SAURASHTRA UNIVERSITY

DEPARTMENT OF MATHEMATICS

SYLLABUS

FOR

M. SC. (MATHEMATICS)

WITH EFFECT FROM - June – 2005

SYLLABUS FOR M.SC. (MATHEMATICS) w.e.f. JUNE-2005

The M.Sc. Course in Mathematics will consist of two years divided into four semesters.

In each Semester there will be five papers each of 100 marks.

In third semester course No. 3001 (Computer Programming in C) will have **to parts Theory and Practicals. Each of 50 marks.**

Name of subjects to be taught in M.Sc. (Maths) are listed below :

SEMESTER-1

01. M-1001 : Algebra-I
02. M-1002 : Real Analysis-I
03. M-1003 : Topology-I
04. M-1004 : Complex Analysis-I
05. m-1005 : Mechanics and partial diff. Equans-I

SEMESTER-2

01. M-2001 : Algebra-II
02. M-2002 : Real Analysis-II
03. M-2003 : Topography-II
04. M-2004 : Complex Analysis-II
05. M-2005 : Mechanics & Partial diff. Equns-II

SEMESTER-3

01. M-3001 : Computer Programming in C.
02. M-2003 : Functional Analysis.
03. M-3003 : Discrete Mathematics
04. M-3004 : Number theory-I
05. M-3005 : Special theory of Relativity &Tensor Analysis.

SEMESTER-4

01. M-4001 : Differential Geometry.
02. M-4002 : Integration Theory.
03. M-4003 : Graph Theory.
04. M-4004 : Number Theory-II
05. M-4005 : The General theory of Relativity &Cosmology

The following subjects can also be offered depending upon the availability of the faculty, infrastructure of the Department and interest of students in the subject.

01. Algebraic Number Theory
02. Commutative Ring Theory
03. Orbital Mechanics
04. Operator Theory
05. Differentiable Manifolds
06. Quantum Mechanics
07. Operations Research
08. Coding theory
09. Fuzzy Mathematics

M.Sc. Mathematics Semester-I

Course No. M-1001

Algebra – I

- **Groups Permutation Groups**
- **Alternating group An.**

- simplicity of An, Normal and Subnormal series, Composition Series, Jordan – If order theorem, Solvable groups, Nilpotent groups, sylow theorems.

- **Rings Ideals.**

Homeomorphisms, Maximal and Prime ideas, unique Factorization domains, Principal ideal domains, Euclidean domains, polynomials and Eisenstein criterion.

- **Modules Definition and Examples**,

Submodules and direct sums, quotient modules, Completely reducible modules, schur's remma, Free modules.

- **Canonical Forms Similarity of Linear Transformations**,

Invariant subspaces, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, Invariant of a nilpotent transformation. The primary decomposition theorem, Jordan blocks and Jordon forms, Quadratic forms.

M.Sc. Mathematics Semester-I

Course No. M-1002

Real Analysis – I

Definition and existence of Riemann-Stieltges integral, properties of the integral, integration and differention, the fundamental theorem of calculus, integration of vector valued valued function, Rectifiable curves (Quick Review).

Rearrangement of terms of series, Riemann's theorem, sequences and series of functions, point wise and uniform convergence, Cauchy criterion for uniform convergence, weirstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltges integration, uniform convergence and differentiation, weirstrass approximation theorem, power series, uniqueness theorem for power series, Abel's and Tauber's theorems.

Functions of several variables, linear transformations, derivatives in an open subset of R. Chain-rule, Partial derivatives, interchange of the order of differentiation, derivatives of higher order, Taylor's theorem, inverse function theorem, implicit function theorem.

- **References :**

01. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra Second Edition, Cambrige University Press, Indian Edition, 1997.

02. I. N. Hersterm, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

03. S. Lang, Algebra, 3rd Edition, Addison-Wesley, 1993.

04. M. Artin, Algebra, Prentice-Hall of India, 1991.

05. N.S. Gopalkrishnan, University Algebra, New Age International (p) Limited, Publishers, New Delhi, Sixth Reprint, 1998.

- **References :**

01. Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, MC-Graw Hill, 1976, International Student Edition.

02. T. M. Apostal, Mathematical Analysis, Narora Publishing House, New Delhi, 1985.

03. E. Hewitt and K. Stromberg, Real Abstract Analysis, Berlin, Springer, 1969.

04. P.K. Jain, V. P. Gupta Lebesgue Measure and integration, New Delhi, 1986, 2000.

05. I. P. Nantanson, Theory of functions of real variable, Vol.-I, Frederick Lengor publishing Co., 1961.

06. H. L. Raydon, Real Analysis, Macmillon publishing Co., Inc, 4th edition, New York-1993.

M.Sc. Mathematics Semester-I

Course No. M-1003

Topology – I

A Review of set Theory, Logic, Topological spaces and continuous functions, connectedness.

The syllabus will be covered by Chapter-1, Chapter-2 (except-2.8), Sections 3.1, 3.2, 3.3 & 3.4 of chapter 3 of the book Topology a first course by J. R. Munkres Prentice-Hall of India.

- **References :**

01. J. R. Munkres, Prentice – Hall of India.

02. General Topology – S. Willard.

03. Topology – K. D. Joshi

M.Sc. Mathematics Semester-I

Course No. M-1004

Complex Analysis – I

Complex integration, Cauchy Goursat theorem, Cauchy integral formula, Higher order derivatives, Morera's theorem, cauchy's inequality, Liouville's theorem, the fundamental theorem of algebra, Taylor's theorem, maximum modules principle, Schwartz lemma, Laurent's series, Isolated singularities.

Rouche's theorem, inverse function theorem. Branches of many valued functions with special reference to arg Z, log Z and Z power a, bilinear transformations, their properties and classifications.

- **References :**

01. J. B. Conay, functions of one complex variable, springer-verlag intermational student edition by Narora Publishing House, 3rd edition.

02. S. Lang, complex Analysis, Addison-Wesley, 1977.

03. D. Sarasan, complex function throry.

04. L. V. Ahlfors, complex Analysis, Egraw-Hill, 1979.

05. S. Ponnusamy, Foundations of xomplex Analysi, Narora publishing House, 1977.

M.Sc. Mathematics Semester-I

Course No. M-1005

Mechanics and Partial differential Equations – I

Unit-1 : D'Alembert's Principle and Lagrange's Equations.

1. Conservation theorems for Linear momentum and angular momentum for a partial.
2. Conservation theorems for Linear momentum and angular momentum for system of particles.
3. Classification of dynamical system.
4. Constraints.
5. Virtual displacement and principle of virmal work.
6. Generalized force in holonomic system.
7. Mathematical expression for principle of virtual work.
8. D'Alembert's principle.
9. Lagrange's equations for holonomic system.
10. Lagrange's equations for conservative non holonomic system.
11. Problems related to above topic.

Unit-2 : Variational Principle and Lanrange's Equatins.

1. Variational principle.
2. Calculus of variations.
3. Hamilton's principle.

4. Derivation of Hamilton's principle from Lagrange's equations.
5. Derivation of Lagrange's equations from Hamilton's principle.
6. Cyclic Co-ordinates.
7. Conservation theorems.
8. Problems related to above topics.

Unit-3 : Two body central force problem.

1. Reduction to equivalent one body problem.
2. The equations of motion and first integrals.
3. The equivalent one dimensional problem and classification of orbits.
4. The inverse square law of force.

Unit-4 : Partial differential equation.

1. Origin of the first order pde.
2. Linear differential equations of first order.
3. Cauchy problem.
4. Charpit's method.
5. Special type of first order equations & their solutions.
6. Jacobi's methods.

- **Books :**

1. Classical Mechanics – C. R. Mondal.
   Pub : Prentice-Hall of India Pvt. Ltd.
2. Classical Mechanics (2ed) – H. Goldstein.
   Pub :- Narosa Pub. Houses.

For Unit-4 :

Related topics will be covered from **Ch.: 2** of the book.

Elements of partial differential equations- Ian Sendden.

Pub :- Mc – Graw Hill Kogakushan Ltd.,

- **Reference Books.**

(i) Classical Mechanics – N. C. Rana & P. S. Joag.

Pub : - Tata-McGraw Hill Pub. Company Ltd.,

(ii) Partial differential equations – F. John.

Pub : - Prentice-Hall India Pvt. Ltd.,

M.Sc. Mathematics Semester-2

Course No. M-2001

Algebra – II

- **Field theory :**

Extension fields, Algebraic and transcendental extensions, Separable and Inseparable extensions, Normal extensions, Perfect fields, Finite fields, Primitive elements, Algebraically closed fields, Automorphisms of extensions, Galois extensions, Fundamental theorem of Galois theory, solution of polynmomial equations by radicals, Insolvability of the general equation of degree 5 by radioals, Geometric constructions with straightedge and compass.

Noetherian and Artinian modules and rings, Hilbert basis theorem, Wedderban – Artin theorem, uniform modules, [rimary modules and Noether – Lasker theorem.

Smith normal form over a principal ideal domain and rank.

Fundamenal structure theorem for finitely generated modules over a principal ideal domain and its applications to finitely generated abelian groups Rational canonicacal form, Generalized Jordan form over any field.

- **References :**

01. P. B. Bhattaharya S. K. Jain and S. R. Nagpal, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.

02. N. Jacobson, Basic Algebra, Vols. I and II, W. H. Freeman, 1980 (Also published by Hindustan Publishing Company, 1984)

03. I. N. Herstern, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

04. J. A. Gallian, Contemporary Abstract Algebra, Fourth Edition, Narora Publishing House, 1999.

05. S. Lang Algebra, 3rd Edition, Addison – Wesley, 1993.

06. I. Stewart, Galois theory, 2nd Edition, Champman and Hall, 1998.

M.Sc. Mathematics Semester-2

Course No. M-2002

Real Analysis - II

Jacobains, extremum problems with constraints, Lagrange multiplier method, differentiation of integrals, partition of unity, differential forms, stoke's theorem.

Labesgue's outer measure, measurable sets, regularity, measurable functions, Borel and Lebesgue measurability, Non-measurable sets, integration of non-negative functions, the general integral, integration of series, Riemann and Lebesgue. Integrals.

The four derivative, the function of bdd variation, Lebesgue differentiation theorem, differentiation and integration.

The L^p spaces, convex functions, Jensen's inequality, Holder and Minkowski inequality, completeness of L^p , convergence in measure, almost uniform convergence.

- **References :**

01. Walter Rudin Principles of Mathematical Analysis, 3rd edition. M.c-Graw Hill, 1976, International student edition.

02. T. M. Apostal, Mathematical Analysis, Narosa publishing house. New Delhi, 1985.

03. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Berlin, Springer, 1969.

04. P. K. Jain, V. P. Gupta, Lebesgue measure integration, New Age international limited publisher, New Delhi 1986, 2000.

05. I. P. Natanson, theory of functions of real variable, Vol. 1, Frederick lengor publishing Co., 1961.

06. H. L. Rodon, Real Analysis, Macmillan Publishing Co., Inc. 4^{th} edition, New York, 1993.

M.Sc. Mathematics Semester-2

Course No. M-2003

Topology - II

Compactness, Countability and Separation Axioms complete metric spaces, Baire spaces.

The syllabus will be covered by secton 3.5 to 3.8 of Chapter 3, 4.1 to 4.4 of chapter 4, 7.1, 7.3 and 7.7 of Topology A first course by J. R. Munkres Prentice Hall of India.

M.Sc. Mathematics Semester-2

Course No. M-2004

Complex Analysis - II

Meromorphic functions, the argument principle, residues, Cauchy's residue theorem, evaluation of integrals, definations and examples of conformal mappings, spaces of analytic functions, Hureuwitz's theorem, Montel's theorem, Riemann mapping theorem, weirstrass' factorization theorem, gamma functions and its properties, Riemann Zeta function, Riemann's functional equation, Reeng's theorem. Mittag-Laffeler's theorem, analytic continuation, uniqueness of analytic continuation along a curve, power series method of analytic continuation, schwerbe's reflection principle, monodromy theorem and its consequences, Harmonic functions on a disk, Hernack's inequality and theorem, Dirichlet's problem, Green's function.

Canonical products,Jensen's formula, poisson-Jensen's formula, Hadamord's three circle theorem, order of an entire function, exponent of convergence, Borel's theorem, Hamord's factorization theorem.

- **References :**

01. J. B. Conway, Functions of one complex variable, Springer verlag international student edition by Narora publishing House, 3rd edition.
02. S. Lang, complex Analysis. Addison-Wesley 19977.
03. D. Sarasan, Complex function theory.
04. L. V. Ahlfors, complex Analysis, McGraw-Hill, 1979.
05. S. Ponnusamy, foundations of complex Analysis, Narrora publishing house, 1977.

M.Sc. Mathematics Semester-2

Course No. M-2005

Mechanics and Partial Differential Equations - II

03. Euler angles.
04. Components of angular velocity along the body set of axes.
05. Euler's theorem on the motion of a rigid body.
06. Rate of change of a vactor.
07. The coriolis force.
08. Euler's equations of motion for a rigid body.
09. Motion of a Heavy symmetrical top.

UNIT-2 : Hamilton's Equations of Motion :

01. Derivation of Hamilton's equations of motion.
02. Routh's procedure.
03. Derivation of Hamilton's equations from Hamilton's principle.
04. Principle of least action.
05. Problems related to above topics.

UNIT-3 : Conical transformations :

01. Canonical transformations and generating functions.
02. Poisson's brackets and their properties.
03. Hamilton – Jacobi theory.
04. Problems related to above topics.

UNIT-4 : Partial differential equations of the Second Order :

01. The origin of second order equations.
02. Second and Higher order equations in Physics.
03. Linear partial differential equations with constant coefficients.
04. Separation of variables.
05. Laplace's equation
06. Elementary solutions of Laplace's equation.
07. The two dimensional Laplace's equation.

- **Books :**

01. For Unit 1, 2, 3 related topics will be covered from

(i) Classical Mechanics – C. R. Mondal
Pub : Prentice – Hall of India Pvt. Ltd.,

(ii) Classical Mechanics (2^{nd} Edition) – H. Goldstein
Pub : Narase Pub. House.

For Unit-4 :

Related topics will be covered from chapter 03 of the book.

Elements of partial differential equations.

Ian Snedden Pub : Mc-Graw Hill Kogakusha Ltd.,

- **References :**

01. Classical Mechanics – N.C. Rana & P. S. Joag.
Pub : Tata McGraw Hill Pub. Company Ltd.,
02. Partial differential equations – F. John
Pub : Narora Pub. House.
03. Differential equations and their applications– Zafar Ahesan
Pub : Prentice Hall India Pvt. Ltd.

M.Sc. Mathematics Semester-3

Course No. M-3001

Computer Programming in – 'C'

- Constants, Variables, C tohens, Key Words, identifiers, declaration of variables, operations and expressions.
- Managing input and output operations and formatted output.
- Decision making and branching statements like – if then else, if then switch, go to and Loops, Jump in Loops.
- One or two decimal array and their initialization, Handling of character strings.
- User – defined function, structure, unions, pointer and file management in 'C'.

- **Books**

  Programming in 'C' by E. Balagurusami Unit 2 to 12.

- **Reference Books :**

  01. Let us 'C' by Y. Kanitkar.

M.Sc. Mathematics Semester-3

Course No. M-3002

Functional Analysis

Normal linear spaces, Banach Spaces and examples, Quotient Space of normed Linear spaces and its completeness, equivalent norma, Riesz Lemma, basic properties finite dimensional normed Linear Spaces and compactness, weak convergence and bounded Linear transformations, normed Linear spaces of bounded Linear transformations, dual spaces with examples, uniform boundedness theorem and some of its consequences, open mapping and closed graph theorems, Hahn – Banach theorem for real Linear spaces, complex Linear spaces, Reflexive spaces, weak sequential compactness, Compact operators, Solvability of Linear equations in Banach Spaces, the closed Range Theorem.

In product spaces, Hilbert spaces, Orthonormal sets, Bessel's inequality, Complete orthonormal sets and Parseval's identity structure of Hilbert spaces, Projection theorem, Riesz representation theorem, adjoint of an operator on a Hilbert space, Reflexivity of Hilbert spaces, self – adjoint operators, Positive, projection, normal and unitary operators, Abstract variation boundary – value problem. The generalized Lax – Milgram theorem.

- **Reference :**

01. E. Kreyszing, Interductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.

02. B. V. Limaye, Functional Analysis, Wiley Estern limited, 1981.

03. J.B. Conway, A course in Functional Analysis, Springer – Verlag, New York, 1990.

04. G. Bachman and L. Narici, Functional Analysis, Academic Press, 1966.

05. A. E. Taylor, Introduction to functional Analysis, John Wiley and Sons, New York, 1958.

06. G. F. Simmons, Introduction to topology and modern Analysis, McGraw – Hill Book Company, New York, 1963.

M.Sc. Mathematics Semester-3

Course No. M-3003

Discrete Mathematics

- **Formal language**

Statements, symbolic representation and Tautologies, Quantifiers, Predicates and Validity, Proportional Logic.

- **Semigroups and Monoids :**

Definitions and examples of semi groups and Monoids (including those pertaining to concatenation operation) Homomorphism of semi-groups and monoids. Conference relation and quotient semi-groups. Subsemi-groups and submonoids. Direct products. Basic Homomorphism theorem.

- **Lattices :**

Lattices as partially ordered sets. Their properties. Lattices as algebraic systems; sublattices, Direct products and Homomorphism. Some special lattices e.g. complete, complemented and Distributive Lattices.

- **Boolean algebras :**

Boolean algebra as lattices, various Boolean identities. The switching algebra example, subalgebras, Direct products and homomorphism, join – irreducible elements, atoms and minters, Boolean forms and their equivalence minterms Boolean forms, sum of products canonical forms, Minimization of Boolean functions, Applications of Boolean Algebra to switching theory (using AND, OR & Not Gates). The Kamnaugh map method.

- **Introductory Computability Theory :**

Finite state machines and their Transition Table Digrams. Equivalence of finite state machines, Reduced Mechines, Homeomorphisms, Finite Automata, Acceptors, Non-deterministic finite automata and equivalent of its power to that of Deterministic Finite Automata, Moore and Mealy Machines.

Tuning machine and partial recursive functions.

Grammars and language – phrase – structure Grammars, Rewiring Rules, Derivations, Sentential forms, Language generated by a Grammar. Regular, Content – Free and Context Sensitive Grammars and Langues. Regular sets, Regular expressions and the pumping lemma; Kleene's theorem.

Notions of syntax Analysis, Polish Notations, Conversion of infix expressions to polish notations. The nerverse polish notation.

- **REFERENCES :**

0.1 J.P.Tremblay & R.Manohar,Discrete Mathematical structure with applications to computer science, McGraw-Hill Book Co., 1997.

0.2 J. L. Gestring, Mathematical structures for computer science, (3rd edition), computer science press, New York.

0.3 Seymour lepschutz, Finite mathematics (International edition, 1983). McGraw Hill Book Company, New York.

0.4 S. Witala, Discrete Mathematics – A unified approach McGraw-Hill Book Co.

0.5 J. E. Hoporoft and J. D. Vallman, Introduction to Automata theory, Language of computation, Narosa Publishing House.

0.6 C.L.Liu,Elements of Discrete Mathematic,McGraw-Hill Book Co

M.Sc. Mathematics Semester-3

Course No. M-3004

Number Theory - I

Divisibility, Congruencies, Quadratic, Reciprocity, Some Functions of Number Theory.

The syllabus covered by chapters 1 to 4 of "An Introduction to the Theory of Numbers" by Ivan Niven & H. S. Zuckermann Published by Wiley Easter Limited, New Delhi.

M.Sc. Mathematics Semester-3

Course No. M-3005

Special Theory of Relativity and Tensor Analysis

- **Unit-1 : Special Theory of Relativity.**

  01. Newtonian Relativity (Galilean transformation)
  02. Lorentz transformation.
  03. Michelson – Morley experiment.
  04. Length Contraction.
  05. Time dilation.
  06. Relativistic law of addition of velocities.
  07. Equivalence of Mass and Energy.,
  08. Problems Related to above topic.

- **Unit-2 : Tensor analysis :**

  01. Tensor Algebra
  02. Vector field in affine and Riemann space.
  03. Chistoffel Symbols.
  04. Tensor Analysis.

- **Books :**

  01. Related topics of Unit : 1 will be covered from the bock. Special Relativity. – W. Rindler, Pub : - Oliver and Bosd.
  02. Related topics of Unit : 2 will be covered from the book. Introduction to General Relativity. R. Adler, M. Basin, M. Schiffer

      Pub. : Mc Graw Hill Kogakusha Ltd.

M.Sc. Mathematics Semester-4

Course No. M-4001

Differential Geometry

Local theory of curves, space curves, Examples. Planar curves, Helices, Scapilcal – Frenet apparatus. Existence of space curves, involutes and evolutes of curves.

Local theory of surfaces – parametric patches on surface. First fundamental form and arc length. Normal curvature.. Geodesic curvature and Gauss formulae, Shape operator L^p of a surface at a point, vector field a curve. Second and third fundamental forms of a surface. Weingarten map, principal curvatures, Gaussian curvature, men and normal curvatures, Riemannian curvatures, Gauss theorem of Egregium, isometry groups and fundamental existence theorem for surfaces.

- **Reference Book :**

01. R. S. Milman and G. D. Parker, Elements of Differential Geometry, Prentice-Hall, 1977.
02. B. O. Neil, Elements of differential geometry, Academic Press, 1966.
03. M. Docermo, Differential geometry of curves and surfaces, Prentice Hall, 1976.
04. J. A. Thorpe, Introduction to Differential Geometry, Springer – Verlag.
05. S. Sternberg, Lecture notes on differential geometry, Prentice – Hall, 1964.

- **Reference Book :**

01. The Special theory of Relativity – Benerji and Benarjee

    Pub : Mc-Graw Hill Kogakusha Ltd.

02. Essential Relativity – By W. Rindler.

    Pub : Springer Verlag.

M.Sc. Mathematics Semester-4

Course No. M-4002

Integration Theory

Measure spaces, Measurable functions, Integration, General Convergence theorems, Signed Measures, Hahn decomposition theorem, Mutually singular measures, Radon – Nikodym theorem, Lebesgue decomposition, Riesz representation theorem, Extension theorem (Caratheo dory), Lebesgue – Stielgtes integral, product measuresm, Fubini's theorem, Differentiation and Integration, Decomposition into absolutely continuous and singular parts.

Bairs Sets, Baire measure, continuous functions with compact support, Regularity of measures on locally compact spaces, Integration of continuous functions with compact support, Riez – Markov theorem.

Reference Book :

0.1 H. L. Royden, Real Analysis, Prentice Hall of India, Third Edition, 1987. (Eighth Printing, 2002).

0.2 G. de Barra, Measure theory and integration, Wiley Eastern Limited, 1981.

0.3 P. R. Halmos, Measure theory. Van Nostrand, Princeton, 1950.

0.4 Walter Rudin, Real and Complex Analysis, Tata McGraw Hill Publishing Company, Second Edition, 1974.

0.5 S. K. Berberian, Measure and Integration, Chelsea Publishing Company, New York, 1965.

06. E. Hewitt and K. Stromberg, Real and Abstract Analysis, Springer- Verlag, New York.

M.Sc. Mathematics Semester-4

Course No. M-4003

Graph Theory (Optional Paper)

1. A quick review of the following concepts, Graph, degree of a Vertex, Path, Circuit, Connected and Disconnected Graph, Components, Euler Circuits, Euler Graph, Hamiltonian Paths and Circuits.
2. Trees and Fundamental Circuits.
3. Cut-sets and Cut-Vertices.
4. Planar Graphs, Kuratowski's two graphs, Different Representations of planarity, Detection of planarity.
5. Colouring of graphs, Chromatic number, chromatic polynomial. The four colour problem matching.
6. Graph theory in OR : Transport Networks, Extension of Max-Flow, Min-Cut Theorem, Minimal cost flows.

The syllabus is a covered by chapters 1 & 2 (for quick review) Chapter 3 (3.1 to 3.8), 4(4.1 to 4.6), 5 (5.1 to 5.5), 8 (8.1 to 8.4) and 14 (14.1 to 14.3).

From "Graph Theory with application to Engineering & Computer Science" by Narisingh Deo, Prentice Hall of India New Delhi.

- **Reference Book :**

01. Graph Theory by F. Haray – Addision – Wesley, 1969.
02. Introduction to graph Theory by R.J. Wilson, Peterson E'du Asia (Low price)
03. R. J. Wilson & J. J. Watkms : Graphs : An Introductory Approach Wiley, 1990.

M.Sc. Mathematics Semester-4

Course No. M-4004

Number Theory - II

Some Diophantine Equations, simple continued fractions. Farcy fractions & Irrational numbers.

The syllabus will be covered by chapters 5(5.1 to 5.12) 6, 7 from the book. An introduction to the theory of numbers" by Ivan Niven & H. S. Zuckerman. Wiley Eastern Ltd.

Reference for Number Theory I and II

01. Number Theory by Z. I. Borevich & I. R. Shafarevich Academic Press, 1966.

02. Introduction to Number Theory in L. K. Hua Sp. Ver. 1982.

03. Topics from the Theory of Number. Email Grosswald, 1966

04. An Introduction to the theory of Number by G. H. Hardy & E. M. Wright oxford clarendon press, 1966.

05. Elementary Number Theory D. M. Burton, Wm. C. Brown Publishers.

M.Sc. Mathematics Semester-4

Course No. M-4005

General Theory of Relativity and Cosmology

- **Unit-1 :**

01. The gravitational field equation in empty space.
02. Criteria for the field equations.
03. The Riemann curvature tensor and its properties.
04. The Bianchi identities.

- **Unit-2 :**

The Schwarzschild Solution and its consequences, experimental tests of General Relativity.

01. The Schwarzschild Solution.
02. The Schwarzschild solution is isotropic co-ordinates.
03. The General Relativistic kepler problem and the perihilc Shift of mercury.
04. The Trajectory of light ray in Schwarzschild field.
05. The Schwarzschild Radius, Kruskal Co-ordinates and the Black hole.

- **Unit-3 :**

The Kerr Solution.

01. The Schwarzschild and Kerr Solution.
02. The Kerr Solution and Rotation.

- **Books :**

  Relevant topics will be covered Introduction to General Relatvity – by R. Addees, M. Bazin, M. Schiffer. (2/e)

- **Reference Books :**

01. Essential Relativity, - W. Rindeer.

    Pub : Springer Verlas.

02. General Relativity and Cosmology, - V. J. Narlivar

    Pub : Mc Millan India Ltd.

03. An Introduction to Cosmology, - J. V. Narlikar (3/e)

    Pub : Cambridge University Press.