introduction to Commutative Algebra, Addison-Wesley.

2. C. Musili – Introduction to Rings and Modules, Narosa Publishing House.

3. Miles Reid – Under-graduate Commutative Algebra, Cambridge University Press.

4. N. S. Gopalakrishnan, Commutative Algebra, Oxonian Press.

MATH SC 07	Theory of Numbers

Unit I

Prime numbers, The Fundamental theorem of Arithmetic, The series of Reciprocals of primes, The Euclidean Algorithm.
Fermat and Mersenne numbers.
Farey series, Farey dissection of the continuum,
Irrational numbers-Irrationality of m^{th} root of N, e and π.

Unit II

Arithmetical Functions – The Mobius function, The Euler' function and Sigma function, The Dirichlet product of Arithmetical functions, Multiplicative functions. Averages of Arithmetical functions – Euler summation formula, Some elementary asymptotic formulas, The average orders of $d(n)$, $\sigma(n)$, $\varphi(n)$, $\mu(n)$. An application to the distribution of lattice points visible from the origin.

Unit III

Approximation Irrational numbers, Hurwitz's Theorem, Representation of a number by two or four squares, Definition g(k) and G(k), Proof of $g(4)<50$, Perfect numbers. The series of Fibonacci and Lucas.

Unit IV

Continued fractions - Finite continued fractions, Convergent of a continued fraction, Continued fractions with positive quotients. Simple continued fractions, The representation of an irreducible rational fraction by a simple continued fraction. The continued fraction algorithm and Euclid's algorithm. The difference between the fraction and its convergents, Infinite simple continued fractions, the representation of an irrational number by an infinite continued fraction, Equivalent numbers and periodic continued fractions, some special quadratic surds.

Books for Reference:

1. G. H. Hardy and E. M. Wright – An Introduction to Theory of Numbers, Oxford University Press, 1979, 5th Ed.,

2. I. Niven, H. S. Zuckerman and H. L. Montgomery – An Introduction to the Theory of Numbers, New York, John Wiley and Sons, Inc., 2004, 5th Ed.,

3. Bruce C. Berndt – Ramanujan's Note Books Volume-1 to 5, Springer.

4. G. E. Andrews – Number Theory, Dover Books, 1995.

5. T. M. Apostol – Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MATH SC 08	Algebraic Number Theory

Unit I

Number theoretical applications of unique factorization - Algebraic integers.

Unit II

Quadratic fields, Certain Euclidean rings of algebraic integers, Some Diophantine equations, Ramanujan - Nagell theorem.

Unit III

Factorization of Ideals - Dedekind domains, Fractional ideals, Invertible ideals, Prime factorization of ideals.

Unit IV

Class group and Class number, Finiteness of the Class group, Class number computations.

Books for Reference:

1. Karlheinz Spindler – Abstract Algebra with Applications, Vol. II, Rings and Fields, Marcel Dekker, Inc.

2. I. N. Stewart and David Tall – Algebraic Number Theory, Chapman and Hall.

3. Jody Esmonde and M. Ram Murthy – Problems in Algebraic Number Theory, Springer Verlag.

4. I. S. Luthar and I. B. S. Passi – Algebra Vol. II: Rings, Narosa Publishing House.

MATH SC 09	**Galois Theory**

Unit I

Algebraically closed fields and algebraic closures, The existence of an algebraic closure, The basic isomorphisms of algebraic field theory, Automorphisms and fixed fields, The Frobenius automorphism, The isomorphism extension theorem.

Unit II

The index of a field extension, Splitting fields, Separable extensions, Perfect fields, Normal extensions.

Unit III

Galois theory - the main theorem of Galois theory, Galois groups over finite fields, Symmetric functions, Cyclotomic extensions, Constructible numbers.

Unit IV

The impossibility of certain geometrical constructions, constructible polygons, Subnormal and normal series, the Jordan - Holder theorem, Radical extensions and solution of equation by radicals, The insolvability of the quintic.

Books for Reference:

1. J. B. Fraleigh – A First Course in Abstract Algebra, Narosa Publishing House.

2. Ian Steward – Galois Theory, Chapman and Hall.

3. Joseph Rotman – Galois Theory, Universitext Springer, 1998.

4. Michael Artin – Algebra, Prentice-Hall of India, New Delhi.

5. Joseph A. Gallian – Contemporary Abstract Algebra, Narosa Publishing House, 4th Ed.,

6. D. S. Dummit and R. M. Foote – Abstract Algebra, John Wiley and Sons, 1999.

7. I. N. Herstein – Topics in Algebra, Vikas Publishing House, New Delhi.

8. N. S. Gopalakrishnan – University Algebra, New Age International, 2nd Ed.,

MATH OE 02	Differential equations and its applications

Unit I

Recap of Elementary Functions of Calculus - Properties of limits, derivatives and integrals of elementary functions of Calculus, Polynomials, Rational functions, exponential and logarithmic functions, trigonometric and inverse trigonometric functions, hyperbolic and inverse hyperbolic functions.

Unit II

Special Functions of Mathematical Physics - Bessel functions, Legendre polynomials, Tchebyshev polynomials, Hermite polynomials and Laguerre polynomials. Power series solutions of Second Order Linear Differential Equations. Their Mathematical properties.

Unit III

Applications of First Order Ordinary Differential Equations - Simple problems of dynamics – falling bodies and other motion problems, Simple problems of Chemical reactions and mixing, Simple problems of growth and decay.

Unit IV

Applications of Second Order Ordinary Differential Equations - Undamped simple harmonic motion, damped vibrations, Forced vibrations, Problems on simple electric circuits – Laplace transforms.

Books for Reference:

1. G. F. Simmons, Differential Equations with Applications and Historical Notes, Tata McGraw-Hill, New Delhi, 1991.

2. E. D. Rainville and P. Bedient– Elementary course on Ordinary Differential Equations, Macmillan, New York, 1972.

3. R. Courant and D. Hilbert, Methods of Mathematical Physics, Vol. I, Tata McGraw- Hill, New Delhi, 1975.

FOURTH SEMESTER

MATH HC 10	Measure and Integration

Unit I

Lebesgue measure - outer measure, measurable sets and Lebesgue measure, a nonmeasurable set, measurable functions.

Unit II

The Lebesgue integral – the Lebesgue Integral of a bounded function over as set of finite measure, the integral of a non-negative function, the general Lebesgue integral.

Unit III

Differentiation and integration - Differentiation of monotonic functions, functions of bounded variation, differentiation of an integral, absolute continuity.

Unit IV

Measure and integration - Measure spaces, Measurable functions, integration, Signed measures, the Radon - Nikodym theorem, Measure and outer measure, outer measure and measurability, the extension theorem, product measures.

Books for Reference:

1. H. L. Royden – Real Analysis, Prentice Hall, 3rd Ed.,

2. G. de Barra – Measure Theory and Integration, Wiley Eastern Limited.

3. Inder K. Rana – An Introduction to Measure and Integration, Narosa, 1997.

MATH HC 11	Topology II

Unit I

Countability and Separation axioms - the countability axioms, the separation axioms, normality of a compact Hausdorff space.

Unit II

Urysohn's lemma, Tietze's extension theorem, Urysohn's metrization theorem, Partitions of unity.

Unit III

Tychonoff's theorem on the product of compact spaces. Local finiteness, Paracompactness, Normality of a paracompact space.

Unit IV

The Fundamental group and the Fundamental group of a circle, The Fundamental group of the punctured plane, Essential and Inessential Maps, The Fundamental Theorem of Algebra.

Books for Reference:

1. James R. Munkres - A First Course in Topology , Prentice Hall India, 2000, 2nd Ed.,

2. G. F. Simmons – Introduction to Topology and Modern Analysis, McGraw-Hill, Kogakusha, 1968.

3. S. Willard – General Topology, Addison Wesley, New York, 1968.

4. J. Dugundji – Topology, Allyn and Bacon, Boston, 1966.

5. J. L. Kelley – General Topology, Van Nostrand and Reinhold Co., New York, 1955.

MATH SC 10	Differential Geometry

Unit I

Plane curves and Space curves – Frenet-Serret Formulae.
Global properties of curves – Simple closed curves, The isoperimetric inequality, The Four Vertex theorem.
Surfaces in three dimensions – Smooth surfaces, Tangents, Normals and Orientability, Quadric surfaces.

Unit II

The First Fundamental form – The lengths of curves on surfaces, Isometries of surfaces, Conformal mappings of surfaces, Surface area, Equiareal Maps and a theorem of Archimedes.

Unit III

Curvature of surfaces – The Second Fundamental form, The Curvature of curves on a surface, Normal and Principal Curvatures.

Unit IV

Gaussian Curvature and The Gauss' Map – The Gaussian and The mean Curvatures, The Pseudo sphere, Flat surfaces, Surfaces of Constant Mean Curvature, Gaussian Curvature of Compact surfaces, The Gauss' Map.

Books for Reference:

1. A. Pressley – Elementary Differential Geometry, Under-graduate Mathematics Series, Springer.

2. T. J. Willmore – An Introduction to Differential Geometry, Oxford University Press.

3. D. Somasundaram – Differential Geometry: A First Course, Narosa, 2005.

MATH SC 11	**Advanced Graph Theory**

Unit I

Traversability - Eulerian graphs, Hamiltonian graphs.
Line Graphs - Some properties of line graphs, Characterization of line graphs, Special line graphs, Line graphs and traversability.

Unit II

Factorization.
Planarity - Plane and planar graphs, Euler's formula, Characterizations of planar graphs, Nonplanar graphs, Outerplanar graphs.

Unit III

Colorability - the chromatic number, Five color theorem.
Matrices – The adjacency matrix, The incidence matrix, The cycle matrix.

Unit IV

Groups – The automorphism group of a graph, Operation on Permutation groups, The group of a composite graph, Graphs with a given group, Symmetric graphs, Highly symmetric graphs.
Domination Theory - Domination numbers, Some elementary properties.

Books for Reference:

1. F. Harary – Graph Theory, Addition Wesley Reading Mass, 1969.

2. N. Deo – Graph Theory With Applications to Engineering and Computer Science, Prentice Hall of India, 1987.

3. K. R. Parthasarathy – Basic Graph Theory, Tata McGraw-Hill, New Delhi, 1994.

4. G. Chartand and L. Lesniak – Graphs and Diagraphs, Qwadsworth and Brooks, 2nd Ed.,

5. Clark and D. A. Holton – A First Look at Graph Theory, Allied publishers.

6. D. B. West – Introduction to Graph Theory, Pearson Education Inc., 2001, 2nd Ed.,

7. J. A. Bondy and U. S. R. Murthy – Graph Theory with applications, Elsevier, 1976.

MATH SC 12	Theory of Partitions

Unit I

Partitions - partitions of numbers, the generating function of p(n), other generating functions, two theorems of Euler, Jacobi's triple product identity and its applications.

Unit II

${}_1\psi_1$ - summation formula and its applications, combinatorial proofs of Euler's identity, Euler's pentagonal number theorem, Franklin's combinatorial proof.

Unit III

Congruence properties of partition function, the Rogers - Ramanujan Identities.

Unit IV

Elementary series - product identities, Euler's, Gauss', Heine's, Jacobi's identities. Restricted Partitions – Gaussian, Frobinius partitions.

Books for Reference:

1. G. H. Hardy and E. M. Wright – An Introduction to Theory of Numbers, Oxford University Press, 1979, 5th Ed.,

2. I. Niven, H. S. Zuckerman and H. L. Montgomery – An Introduction to the Theory of Numbers, New York, John Wiley and Sons, Inc., 2004, 5th Ed.,

3. Bruce C. Berndt – Ramanujan's Note Books Volumes-1 to 5.

4. G. E. Andrews – The Theory of Partitions, Addison Wesley, 1976.

5. A. K. Agarwal, Padmavathamma, M. V. Subbarao – Partition Theory, Atma Ram & Sons, Chandigarh, 2005.

MATH SC 13	Advanced Functional Analysis

Unit I

Bounded linear operators on Hilbert spaces, the adjoint of an operator, self adjoint operators, positive operators, properties of normal and unitary operators. One to one correspondence between projections on a Banach space and pairs of closed linear subspaces of the space, properties of orthogonal projections on Hilbert spaces.

Unit II

Spectral resolution of an operator on a finite dimensional Hilbert space H and the spectral theorem of a normal operator on H.

Unit III

The structure of commutative Banach algebras - properties of the Gelfand mapping, the maximal ideal space, multiplicative functional and the maximal ideal.

Unit IV

Applications of
spectral radius formula. Involutions in Banach algebras, the Gelfand - Neumark theorem.

Books for Reference:

1. G. F. Simmons – Introduction to Topology and Modern Analysis, Tata McGraw- Hill, New Delhi.

2. A. E. Taylor – Introduction to Functional Analysis, Wiley, New York, 1958.

3. A. Page and A. L. Brown – Elements of Functional Analysis.

4. George Bachman and Lawrence Narici – Functional Analysis, Dover Publications, Inc., Mineola, New York.

5. J. B. Conway – A course in Functional Analysis, GTM, Vol. 96., Springer, 1985.

MATH OE 03	Algorithms and computations

Unit I

Introduction to Computers, Flowcharts, Algorithms and their features, Languages, Types of language and translators. Numerical Algorithms - Solving a simultaneous system of linear equations using iterative and direct methods.

Unit II

Interpolation algorithms - equal, unequal intervals, central difference and inverse interpolation.
Numerical differentiation and integration and their errors calculations.

Unit III

Graph theoretical algorithms - Connectivity, finding shortest path between two vertices, enumeration of all paths, construction of minimum spanning tree, cutest, cut vertex, coding and decoding.

Unit IV

Computation - Algorithms complexities, strategies, Divide and conquer, greedy technique, Introduction to NP hard problems.

Books for Reference:

1. Conte and D'bear – Numerical Algorithms, McGraw-Hill, 1985.

2. N. Deo – Graph Theory With Applications to Engineering and Computer Science, Prentice Hall of India, 1987.

3. E. V. Krishnamurthy – Introductory Theory of Computer Science, Prentice Hall of India, 1980.

4. Horowitz and Sahni – Fundamentals of Computer Algorithms, Addison Wesley, 1987.

5. V. Rajaraman – Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

6. G. Shankar Rao – Numerical Analysis, Prentice Hall of India, 1985.

UNIVERSITY OF MYSORE
DEPARTMENT OF STUDIES IN MATHEMATICS

LIST OF COURSES (Hard Core, Soft Core and Open Elective) with CREDIT PATTERN

Sl. No.	Title of the Paper	Hardcore/ Soft core/Open Elective	No. of Credits L:T:P	Total Credits
	FIRST SEMESTER			
1	Algebra I	HC	3: 1 : 0	4
2	Real Analysis I	HC	3 : 1 : 0	4
3	Real Analysis II	HC	3 : 1 : 0	4
4	Complex Analysis I	HC	3 : 1 : 0	4
5	Linear Algebra	SC	3 : 1 : 0	4
6	Combinatorics and Graph Theory	SC	3 : 1 : 0	4
7	Graph Theory	SC	3 : 1 : 0	4
	SECOND SEMESTER			
1	Algebra II	HC	3 : 1 : 0	4
2	Real Analysis III	HC	3 : 1 : 0	4
3	Complex Analysis II	HC	3 : 1 : 0	4
4	Ordinary and Partial Differential Equations	SC	3 : 1 : 0	4
5	Representation Theory of Finite Groups	SC	3 : 1 : 0	4
6	Discrete Mathematics	OE	3 : 1 : 0	4
	THIRD SEMESTER			
1	Elements of Functional Analysis	HC	3 : 1 : 0	4
2	Topology I	HC	3 : 1 : 0	4
3	Commutative Algebra	SC	3 : 1 : 0	4
4	Theory of Numbers	SC	3 : 1 : 0	4
5	Algebraic Number Theory	SC	3 : 1 : 0	4
6	Galois Theory	SC	3 : 1 : 0	4
7	Differential equations and its applications	OE	3 : 1 : 0	4
	FOURTH SEMESTER			
1	Measure and Integration	HC	3 : 1 : 0	4
2	Topology II	HC	3 : 1 : 0	4
3	Differential Geometry	SC	3 : 1 : 0	4
4	Advanced Graph Theory	SC	3 : 1 : 0	4
5	Theory of Partitions	SC	3 : 1 : 0	4
6	Advanced Functional Analysis	SC	3 : 1 : 0	4
7	Algorithms and computations	OE	3 : 1 : 0	4