SOLAPUR UNIVERSITY, SOLAPUR

SYLLABUS

FOR

M.Sc. (Part-I) MATHEMATICS
(Semester I and II)
Choice Based Credit System(CBCS)

WITH EFFECT FROM ACADEMIC YEAR 2016-17

(JUNE-2016).

SOLAPUR UNIVERSITY, SOLAPUR

SCHOOL OF COMPUTATIONAL SCIENCES

DEPARTMENT OF MATHEMATICS

Revised Syllabi of M.Sc. in Mathematics (Choice Based 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 Choice Based Credit System) to be effective from the Academic Year 2016-17

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	Type of course	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
				Internal	External	Total	
MM-101	Core	Algebra- I	04	30	70	100	04
MM-102	Core	Real Analysis - I	04	30	70	100	04
MM-103	Core	Differential Equations	04	30	70	100	04
MM-104	Core	Number Theory	04	30	70	100	04
MM-105	Elective	Classical Mechanics / Transform Analysis	04	30	70	100	04
MM-106	------	Practical-I	12	30	70	100	04
		Seminar	02	25	--	25	01
Total			**34**	**205**	**420**	**625**	**25**

M.Sc. Mathematics Semester-II

Paper Code	Type of Course	Title of the Paper	Contact hours/ week	Distribution of Marks for Examination			Credits
				Internal	External	Total	
MM-201	Core	Algebra - II	04	30	70	100	04
MM-202	Core	Real Analysis - II	04	30	70	100	04
MM-203	Core	General Topology	04	30	70	100	04
MM-204	Core	Complex Analysis	04	30	70	100	04
MM-215	Open Elective	Fundamentals in Mathematics	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.	CGPA Syllabus		CBCS Syllabus	
	Paper No.	**Title of the Paper**	**Paper No.**	**Title of the Paper**
I	MM-101	Object Oriented Programming Using C++	MM-104	Number Theory
	MM-102	Algebra- I	MM-101	Algebra- I
	MM-103	Real Analysis - I	MM-102	Real Analysis - I
	MM-104	Differential Equations	MM-103	Differential Equations
	MM-105	Classical Mechanics	MM-115	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-215	Fundamentals in Mathematics

MM 101 : Algebra - I

UNIT I: Groups (15 lectures)

Commutator subgroups, P- Subgroups, Conjugate classes , 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, (15 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, Modules, Submodules.

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Recommended Books:

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

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

3. Joseph A. Gallian, Contemporary Abstract 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.

MM102 : 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 103 : 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-104 Number Theory

Unit- I

Review of divisibility, The division algorithm, G.C.D., Euclidean algorithm Diophantine equation ax + by = C.Primes and their distribution:Fundamental theorem of Arithmetic, The Goldback Conjecture

Unit- II

Congruences, Properties of Congruences, Linear congruences, Special divisibility tests.

Fermats theorem :Fermats factorization method, Little theorem, Wilsons theorem

Unit-III

Number theoretic functions, The functions τ and σ, The Mobius Inversion formula, The greatest integer function.Eulers Generalization of Fermats theorem Euler's phi function, Euler's theorem, properties of phi function,

Unit-IV

Primitive roots, The order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, The theory of Indices.

Recommended book:

1. D.M.Barton : Elementary Number Theory, Universal book stall, New Delhi.

Reference Books :

2. S.B.Malik : Baisc Number theory Vikas publishing House.
3. George E.Andrews : Number theory, Hindusthan Pub. Corp.(1972)
4. Nisen Zuckerman : An Introduction to theory of numbers.

MM 115: 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, [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

5. Classical Mechanics by J. C. Upadhyay, Himalaya Pub.

MM 106: Practical I

Unit – I :- 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 – II :- Real Analysis I

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

Unit – III :- Differential Equations

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 – IV:-Number Theory

1) Problems on Division Algorithmand Diophantine Equations.
2) Problems on Linear congruences and Fermats theorem.
3) Problems on Number theoretic functions.
4) Problems on Primitive roots.

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 Finite fields and applications (08 lectures)

4] Unit –IV : Constructible real number, Solvability by radicals, Totally in separable extensions cyclotomic extensions (10 lectures)

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.

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 (10 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: Fundamental in Mathematics

UNIT I: (20 lectures)

Elementary Matrix Operations and Elementary Matrices, Types of Matrices and Determinants, Rank of Matrix and Matrix inverses

UNIT II:. (15 lectures)

System of Linear equations, homogenous and non-homogenous

UNIT III : (10 lectures)

Vector Spaces, Subspaces, Linear Combinations, Linear Dependence and Linear independence, Bases, Dimensions

UNIT IV: (05 lectures)

Linear transformations, Null spaces, Range Spaces, Matrix representations of linear transformations

Recommended Books :

1. Linear Algebra, by Stephen H. Friedberg (Author), Pearson Pub.

Reference Books :

1) Linear Algebra by A.R.Vasistha and J.N.Sharma (Author), Krishna Pub.

2) Linear Algebra by K.P.Gupta(Author), A Pragati Edition.

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.

Unit – V: - Fundamentals in Mathematics.

1) Problems on Matrices.
2) Problems on linear Equations.
3) Problems on Vector spaces and linear transformation.