Scheme of Examination and Syllabi
For the programme
M.Sc. Mathematics
(Regular Course)

(w.e.f. Session 2017-18)

Scheme of Examination of
M.Sc. Mathematics, Semster-I
(w.e.f.Session 2016-17)

Course Code	Title of The Course	Theory Marks	Internal Marks	Practical Marks
MM11	Adavanced Abstract Algebra-I	80	20	--
MM12	Real Analysis-I	80	20	--
MM13	Topology –I	80	20	--
MM14	Differential Equations -I	80	20	--
MM15	Programming in C	60	--	40

Note 1 : The Criteria for awarding internal assessment of 20 marks shall be as under-

A) Class Test : 10 marks
B) Assignment & Presentation : 5 marks
C) Attendence : 5 marks

Less than 65% : 0 marks
Up to 70% : 2 marks
Up to 75% : 3 marks
Up to 80% : 4 marks
Above 80% : 5 marks

Note 2 : The syllabus of each course will be divided into four sections of two questions each.The question paper of each course will consist of five sections. Each of thr sections I to IV will contain two questions and the students shall be asked to attempt one question from each.Section V shall be compulsory and contain eight short answer type questions without any internal choice covering the entire syllabus.

Syllabus- 1 st SEMESTER

MM11: Advanced Abstract Algebra-I

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Groups : Zassenhaus lemma, Normal and subnormal series, Composition series, Jordan-Holder theorem, Solvable series, Derived series, Solvable groups, Solvability of S_n - the symmetric group of degree $n \geq 2$.

Unit - II (2 Questions)

Nilpotent group: Central series, Nilpotent groups and their properties, Equivalent conditions for a finite group to be nilpotent, Upper and lower central series, Sylow-p sub groups, Sylow theorems with simple applications. Description of group of order p and pq, where p and q are distinct primes(In general survey of groups upto order 15).

Unit - III (2 Questions)

Field theory, Extension of fields, algebraic and transcendental extensions. Splitting fields, Separable and inseparable extensions, Algebraically closed fields, Perfect fields.

Unit - IV (2 Questions)

Finite fields, Automorphism of extensions, Fixed fields, Galois extensions, Normal extensions and their properties, Fundamental theorem of Galois theory, Insolvability of the general polynomial of degree $n \geq 5$ by radicals.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. P.B. Bhattacharya,, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Edition), Cambridge University Press, Indian Edition, 1997.
3. P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991.
4. N. Jacobson, Basic Algebra, Vol. I & II, W.H Freeman, 1980 (also published by Hindustan Publishing Company).
5. S. Lang, Algebra, 3rd editioin, Addison-Wesley, 1993.
6. I.S. Luther and I.B.S.Passi, Algebra, Vol. I-Groups, Vol. II-Rings, Narosa Publishing House (Vol. I - 1996, Vol. II -1990).
7. D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw Hill, International Edition, 1997.
8. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.

MM - 12: **Real Analysis -I**

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Riemann-Stieltjes integral, its existence and properties. Integration and differentiation. The fundamental theorem of calculus. Integration of vector-valued functions. Rectifiable curves.

Unit - II (2 Questions)

Set functions. Intuitive idea of measure. Elementary properties of measure. Measurable sets and their fundamental properties. Lebesgue measure of a set of real numbers. Algebra of measurable sets. Borel set. Equivalent formulation of measurable sets in terms of open. Closed. F and G sets. Non measurable sets.

Unit - III (2 Questions)

Measurable functions and their equivalent formulations. Properties of measurable functions. Approximation of a measurable function by a sequence of simple functions. Measurable functions as nearly continuous functions. Egoroff's theorem. Lusin's theorem. Convergence in measure and F. Riesz theorem. Almost uniform convergence.

Unit - IV (2 Questions)

Shortcomings of Riemann Integral. Lebesgue Integral of a bounded function over a set of finite measure and its properties. Lebesgue integral as a generalization of Riemann integral. Bounded convergence theorem. Lebesgue theorem regarding points of discontinuities of Riemann integrable functions. Integral of non-negative functions. Fatou's Lemma. Monotone convergence theorem. General Lebesgue Integral. Lebesgue convergence theorem.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Walter Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha, 1976, International Student Edition.
2. H.L. Royden, Real Analysis, Macmillan Pub. Co., Inc. 4th Edition, New York, 1993.
3. P. K. Jain and V. P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986.
4. G De Barra, Measure Theory and Integration, Wiley Eastern Ltd., 1981.
5. R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co. Pvt. Ltd.
6. R. G. Bartle, The Elements of Real Analysis, Wiley International Edition.

MM - 13 : **Topology - I**

Max. Marks : 80
Time : 3 hours

Unit - I (2 Questions)

Statements only of (Axiom of choice, Zorn's lemma, Well ordering theorem and Continuum hypothesis)

Definition and examples of topological spaces, Neighbourhoods, Interior point and interior of a set , Closed set as a complement of an open set , Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set , Dense subsets, Interior, Exterior and boundary operators.

Base and subbase for a topology, Neighbourhood system of a point and its properties, Base for Neighbourhood system.

Relative(Induced) topology, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Comparison of topologies on a set, Intersection and union of topologies on a set.

Unit - II (2 Questions)

Continuous functions, Open and closed functions , Homeomorphism.

Tychonoff product topology, Projection maps, Characterization of Product topology as smallest topology, Continuity of a function from a space into a product of spaces.

Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Connectedness and product spaces, Components, Locally connected spaces, Locally connected and product spaces.

Unit - III (2 Questions)

First countable, second countable and separable spaces, hereditary and topological property, Countability of a collection of disjoint open sets in separable and second countable spaces. Product space as first axiom space. Lindelof theorem. T_0, T_1, T_2 (Hausdorff) separation axioms, their characterization and basic properties.

Unit - IV (2 Questions)

Compact spaces and subsets. Compactness in terms of finite intersection property. Continuity and compact sets. Basic properties of compactness, Closedness of compact subset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets. Local compactness. Compactness and product space. Tychonoff product theorem and one point compactification. Quotient topology. Continuity of function with domain- a space having quotient topology. Hausdorffness of quotient space.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to ten** short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, 1963.
2. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.
3. J. L. Kelly, General Topology, Affiliated East West Press Pvt. Ltd., New Delhi
4. J. R. Munkres, Toplogy, Pearson Education Asia, 2002
5. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York 1964.

Semester-I

MM14: Differential Equations -I

Examination Hours : 3 Hours
Max. Marks : 100
(External Theory Exam. Marks:80
+ Internal Assessment Marks:20)

NOTE : The examiner is requested to set nine questions in all taking two questions from each section and one compulsory question. The compulsory question will consist of eight parts and will be distributed over the whole syllabus. The candidate is required to attempt five questions selecting at least one from each section and the compulsory question.

Section -I (Two Questions)

Preliminaries: Initial value problem and equivalent integral equation. ε-approximate solution. equicontinuous set of functions.
Basic theorems: Ascoli- Arzela theorem, Cauchy -Peano existence theorem and its corollary. Lipschitz condition. Differential inequalities and uniqueness. Gronwall's inequality. Successive approximations. Picard-Lindelöf theorem. Continuation of solution, Maximal interval of existence, Extension theorem. Kneser's theorem (statement only)
(Relevant portions from the book of 'Theory of Ordinary Differential Equations' by Coddington and Levinson)

Section-II (Two Questions)

Linear differential systems: Definitions and notations. Linear homogeneous systems: Fundamental matrix, Adjoint systems, reduction to smaller homogeneous systems. Non-homogeneous linear systems: variation of constants. Linear systems with constant coefficients. Linear systems with periodic coefficients: Floquet theory.
(Relevant portions from the book of 'Theory of Ordinary Differential Equations' by Coddington and Levinson)

Section-III (Two Questions)

Higher order equations: Linear differential equation (LDE) of order n: Linear combinations, Linear dependence and linear independence of solutions. Wronskian theory: Definition, necessary and sufficient condition for linear dependence and linear independence of solutions of homogeneous LDE. Abel's Identity. Fundamental set. More Wronskian theory. Reduction of order. Non-homogeneous LDE. Variation of parameters. Adjoint equations. Lagrange's Identity. Green's formula. Linear equation of order n with constant coefficients. (Relevant portions from the books of 'Theory of Ordinary Differential Equations' by Coddington and Levinson and the book 'Differential Equations' by S.L. Ross)

Section -IV (Two Questions)

System of differential equations, the n-th order equation. Dependence of solutions on initial conditions and parameters: Preliminaries, continuity and differentiability. (Relevant portions from the book of 'Theory of Ordinary Differential Equations' by Coddington and Levinson)

Maximal and Minimal solutions. Differential inequalities. A theorem of Wintner. Uniqueness theorems: Kamke's theorem, Nagumo's theorem and Osgood theorem. (Relevant portions from the book 'Ordinary Differential Equations' by P. Hartman)

Referneces:

1. E.A. Coddington and N. Levinson, *Theory of Ordinary Differential Equations*, Tata McGraw-Hill , 2000.
2. S.L. Ross, *Differential Equations*, John Wiley & Sons.
3. P. Hartman, *Ordinary Differential Equations*, John Wiley & Sons NY, 1971.
4. G. Birkhoff and G.C. Rota, *Ordinary Differential Equations*, John Wiley & Sons, 1978.
5. G.F. Simmons, *Differential Equations*, Tata McGraw-Hill , 1993.
6. I.G. Petrovski, *Ordinary Differential Equations*, Prentice-Hall, 1966.
7. D. Somasundaram, *Ordinary Differential Equations, A first Course*, Narosa Pub., 2001.
8. S G. Deo, V. Lakshmikantham and V. Raghavendra, *Textbook of Ordinary Differential Equations*, Tata McGraw-Hill , 2006.

MM 15 : Programming in C (ANSI Features)

Max. Marks : 60
Time : 3 hours

Unit - I (2 Questions)

An overview of Programming, Programming Language, Classification. Basic structure of a C Program, C language preliminaries.
Operators and Expressions, Two's compliment notation. Bit - Manipulation Operators, Bitwise Assignment Operators, Memory Operators.

Unit - II (2 Questions)

Arrays and Pointers, Encryption and Decryption. Pointer Arithmetic, Passing Pointers as Function Arguments, Accessing Array Elements through Pointers, Passing Arrays as Function Arguments. Multidimensional Arrays. Arrays of Pointers, Pointers to Pointers.

Unit - III (2 Questions)

Storage Classes -Fixed vs. Automatic Duration. Scope. Global Variables Definitions and Allusions. The register Specifier. ANSI rules for the Syntax and Semantics of the Storage-Class Keywords. Dynamic Memory Allocation.

Structures and Unions. *enum* declarations. Passing Arguments to a Function, Declarations and Calls, Automatic Argument Conversions, Prototyping. Pointers to Functions.

Unit - IV (2 Questions)

The C Preprocessors, Macro Substitution. Include Facility. Conditional Compilation. Line Control.

Input and Output -Streams. Buffering. Error Handling. Opening and Closing a File. Reading and Writing Data. Selecting an I/O Method. Unbuffered I/O. Random Access. The Standard Library for I/O.

Note : The question paper will consist of **five** units. Each of the first four units will contain **two** questions from unit **I , II , III , IV** respectively and the students shall be asked to attempt **one** question from each unit. Unit five will contain **eight to**

ten short answer type questions without any internal choice covering the entire syllabus and shall be **compulsory**.

Books Recommended :

1. Peter A. Darnell and Philip E. Margolis, C : A Software Engineering Approach, Narosa Publishing House (Springer International Student Edition) 1993.
2. Samuel P. Harkison and Gly L. Steele Jr., C : A Reference Manual, Second Edition, Prentice Hall, 1984.
3. Brian W. Kernighan & Dennis M. Ritchie, The C Programme Language, Second Edition (ANSI features) , Prentice Hall 1989.
4. Balagurusamy E : Programming in ANSI C, Third Edition, Tata McGraw-Hill Publishing Co. Ltd.
5. Byron, S. Gottfried : Theory and Problems of Programming with C, Second Edition (Schaum's Outline Series), Tata McGraw-Hill Publishing Co. Ltd.
6. Venugopal K. R. and Prasad S. R.: Programming with C , Tata McGraw-Hill Publishing Co. Ltd.

<u>PRACTICALS</u> : Based on MM 15: Programming in C (ANSI Features)

Max. Marks : 40

Time 4 Hours

Notes :

a) The question paper shall consist of **four** questions and the candidate shall be required to attempt any **two** questions.

b) The candidate will first write programs in C of the questions in the answer-book and then run the same on the computer, and then add the print-outs in the answer-book. This work will consist of 20 marks, 10 marks for each question.

c) The practical file of each student will be checked and viva-voce examination based upon the practical file and the theory will be conducted by external and internal examiners jointly. This part of the practical examination shall be of 20 marks.