SOLAPUR UNIVERSITY, SOLAPUR

SYLLABUS

FOR

M.Sc. (Part-I) MATHEMATICS

(Semester I and II)

Credit System

WITH EFFECT FROM ACADEMIC YEAR 2011-12

(JUNE-2011).

SOLAPUR UNIVERSITY, SOLAPUR

SCHOOL OF COMPUTATIONAL SCIENCES

DEPARTMENT OF MATHEMATICS

Revised Syllabi of M.Sc. in Mathematics (Credit System)

1) **Title of the course:** M.Sc. in Mathematics
2) **Pattern:** Semester and Credit system.
3) **Duration of Course**: 2 years
4) **Strength of the Students:** 40
5) **Eligibility:** For M. Sc. in Mathematics following candidates are eligible.
   (i) B.Sc. with Mathematics as principal level.
   (ii) B.Sc. with any subject as principal and Mathematics at subsidiary level.

M. Sc. program in Mathematics consists of 100 credits. Credits of a course are specified against the title of the course.

A Four Semester M.Sc. Mathematics Course

Semester	No. of Papers/ Practical's / Seminar	Marks	Credits
Semester I			
• Theory Papers	05	500	20
• Practical Papers	01	100	04
• Seminar/Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester II			
• Theory Papers	05	500	20
• Practical Papers	01	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester III			
• Theory papers	05	500	20
• Practical Papers	01	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester IV			
• Theory papers	05	500	20
• Practical Papers	01	100	04
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Total marks and credits for M.Sc. Course		**2500**	**100**

M.Sc. Part-I (Mathematics) revised syllabus (according to the Semester Pattern Examination and Credit System) to be effective from the Academic Year 2011-12

Notations: A five – character code is given to each paper. In that "MM" stands for Master of Mathematics. The first digit following 'MM' is semester number. The second digit "0" stands for the compulsory paper, the digit "1" stands for the elective paper. The third digit indicates the serial number of the paper in that semester.

.M.Sc. Mathematics Semester-I

Paper Code	Title of the Paper	Contact hours/week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
MM-101	Object Oriented Programming Using C++	04	30	70	100	04
MM-102	Algebra- I	04	30	70	100	04
MM-103	Real Analysis - I	04	30	70	100	04
MM-104	Differential Equations	04	30	70	100	04
MM-105	Classical Mechanics	04	30	70	100	04
MM-106	Practical-I(Batchwise)	12	30	70	100	04
	Seminar	02	25	--	25	01
Total		**34**	**205**	**420**	**625**	**25**

M.Sc. Mathematics Semester-II

Paper Code	Title of the Paper	Contact hours/week	Distribution of Marks for Examination			Credits
			Internal	External	Total	
MM-201	Algebra - II	04	30	70	100	04
MM-202	Real Analysis - II	04	30	70	100	04
MM-203	General Topology	04	30	70	100	04
MM-204	Complex Analysis	04	30	70	100	04
MM-205	Relativistic Mechanics	04	30	70	100	04
MM-206	Practical-II(Batchwise)	12	30	70	100	04
	Seminar	02	25	--	25	01
Total		**34**	**205**	**420**	**625**	**25**

Each theory and practical paper will have 100 marks out of which 70 marks will be for Term End examination and 30 marks for Internal Assessment. The candidate has to appear for internal evaluation of 30 marks and external evaluation (University Examination) of 70 marks for each paper/ practical.

Internal Evaluation:

- In case of theory papers internal examinations will be conducted by school.
- In case of practical paper 10 marks shall be for day-to-day journal and internal examination 20 mark will be conducted by the school.

External Evaluation (End of Term University Examination):

I) Nature of Theory question paper:

1) Each theory paper will be of 3 hours duration
2) There shall be 7 questions each carrying 14 marks.
3) Students have to attempt **five questions**.
4) Question No.1 is **compulsory** and shall contain 14 objective type sub-questions each carrying 1 mark.
5) Question No.2 is **compulsory** and shall contain 4 short answer / short note type sub-questions each carrying 3 or 4 marks.
6) Students have to attempt **any three** questions from Question N0. 3 to Question No. 7.
7) Question N0. 3 to Question No. 7 shall contain 2 long answer type sub-questions.

II) Nature of Practical question paper:

Practical examination will be of 3 hours duration carrying 60 marks. There shall be 6 questions each of 15 marks, of which student has to attempt any 4 questions. VIVA will be for 10 marks.

Equivalence for Theory Papers:

Semester No.	Old Syllabus		Revised Syllabus	
	Paper No.	**Title of the Paper**	**Paper No.**	**Title of the Paper**
I	MM-101	Algebra- I	MM-102	Algebra- I
	MM-102	Real Analysis - I	MM-103	Real Analysis - I
	MM-103	Differential Equations	MM-104	Differential Equations
	MM-104	Differential Geometry	MM-101	Object Oriented Programming Using C++
	MM-105	Classical Mechanics	MM-105	Classical Mechanics
II	MM-201	Algebra - II	MM-201	Algebra - II
	MM-202	Real Analysis - II	MM-202	Real Analysis - II
	MM-203	General Topology	MM-203	General Topology
	MM-204	Complex Analysis	MM-204	Complex Analysis
	MM-215	Relativistic Mechanics or MATLAB	MM-205	Relativistic Mechanics

MM 101: OBJECT ORIENTED PROGRAMMING USING C++

1. Algorithm Development : Problem definition, Writing step by step procedure, representation in terms of Flow chart,, Tracing, Testing
   (2 Lectures)
2. Overview Of C++ : Object Oriented Programming, Introducing C++ Classes, Concepts of Object Oriented Programming, C++ as a superset of C, New style comments, main function in C++, meaning of empty argument list, function prototyping, default arguments and argument matching, User defined data types: enumerated types, use of tag names, anonymous unions, scope of tag names.
   (4 Lectures)
3. Classes & Objects :Classes, Structure & Classes, Union & Classes, Inline Function, Scope Resolution operator, Static Class Members: Static Data Member, Static Member Function, Passing Objects to Function, Returning Objects, Object Assignment. Friend Function, Friend Classes.
   (4 Lectures)
4. Array, Pointers References & The Dynamic Allocation Operators: Array of Objects, Pointers to Object, Type Checking C++ Pointers, The This Pointer, Pointer to Derived Types, Pointer to Class Members, References: Reference Parameter, call by reference and return by reference Passing References to Objects, Returning Reference, Independent Reference, C++'s Dynamic Allocation Operators, Initializing Allocated Memory, Allocating Array, Allocating Objects.
   (5 Lectures)
5. Constructor & Destructor: Introduction, Constructor, access specifiers for constructors, and instantiation, Parameterized Constructor, Multiple Constructor in A Class, Constructor with Default Argument, Copy Constructor, Destructor.
   (4 Lectures)
6. Overloading as polymorphism : Function & Operator Overloading : Function Overloading, Overloading Constructor Function Finding the Address of an Overloaded Function, Operator Overloading: Creating A Member Operator Function, Creating Prefix & Postfix Forms of the Increment & Decrement Operation, Overloading The Shorthand Operation (I.E. +=,-= Etc), Operator Overloading Restrictions, Operator Overloading Using Friend Function, Overloading New & Delete, Overloading Some Special Operators, Overloading[ ], ( ), -, Comma Operator.
   (6 Lectures)
7. Inheritance : Base Class Access Control, Inheritance & Protected Members, Protected Base Class Inheritance, Inheriting Multiple Base Classes, Constructors, Destructors & Inheritance, When Constructor & Destructor Function are Executed, Passing Parameters to Base Class Constructors, Granting Access, Virtual Base Classes . **(6 L)**
8. Virtual Functions & Polymorphism : Virtual Function, Pure Virtual Functions, Early Vs. Late Binding, Templates and Exception Handling.
   (4 Lectures)
9. Templates: Reason for templates compactness and flexibility, function template examples explicit specialization, class templates, out of class definition of member functions
   (2 Lectures)
10. The C++ I/O System Basics : C++ Streams, The Basic Stream Classes C++ Predefined Streams, Formatted I/O: Formatting Using The Ios Members, Setting The Formal Flags, Clearing Format Flags, An Overloaded Form Of Setf ( ), Using Width()

Precision() and Fill(), Using Manipulators to Format I/O, Creating Your own Manipulators. **(4 Lectures)**

11. Working with files : Introduction, Classes for file stream operations, Opening and Closing file, Open(): File Modes, File pointers and their Manipulations, Sequential Input and Output Operations, Updating a File: Random Access , Error Handling During File Operations
(4 Lectures)

Reference books:

1) C++ The Complete Reference By *Herbert Sehildt - Tmh*
2) C++ By *Balguruswami – Tata Mcgraw Hills*
3) C++ By M. Kumar, Tata Mcgraw

MM 102 : Algebra - I

UNIT I: Groups (15 lectures)

Commutator subgroups, P- Subgroups, Conjugate classes, Isomorphism theorems, zassenhaus lemma, G- sets, class equation, Sylow theorems

UNIT II: (10 lectures)

Normal and subnormal series, Composition series , Jordan -Holder Theorem, Solvable groups, Nilpotent groups.

UNIT III: (10 lectures)

UFD, PID, Euclidean domain, arithmetic in Euclidean domains

UNIT IV: Polynomial rings, (10 lectures)

Polynomial ring over the rational field. The Eisenstien criteria, Division algorithm, irreducible polynomials, ideal structure in F[X], Uniqueness of factorization in F[x], UFD in Polynomial rings.

UNIT V: Modules (05 lectures)

Modules, submodules, Fundamental isomorphism theorems for modules

Recommended Books:

1. I.N.Herstein . Topics in Algebra. Wiley Eastern Ltd. New Delhi 1975.

2. J. B. Fraleigh, Basic Algebra, Narosa pub.

Books for Reference :

1. P.B.Bhattacharya, S.K.Jain and S.R. Nagpaul. Basic Abstract Algebra (2nd Edition) Cambridge University, Press Indian Edition 1997.

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

3. N.Jacobson, Basic Algebra Vols I and II Freeman 1988 (Kalse Published by Firncustan Publishing Company.)

4. S.Lang Algebra 3rd edition. Addison-Westely 1993

5. O.S. Luther and I.B.S. Passi, Algebra Vol. I-Groups. Vol. II-Rings, Narosa Publishing House (Vol 1-1996 Vol. II 1- 1999)

6. D.S.Malik & N.Mordeson and M.K.Sen Fundametnals of Abstract Algebra, Mc. Graw Hill International Edition, 1997

MM103 : Real Analysis – I

I] Riemann Integration :- [1] (15 lectures)

Definition and existence of the integral, Refinement of partitions, Darboux's theorem, Conditions of integrability, Integrability of the Sum and difference of integrable functions, The integral as a limit of sums, Some intrgable functions, Integration and differentiation, the fundamental theorem of Calculus, Mean Value theorem of integral Calculus, Second Mean Value theorem.

II]Riemann – Stieltijes integral [1] :- (05 lectures)

Defination and existence of the integral, A condition of integrability

III]Multivariable differential calculus : [2] (20 lectures)

Introduction, the directional derivative, Directional derivatives and continuity, total derivative, the total derivative expressed in terms of partial derivatives, the Jacobian matrix, the chain rule, the mean value theorem, for differentiable functions, Taylors formula for functions from R^n to R^1

IV]Implicit functions and Extremum problems . [2,3] (10 lectures)

Functions with nonzero Jacobian determinant, The inverse function theorem, The Implicit function theorem, Extreme of real valued functions of one variable.

Recommended Books :-

1) Mathematical Analysis, 2nd ed., S. C. Malik and Savita Arora, New Age international ltd.
2) Apostoi T. M. Mathematical Analysis , (2nd edition) 12.1 – 12.5 , 12.8, 12.9, 12.11, 12.12, 12.14, 13.1, to 13.5 Narosa Pub.

Reference: Books :-

1]Burkill and Burkill A second course Mathematical Analysis, Cambridge University Press (1970)

2]Walter Rudin,Principles of Mathematical Analysis(3rd Ed)MC Graw Hill

MM 104 : Differential Equations

1] Linear Equations with constant coefficients : (20 lectures)

The second order homogeneous equation, initial value problems for second order equations, Linear dependence and independence. A formula for the Wronskian, the non-homogeneous equations of order two, the homogeneous equations of order n, initial value problems for the nth order equations, Equations with real constants, The non-homogeneous equation of order n [1]

2] Linear Equations with variable coefficients : (15 lectures)

Initial value problems for the homogeneous equations, solutions of the homogeneous equations, The Wronskian and linear independence, reduction of the order of a homogeneous equation, Homogeneous equations with analytic coefficients. [1]

3] Linear Equations with regular singular points: (10 lectures)

The Euler equations, second order equations with regular singular points, The Bessels equation, [1]

4] Existence and uniquencess of solutions : (05 lectures)

The method of successive approximations, The Lipschitz condition [1]

Recommended Books :

1. An introduction to ordinary differential equations. by E.A. Coddington (1974) Prentice Hall of India Pvt.Ltd. New Delhi.

Reference Books :

1. Theory of ordinary differential equations by E.A. Coddington and Levinson (1955) McGraw Hill, New York

2.Elementary differential equations by E.D. Rainvills (1964) The Macmillan company, New York.

3. Ordinary Differential equations by G. Birkoff and G.G.Rota John Willey and Sons.

4. Differential Equations with Applications and Historical note by G.F. Simmons (1972) MacGraw Hill, Inc. New York.

5. Ordinary Differential Equations by Somasundaram, Narosa pub.

MM 105: Classical Mechanics :

1] Unit-I : (15 lectures)

Mechanics of a particle, Mechanics of a system of particles, constraints, Generalised coordinates, D'Alembert's principle, Lagrange's equations of motion, the forms of Lagrange's equation for velocity dependent potential, and dissipative forces, applications of Langragian formulation, cyclic co-ordinates and generalised momentum, conservation theorems. [1]

2] Unit –II (10 lectures)

Functionals, basic lemma in calculus of variations, Euler- Lagrange's equations, the case of several dependent variables, the minimum surface of revolutions, the problem of Brachistochrone, Isoperimetric problems, Problem of the maximum enclosed area, shape of a hanging rope [2] [1].

3] Unit –III (10 lectures)

Hamilton's principle, Lagrange's equations from Hamilton's principle, (holonomic system)Hamilton's equations of motion from a variational principle. The principle of least action cyclic coordinates and Routh's procedure, conservation theorems and physical significance of Hamiltonian [1]

4] Unit –IV (15 lectures)

The kinematics of rigid body motion: The independent co-ordinates of a rigid body, orthogonal transformations, properties of transformation matrix, infinitesimal rotations, the Eulerian angles, the Cayley-Klein parameters, Euler's theorem on motion of rigid body. Angular momentum and kinetic energy of motion of a rigid body about a point, The inertia tensor and moment of inertia, Euler's equations of motion. [1].

Recommended Books :

1. Classical Mechanics by H.Goldstein (1980) Narosa Publishing House, New Delhi
2. Calculus of variations with applications to Physics and Engineering (International series in Pure and Applied Mathematics) by Robert Weinstock (1952) McGraw-Hill book comp. New York.
3. Classical Mechanics by N.C.Rana and P.S. Joag (1991) Tata McGraw Hill, New Delhi.

Reference Books :

1. A treatise on the Analytical Dynamics of Particles and rigid bodies. by E.T.Whittaker (1965) Cambridge University Press.
2. Classical Mechanics by E.A.Desolge, Vol. I and II (1982) John-Wiley and sons, New York.
3. Classical Mechanics A Modern Perspective by V.Barger and Martin Olsson(1995) McGraw Hill, Inc.New York.
4. Classical Machanics with introduction to Non-linear oscillation and chaos by V.B.Bhatia (1997) Narosa Pub.House
6. Classical Mechanics by J. C. Upadhyay, Himalaya Pub.

MM 106: Practical I

Unit – I :- Oops using C++

1) Programs on Control structures, Class and Objects
2) Programs on constructors and Destructors, Arrays and Pointers
3) Programs on overloading and operator overloading and inheritance
4) Programs on Virtual functions, file handling,Templates etc.

Unit – II :- Algebra I

1) Problems on Isomorphism theorems & Sylow's Theorems.
2) Problems on Normal, Solvable & Nilpotent groups
3) Problems on UFD, PID, ED
4) Problems on Polynomial rings.

Unit – III :- Real Analysis I

1) Problems on Riemann Integration.
2) Problems on Multivariable Calculus
3) Problems on Implicit fuctions and Extrernum Problems.

Unit – IV :- ODE

1) Problems on Linear equations with constant coefficients
2) Problems on Linear equations with Variable coefficients.
3) Problems on Linear equations with regular singular points.
4) Problems on Method of successive approximation & Lipchitz condition.

Unit – V :- Classical Mechanics.

1) Problems on Lagrange's equation.
2) Problems on Calculus of Variation.
3) Problems on Hamilton's equations.
4) Problems on Kinematics of Rigid body.

MM 201 : Algebra - II

1] Unit –I (20 lectures)

Field extensions, Finite field extension, Field adjunctions,Simple extension, algebraic element, Transcendental element, Algebraic extensions, Roots of polynomial, Multiple roots, splitting field of polynomial, Separable element, separable extension of a field, perfect field,

2] Unit –II (12 lectures)

The elements of Galois theory. Fixed field, The group G(K,F) of automorphisms of K relative of F, Normal extension, Galois group, Fundamental theorem to Galois theory

3] Unit –III (10 lectures)

Constructible real number, Solvability by radicals, Totally in separable extensions cyclotomic extensions

4] Unit –IV : (08 lectures)

Finite fields and applications

Recommended Books :

1.Herstein I.N. : Topics in Algebra, Wiley Eastern Ltd.,Second ed. 1993.

2.J.B. Fraleigh : A first course in Abstract Algebra, Narosa Pub.Co.

References :

1. P.B.Bhattacharya, S.K.Jain and S.R. Nagpaul. Basic Abstract Algebra (2nd Edition) Cambridge University, Press Indian Edition 1997.

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

3. N.Jacobson, Basic Algebra Vols I and II Freeman 1988 (Kalse Published by Firncustan Publishing Compay.)

4. S.Lang Algebra 3rd edition. Addison-Westely 1993

5. O.S. Luther and I.B.S. Passi, Algebra Vol. I-Groups. Vol. II-Rings, Narosa Publishing House (Vol 1-1996 Vol. II 1- 1999)

6. D.S.Malik & N.Mordeson and M.K.Sen Fundametnals of Abstract Algebra, Mc. Graw Hill International Edition, 1997

MM 202: Real Analysis - II

1. Lebesgue Measure: Outer measure, Measurable sets, Lebesgue measure, non-measurable sets. (10 lectures)

2. Measurable functions: Measurable functions and their properties, Egoroff's theorem (10 lectures)

3. Lebesgue Integral: Lebesgue integral of a bounded function over a set of finite measure, the Lebesgue integral of a non-negative measurable function, Fatou's Lemma, the general Lebesgue integral,convergence in measure. (15 lectures)

4. Differentiation and Integration: Differentiation of monotone functions, function of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions. (15 lectures)

Recommended Books :

1. Simmon G.F. : Introduction to topology and Modern Analysis, McGraw Hill Book Company, New York 1963

2. Royden H.L.: Real Analysis , Printice Hall of India.

Reference Books :

1. Berberian, S.K. Measure and Integration, McMillan N.Y.1965

2. Rana : An Introduction to Measure and Integration, Narosa (1997)

3. G. De. Barra, Measure and Integration

MM 203 : General Topology

1] Unit –I (25 lectures)

Defination and examples of topological spaces, closed sets, closure, dense sets, Neighborhood, Interior, Exterior, Boundary, accumulation points, and derived sets. Bases, subbases, Relative topology. Continuous functions and homeomorphism.

2] Unit –II (10 lectures)

Compact sets and connected sets

3] Unit –III (15 lectures)

First and Second countable spaces, lindeloff spaces, separable spaces, second countability and seperablility, Separation Arioms : To, T_1, T_2, T_3, $T_{3½}$, T_4 - Their characterizations and basic properties. Separation properties of Product spaces,

Recommended Books :-

1]Munkres J. R. :- Topology – A first course, prentice Hall of India (200)

Reference: Books :

1]Joshi K. D. : Introduction to General Topology – Wiley Eastern (1983)

2]Willard S : General Topology, Adisson Weseley (1970)

3] Perwin W.J.: Foundations of General Topolgoy,Academic Press (1964)

MM204: Complex Analysis

1] UNIT –I (05 lectures)

Cross Ratio, Mobius transformations, Analytic functions, Power series representation of analytic functions,

2] UNIT –II (20 lectures)

Liouville's theorem,

Fundamental theorem of algebra, Zeros of analytic function. Index of a closed curve, Cauchy's integral formula, Cauchy's theorem, Morera's theorem, counting zeros of analytic functions, open mapping theorem, Goursat's theorem.

3] UNIT –III (20 lectures)

Isolated singularities, characterization of isolated singularities, Laurent series expansion, Residues Residue theorem, Evaluation of definite integrals, Argument principle, Rouche's theorem, Maximum Modulus theorems, Schwarz's lemma. Hurwitz's theorem Montel theorem, Riemann mapping theorem.

Recommended Books :

J.B.Conway-Function of one complex variable (second edition) Narosa (1980)

Reference Books :

1. L.V. Ahliors : Complex Analysis, McGraw Hall (1979)
2. H.Silverman : Complex Variables, Hanton Mifflin (1975)
3. N.Levinson and R M.Redheffer : Complex Variables, Tata McGraw Hill (1980)
4. Remmert : Complex Function Theory, Springer Verlag
5.S.G.Kvanse : Complex Ananlysis

MM205: Relativistic Mechanics

UNIT I:Relativistic Kinematics : (20 lectures)

Galilean transformations, Newtonian Relativity, Electromagnetism and Newtonian Relativity, Inertial frames, postulates of special relativity, Derivation of the Lorentz Transformation equations, Consequences of the Lorentz Transformation equations, viz. Lorentz contraction, time dilation, simultaneity and colocality of events. Invariance of electromagnetic wave equation. The relativistic addition of velocities (Einstein's formula) Lorentz velocity and acceleration transformation equations, relativistic aberration formula and Doppler effect [1]

UNIT II:.Relativistic Dynamics : (15 lectures)

Variation of mass of a moving particle, relativistic momentum, force, work and energy, The equivalence of mass and energy. The transformation properties of momentum, energy, mass and force Minkowski space-time, four velocity vector, four momentum, Relativistic Lagrangian and Hamiltonian. [1]

UNIT III :Electromagnetism : (10 lectures)

The interdependence of electric and magnetic fields, The transformation for electric and magnetic fields, the field of a uniformly moving point charge, The invariance of Maxwells equations [1]

UNIT IV: Tensor Analysis : (05 lectures)

Transformation of co-ordinates, Laws of transformation of contravariant, covariant and mixed tensors of different ranks. Cartesian tensor, metric tensor.

Recommended Books :

1. Introduction to special Relativity by R.Resnick [1968]

2. "A text book of Matrix and Tensor by Paria G. Scholan's Publication, Indore.

Reference Books :

1. Relativity and Gravitation by Philippe Tourrence (1972) Cambridge University Press.

MM 206: Practical II

Unit – I :- Algebra II

1) Problems on Extension Fields, splitting fields.
2) Problems on Galois theory
3) Problems on Constructible real numbers
4) Problems on Solvability by radicals, & finite fields.

Unit – II :- Real Analysis - II

1) Problems on Measurable sets.
2) Problems on Measurable functions.
3) Problems on Lebesgue diffentiation and integration
4) Problems on functions on bounded variation, absolute continuity, convex functions

Unit – III :- Topology

1) Problems on topology spaces
2) Problems on compact sets & connected sets
3) Problems on Continuous functions & homeomorphisms
4) Problems on separation axioms.

Unit – IV :- Complex Analysis

1) Problems on Mobius transform
2) Problems on analytic functions.
3) Problems on Singularities
4) Problems on theorems given in unit III. Of Paper MM 204

Unit – V :- Relativistic Mechanics

1) Problems on Relativistic Kinematics
2) Problems on Relativistic dynamics
3) Problems on Electromagnetism