SCHEME OF EXAMINATION
AND
COURSE OF STUDY

IN

M.Sc. MATHEMATICS
[Under Choice Based Credit System]
(w. e. f. Session 2015-2016)

DEPARTMENT OF MATHEMATICS & STATISTICS
GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR – 249404
July 2015
# Syllabus w. e. f. Session 2015-16

Gurukula Kangri Vishwavidyalaya, Haridwar

## M.Sc. MATHEMATICS

<table>
<thead>
<tr>
<th>S.N</th>
<th>Subject Code</th>
<th>Subject Title</th>
<th>Period</th>
<th>Evaluation Scheme</th>
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### M. Sc I Year

### Semester – II

1. MMA-C201 Topology
2. MMA-C202 Probability Theory and Statistics
3. MMA-C203 Mathematical Methods
4. MMA-C204 Operations Research

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Total credit **24**

### M. Sc II Year

### Semester – III

1. MMA-C301 Functional Analysis
2. MMA-C302 Measure Theory

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Total credit **24**

### Elective Papers (Select any two)

1. MMA-E301 Programming in C++
2. MMA-E302 Graph Theory
3. MMA-E303 Number Theory
4. MMA-E304 Neural Networks

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Total credit **24**

### Semester – IV

1. MMA-C401 Numerical Analysis
2. MMA-C402 Mathematical Modeling

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Total credit **24**

### Elective Papers (Select any two)

1. MMA-E401 Fuzzy Sets and Their Applications
2. MMA-E402 Fourier Analysis & Wavelet Theory
3. MMA-E403 Fluid Dynamics
4. MMA-E404 Cryptography and Network Security
5. MMA-E405 Dissertation*

<table>
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Total credit **24**

**G Total (credit)** **96**

* Dissertation can be offered to those students securing more than 70% of marks upto IIInd semester and the availability of the requisite resources/ facility.

L = Lecture           T = Tutorial           P = Practical
CT = Cumulative Test  TA = Teacher Assessment
ESE = End Semester Examination

**Note:** Optional papers can be offered subject to availability of requisite resources/ faculty and more option can be added depending upon the availability of the staff.

[w. e. f. Session 2015-2016]
**DISTRIBUTION OF MARKS FOR DISSERTATION**

Distribution of marks for Dissertation shall be as follows:

<table>
<thead>
<tr>
<th>Dissertation</th>
<th>Report</th>
<th>Viva-voce/Presentation</th>
<th>Seminar (Internal)*</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td></td>
<td>50</td>
<td>30</td>
<td>20</td>
<td>100</td>
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</table>

Note:

1. Marks in the Dissertation shall be awarded jointly by the external and internal examiners, after viva-voce examination.
2. *There shall be a seminar on dissertation work of the candidate to be evaluated by a departmental Committee chaired by H.O.D.
MMA-C101
COMPLEX ANALYSIS

MM : 100
Time : 3 hrs
L T P
5 1 0

Sessional : 30
ESE : 70
Pass Marks : 40

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Continuity and differentiability of complex functions, Analytic and regular functions, Cauchy-Reimann equations, Necessary and sufficient conditions for a function to be analytic, some properties of conjugate functions, Construction of an analytic function, Milne Thomson’s method.

UNIT-II
Complex integration, Cauchy Goursat theorem, Cauchy’s theorem, Morera’s theorem, Cauchy’s integral formulae, Cauchy inequalities, Liouville’s theorem.

UNIT-III
Gauss mean value theorem, Maximum & minimum modulus theorems, The Argument Theorem, Rouche’s Theorem, Poisson’s integral formulae.

UNIT-IV
Power series, The circle of convergence of the power series, Taylor’s series, Laurent’s series, The zeros of an analytic function, Types of singularities, Introductory conformal mapping (Bilinear transformation).

UNIT-V
Residue at a single pole, Residue at a pole a of order greater than unity, Residue at infinity, Cauchy’s residue theorem, Evaluation of real definite integral, Integral round the unit circle.

Text /Reference Books
1. B.Churchil, Fundamental of Complex Analysis
2. T.Pati, Fundamental of Complex Variable
4. Murry R. Spiegel, Complex Analysis, Schaum’s outline
5. LV.Ahlfors, Complex Analysis, McGraw-Hill
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

UNIT-II
Boundary value problems: Wave equation, Laplace equation and Heat conduction equation, Their solutions by method of separation of variables and applications, Eigenvalues, Eigenfunctions.

UNIT-III
Ordinary and regular singular points, Power series solution, Series solution (Frobenius method) of first and second order linear equations, Legendre and Bessel Functions and their recursion formulae, Integral representation and properties.

UNIT-IV

UNIT –V

Text/Reference Books
1. G.F. Simmons, Differential equation with Applications and Historical Notes, Tata Mgraw Hill
2. W.I. Martin and E. Reissner, Elementary Differential Equations, Addison-Wesley Publishing Company
3. I. G. Petrovaski, Ordinary Differential Equations, Moscow State University publishing
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Propositional Calculus: Proposition and logical operations, Proposition and truth tables, Tautologies & contradiction, Logical equivalence, Conditional & Bi-conditional statements, Logical implication, Propositional functions & quantifiers.
Semi groups & Monoids: Definitions and examples of semi groups and monoids, Isomorphism & homomorphism of semi groups and monoids.

UNIT-II
Partially ordered set, Hasse diagram, External element of poset, Lattices as algebraic system.
Sub lattices, Isomorphic lattices, Bounded lattices, Complete, Compliment, Complemented lattices, Modular lattices, Pentagonal.

UNIT-III
Boolean algebra: Definition, Principle of duality, Basic Theorems, Sub algebra, Isomorphic, Boolean algebra as lattices, Boolean functions and min-terms, Disjunctive normal form, Complete disjunctive normal form, Conjugate normal form.

UNIT-IV
Language & Grammar and their types: Regular expressions and Regular sets, Regular language, Finite state Automata.

UNIT-V
Finite state Machine, Semi-Machines and languages, Application of Logic Circuit: Sum-of-products form for Boolean algebra, Minimal Boolean expressions, Prime implicants, Logic and Circuits, Boolean functions, Karnaugh map.

Text /Reference Books
1. B.Colman, R.C. Busby & S.Ross, Discrete Mathematical Structures (PHI),[II &III]
3. Susanna S. Epp., Discrete Mathematics with Applications (Thomson Learning TM)
MMA-C104
ABSTRACT ALGEBRA

MM : 100  Sessional : 30  
Time : 3 hrs  
ESE : 70  
L T P  
5 1 0  

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Normal subgroups, Simple groups Conjugacy, Normalization, Centre of a group, Class-equation of a group and its consequences, Theorems for finite groups, Cauchy’s theorem, Sylow’s theorem.

UNIT-II
Homomorphisms, Endomorphisms, Automorphisms, Inner automorphisms, Group of automorphisms and Inner automorphisms, Maximal subgroups, Composition series, Jordan-Holder theorem, Normal series, Solvable groups, Direct-Products.

UNIT-III
Rings, Sub-rings, Integral domain, Euclidean Rings, Ideal, Principal Ideal, Maximal and Prime ideals, Module, Sub-module, Module homomorphism, Linear sum and direct sum of sub-module.

UNIT –IV
Extension fields, Transitivity of finite extensions, Algebraic element, Algebraic field extensions, Minimal polynomials, Roots of polynomials, Multiple roots, Splitting field, Uniqueness of SF of a polynomial.

UNIT- V
Automorphism of a field, Fixed field, Group of Automorphism of a field K relative by a subfield F of K, Galois group of a Polynomial over a field, Construction with straight edge and Compass, Solvability by radicals.

Text /Reference Books
1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd.
2. J. Fraleigh, A First Course in Abstract Algebra, Pearson Education.
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Metric space, Open sets, Closed sets, Convergence, Completeness, Continuity in metric space, Cantor intersection theorem.

UNIT-II
Topological space, Elementary concept, Basis for a topology, Open and closed sets, Interior and closure of sets, Neighborhood of a point, Limits points, Boundary of a set, Subspace topology, Weak topology, Product topology, Quotient topology.

UNIT-III
Continuous maps, Continuity theorems for Open and closed sets, Homeomorphism, Connected spaces, Continuity and connectedness, Components, Totally disconnected space, Locally connected space, Compact space, Limit point compact, Sequentially compact space, Local compactness, Continuity and compactness, Tychonoff theorem.

UNIT-IV
First and second countable space, T₁ spaces, Hausdorff spaces, Regular spaces, Normal spaces, Completely normal space, Completely regular space, Tietz-Extension theorem, Metrizability, Uryshon Lemma, Uryshon metrization theorem.

UNIT-V
Fundamental group function, Homotopy of maps between topological spaces, Homotopy equivalence, Contractible and simple connected spaces, Fundamental groups of $S^1$, and $S^1 \times S^1$ etc., Calculation of fundamental groups of $S^n$, $n>1$ using Van Kampen’s theorem, Fundamental groups of a topological group.

Text /Reference Books
2. G.F. Simmons, Introduction to Topology, Mc-Graw Hill
3. J. Munkers, Topology, Prentice Hall of India
MMA-C202
PROBABILITY THEORY AND STATISTICS

MM : 100
Time : 3 hrs
L T P
Pass Marks : 40
Sessional : 30
ESE : 70

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Probability: Sample space and Events, Axioms of Probability, Conditional Probability, Baye’s theorem, Expectations, Moments.

UNIT-II
Probability Distributions: Random Variables, Distribution functions, Probability density function, Discrete Random Variable, Bernoulli’s Distribution, Binomial Distribution, Poisson distribution (their density functions, means, variance, moments up to fourth order)

UNIT-III
Continuous Distributions: Continuous random variable, Normal Distribution, Uniform & Exponential distribution, Null hypothesis, Test of hypothesis, Testing the significance of sample mean and difference between means of two samples.

UNIT-IV

UNIT-V
Curve Fitting, Simple linear regression, Assumptions, Least square estimators of parameter, Correlation, Multiple correlation.

Text /Reference Books
MMA-C203
MATHEMATICAL METHODS

MM : 100  Sessional : 30
Time : 3 hrs  ESE : 70
L T P  Pass Marks : 40
5 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Origin and classification of Integral equations, Conversion of differential equations into integral equations, Linear integral equations of the first and second kind of Fredholm and Voltra types, Solution by successive substitutions and successive approximations.

UNIT-II
Solution of equations with separable kernels. The Fredholm alternative, Holbert-Schmidt theory for symmetric kernels.

UNIT-III
Functional: Some simple variational problems, The variation of a functional, Euler’s equation, Special cases of Euler’s equation, Case of several variables, Simple variable end point problem, Variational derivative, Invariance of Euler’s equation, Fixed end point problem for n unknown functions, Variational problems in parametric form, Functional depending on higher order derivatives, Variational problems with subsidiary conditions.

UNIT-IV

UNIT-V
Z-Transform: Definition, Linearity property of Z-transform, Z-transform of elementary functions, shifting theorems, Convolution theorem, Inversion of Z-transforms, Solution of difference equation by Z-transform.

Text /Reference Books
1. F.B. Hildebrand, Methods of Applied Mathematics, Prentice Hall.
3. I.M Gelfand, & S.V. Fomin, Calculus of Variations, Prentice Hall (Unit-III)
4. N. Seddon, Integral Transforms, Schaum’s Outline Series
5. M.D.Raisinghania, Integral Equations, S. Chand
### MMA-C204
#### OPERATIONS RESEARCH

| MM : 100 | Sessional : 30 |
| Time : 3 hrs | ESE : 70 |
| L T P | Pass Marks : 40 |
| 5 1 0 |

**NOTE:** The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**UNIT-I**


**UNIT-II**

Inventory Management: Inventory control, Types of inventories, Cost associated with inventories, Factors affecting inventory control, Single item deterministic problems with and without shortages, Inventory control with price breaks, Inventory control for one period without setup cost with uncertain demands (News paper boy type problem).

**UNIT-III**

Sequencing Theory: Introduction, Processing with n-jobs and two machines, n-jobs and three machines, n-jobs and m- machines, Concept of jobs blocks.

Non-linear Programming: Convex sets and convex functions, Quadratic programming, Wolfe’s complementary pivot method and Beale’s methods.

**UNIT-IV**

Queuing Theory: Introduction, Characteristics of queuing systems, Poisson process and Exponential distribution, Classification of queues, Transient and steady states, Poisson queues (M/M/1, M/M/C).

**UNIT-V**

Game Theory: Saddle point, Graphical method for 2 x n and m x 2 games, Solution of m x n games by linear programming.

Replacement Problems: Replacement of items that deteriorate gradually and value of money does not change with time, Replacement of items that fail suddenly, Individual and group replacement policies.

### Text /Reference Books

2. P.K. Gupta, Kanti Swarup & Man Mohan, Operations Research, Sultan Chand & Co
4. S.D. Sharma, Operations Research, Kedar Nath Ram Nath
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Normed spaces, Banach space, Subspace of Banach space, Finite dimensional Normed space and subspaces, Compactness and Finite dimension, Linear operators, Bounded and Continuous linear operators. Linear functionals, Linear operators and Functional on finite dimensional spaces, Normed spaces of operators, Dual spaces.

UNIT-II
Principle of uniform boundedness, Boundedness and Continuity of linear transformations, Hahn-Banach theorem, Open mapping theorem, Closed graph theorem.

Inner product space, Schwarz and Minkowski inequalities, Orthogonal compliments and Direct sums, Hilbert spaces, Projections, Orthonormal basis, Riesz-representation theorem, Conjugate Hilbert spaces, Hilbert-Adjoint operator.

UNIT-IV
Bessels inequality, Parsaval’s identity, Self adjoint operators, Normal operators, Unitary operators, Spectral theory in finite dimensional Normed spaces, Spectral properties of bounded linear operators.

UNIT-V
Banach fixed point theorems and their iteration methods, Application to collinear and integral equations, Application to ordinary differential theorems.

Text /Reference Books
1. E Kreyszig, Introductory Functional analysis with applications, J Wiley & Sons
3. B.V. Limaye, Functional analysis, Wiley Eastern Ltd. New Delhi
4. T.Nair, Functional analysis, Prentice Hall
MMA-C302
MEASURE THEORY

MM : 100
Time : 3 hrs
L T P
5 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Equivalent sets, Finite and infinite sets, Countable and uncountable sets, Cardinality of sets, Order relation in Cardinal numbers, Order relation, Addition, Multiplication, Exponentiation of cardinal numbers, Canter like sets, Continuum hypothesis.

UNIT-II
Length of sets, Lebesgue outer measure of sets, Lebesgue measurable sets and their properties, Boolean algebra of sets, Borel field or $\sigma$-Boolean algebra, Borel sets and their measurability, Further properties of measurable sets, Characterization of measurable sets, Non-measurable sets.

UNIT-III
Measurable functions and their properties, algebra of Measurable functions, step function, Max and min functions, Positive and negative parts of a function, Characteristics function, Simple function, Continuity of a function over measurable sets, Sets of measure zero, Almost everywhere property, Egoroff’s theorem, Lusin theorem, Frechet theorem, Convergence in measure, Riesz theorem, Fundamental in measure.

UNIT-IV

UNIT-V

Text /Reference Books
1. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International, ( Relevant parts of Chapter II and Chapter II to VI only)
2. P.P. Gupta, Lebesgue Measure and Integration (chapter VIII only), Wiley Eastern, New Delhi,
3. H.L.Roydon, Real Analysis, Prentice Hall
MMA-E301
PROGRAMMING IN C++

MM : 100
Time : 3 hrs
L T P
3 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I

UNIT-II
Statements and Loops : Control Statements, Loops, Functions : Simple Functions, Passing Arguments to Functions and Returning Values from Functions, Reference Arguments, Overloaded Functions, Inline Functions, Default Arguments.

UNIT-III

UNIT-IV
Operator Overloading: Overloading of Unary and Binary Operators. Inheritance: Derived class and Base class, Derived Class Constructors, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Levels of Inheritance

UNIT-V
Pointers: Pointers with Arrays, Functions, and Objects, Memory Management, This Pointer. Files I/O : Virtual Functions, Friend Functions, Static Functions.

Text /Reference Books
2. E. Balagurusamy, Programming in ANSI C, Tata Mc-Graw Hill
NOTE: Each student shall have to perform any two programs asked by the examiner.

List of Programs in C++

1. Write a program to generate the reverse of a five digit number. Check the number to be palindrome.
2. Write a c++ program to check given number is Armstrong number or not.
3. Write a program in C++ that uses function overloading to do following tasks:
   (I) find the maximum of two integer numbers.
   (II) Find the maximum of three integer numbers.
4. Write a C++ program to generate the Fibonacci series.
5. Write a program to find the product of the two matrices A and B of order m x n.
6. Write a program to transpose a matrix.
7. Write a program, which reads records of N numbers of students in an array of objects and prints the list of students in the following format

<table>
<thead>
<tr>
<th>Lists of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
</tbody>
</table>

The structure of student’s record is given below
Name, Roll No., Marks
The grade obtained by the student is determined according to the rules given below
Marks Grade
Below 200D
200-240C
240-320B
Above320A
7. Write a C++ program to overload ‘==’ and ‘+’ operators for strings to compare and concatenate two string.
8. Use operator overloading to overload addition operator ‘+’ to advance time by h hours, m minutes and s seconds. Also overload the ‘+’ operator to add two time objects.
9. Write a program to demonstrate how the this pointer is used to access the member data of a class.
10. Write a program to performs addition of two matrix using friend function.
11. Write a program in C++ to implement hierarchical inheritance.
12. Use friend function to find the mean of the two data members of the two different objects of different classes.
13. Use static function to determine the count of number of objects created of a class.
14. Write a program to implement constructors in derived class.
15. Write a program to show implicit and explicit use of the this pointer.

NOTE:
1. Marks distribution of practical exam is as follows:
   a. Two programmes 50 marks (25 Marks for each program)
   b. Viva-voce examination 30 marks
   c. Practical record file 20 marks
2. The teacher shall be assigned maximum 20 students for daily practical work.

Addition/deletion in the above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT – I
Introduction, Finite and infinite graphs, Weighted graph, Sub-graph, Walks, Paths, Circuits, Connected and Disconnected graphs, Components, Euler graph, Unicursal graph, Operations on graphs, Hamiltonian paths and circuits, Directed graphs, Types of digraphs, Digraphs and binary relations, Directed paths and Connectedness, Euler Digraphs, Trees with directed edges.

UNIT-II
Trees, Properties of Trees, Distance and Centres in a tree, Counting trees: Counting labeled and unlabeled trees, Fundamental circuits, Spanning trees of a graph and weighted graph.

UNIT-III

UNIT-IV
Modular arithmetic and Galois Fields, Vector space associated with a graph, Incidence matrix, Submatrix of A(G), Circuit matrix, Fundamental circuit matrix and rank of B, Cut-sets matrix, Path matrix and Adjacency matrix.

UNIT-V
Chromatic number, Chromatic partitioning, Chromatic polynomial, Matchings, Coverings, Four-color problem, Five-color theorem.

Text /Reference Books
1. Nar Singh Deo, Graph Theory, PHI
2. Frank Harary, Graph Theory, Addison Wesley Longman Publishing Co.
MMA-E303
NUMBER THEORY

MM : 100
Time : 3 hrs
L T P
5 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT – I
Prime numbers, Unique factorisation theorem, Farey series, Irrational numbers, Congruence, Quadratic residues.

UNIT - II
Quadratic Reciprocity law, Primitive roots, Fermat's theorem, Wilson's theorem, Continued fractions, Approximation of irrationals by rationals.

UNIT - III
Hurwitz theorem, The fundamentals of arithmetic in K(i), K(I) P, Diophantine equations $x^2+y^2=z^2$, $x^4=y^4$, $ax^2+by^2+cz^2=0$, Quadratic fields.

UNIT - IV
The arithmetic functions (Mu, Tau, Phi and Sigma) including elementary results on their order and average order. Representation of a number by two or four squares.

UNIT - V
Warings Prob Elementary results on g (k) and G(K), The prime number theory.

Text /Reference Books
1. D.M.Burton, Elementary Number Theory, Mcgraw-Hill
2. Tailing and Nodkarni, Theory of Numbers
3. M. Coblets, Theory of Numbers
MMA-E304
NEURAL NETWORKS

MM : 100
Time : 3 hrs
ESE : 70
L T P
Pass Marks : 40
5 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Unit-I

Unit-II

Unit-III

Unit-IV

Unit-V

Text /Reference Books
2. K. Gurney, An Introduction to Neural Networks, UCL Press
UNIT – I

UNIT – II
Interpolation: Finite differences: Forward, Backward and central differences, Symbolic relations, Difference of polynomial, Newton’s formulae of interpolation. Central difference interpolation formulae: Gauss’s formula (forward and backward), Stirling’s and Bessel’s formulae. Interpolation with unevenly spaced points: Lagrange’s interpolation formula and its error, Divided differences and their properties, Newton’s general interpolation formula, Inverse interpolation, Method of successive approximations.

UNIT - III
Solution of linear simultaneous equations: Gaussian elimination method, Gauss-Jordon method, Jacobi’s method, Gauss-Seidel method,

UNIT – IV
Numerical differentiation and integration: Newton’s forward and backward difference formula for first and second order derivatives, Errors in numerical differentiation for Newton’s forward and backward difference formula, Numerical integration, Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule, Newton’s-Cotes integration formulae.

UNIT – V
Numerical solution of ordinary differential equations: Taylor’s series, Picard’s successive approximations, Euler’s, Modified Euler’s, Runge-Kutta and Milne’s Predictor-Corrector methods, Simultaneous and higher order equations: Taylor’s series method and Runge-Kutta method, Boundary value problems: Finite differences method.

Text /Reference Books
MMA-C451
NUMERICAL ANALYSIS LAB

Time : 3 hrs  ESE : 100
L  T  P
0  0  4

NOTE: Each student shall have to perform any two programs asked by the examiner.

List of Programs

Based on Theory Paper of Numerical Analysis Code No. MMA-C401

NOTE:
1. Marks distribution of practical exam is as follows:
   a. Two programmes  50 marks  (25 Marks for each program)
   b. Viva-voce examination  30 marks
   c. Practical record file  20 marks
2. The teacher shall be assigned maximum 20 students for daily practical work.
3. Addition/deletion in the above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.
UNIT-I

UNIT-II
Mathematical modeling of Epidemics: Basic concept, Simple Epidemic model through system of ordinary differential equation of first order - A simple epidemic model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration, Compartment models through system of ordinary linear equations.

UNIT-III
Economics based models: Domar Macro model, Domar first debt model, Domar’s second debt model, Samuelson’s investment model, Stability of market equilibrium. Mathematical models in Medicine, arms race and battles: A model for Diabetes Mellitus, Richardson’s Model for arms race, Lancaster’s combat Model, Microbial growth in a chemostat. Product formation due to microbial action, Mathematical modeling through difference equations: Basic theory of difference equations with constant coefficients, complimentary function, particular solution, Obtaining complimentary function by use of Matrices, Solution of linear difference equation by using Laplace and z-transform. Mathematical modeling through difference equations in Economics and Finance: The Harrod Model, the Cobweb model.

UNIT-IV
Equation of continuity in fluid flow (Euler’s and Langrange’s), Equation of continuity in Cartesian, Cylindrical and spherical polar coordinates, Equivalence between Eularian and Langrangian forms of equations of continuity, Euler’s Equation of motion.

UNIT-V

Text/Reference Books
1. F.R. Giordano, M.D. Weir and W.P. Fox, A First Course in Mathematical Modeling, Brooks Cole Publishing
2. J.N.Kapur, Mathematical Modelling, New Age Int.
3. J.N.Kapur, Mathematical models in Biology and Medicine, East-West Press
5. M.D.Raisinghania, Fluid Dynamics, S. Chand.
NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Crisp sets, Fuzzy sets (basic types), Fuzzy sets (basic concepts), Representation of fuzzy sets, Basic operations on fuzzy sets, Fuzzy convex set, $\alpha$-cuts, Additional properties of $\alpha$-cuts, Decomposition Theorems, Extensions principal for fuzzy sets and related theorems,

UNIT-II
Fuzzy Complements, Equilibrium of a fuzzy complement, Theorems on fuzzy complement, Increasing generator, Decreasing generators, Characteristic theorems for fuzzy complement (without proof), Fuzzy intersection (t-norms), Drastic intersection, Characteristic theorem for t-norms (without proof), Theorems on t-norms, Fuzzy Unions (t-conorms), Drastic union, Theorems on t-conorms, Characteristic theorem for t-conorms (without proof), Combinations of operations and related theorems.

UNIT-III
Fuzzy numbers, Linguistic variables, Arithmetic operations on fuzzy numbers, Lattice of fuzzy numbers, Fuzzy equations.

UNIT-IV
Crisp and fuzzy relations, Projections, Binary fuzzy relations, Binary relations on a single set, Fuzzy equivalence relations, Max-min composition, Transitive closure of a binary relation, Fuzzy compatibility relations, Fuzzy ordering relations, Fuzzy morphism, Sup-i compositions of binary fuzzy relations, Inf-wi compositions of fuzzy relations.

UNIT-V
Fuzzy relation equations, Fuzzy logic, Fuzzy decision making, Fuzzy linear programming, Linear Regression with fuzzy parameters, Fuzzy regression with fuzzy data.

Text /Reference Books
2. George J. Klier and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India
MMA-E402

FOURIER ANALYSIS AND WAVELET THEORY

MM : 100
Time : 3 hrs
L T P : 5 1 0
Sessional : 30
ESE : 70
Pass Marks : 40

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Trigonometric Fourier series: Periodic functions, Harmonic functions, Trigonometric polynomial and series, Orthogonality of sine and cosine systems, Fourier series of 2π-periodic functions. Orthogonal Systems: Definition and examples, Fourier series for orthogonal system, Definition of Lp-space and examples, Complete system and its important properties, Bessel’s inequality.

UNIT-II
The limit as \( n \to \infty \) of the trigonometric integrals, Formula for sum of cosine-auxiliary integral, Integral formula for partial summation Fourier series, Sufficient condition for convergence of a Fourier series at a point of Continuity and discontinuity, Absolute and uniform convergence of the Fourier series of a continuous function (Piecewise smooth function of period 2π), Integration of Fourier series, Differentiation of Fourier series. Double Fourier series: Orthogonal systems in two variables and examples, The Fourier integral as a limiting case of the Fourier series.

UNIT-III
The Fourier transform and examples, Definitions of wavelets and examples, Continuous wavelet transforms and examples, Basic properties of wavelet transforms, Parseval’s formula for wavelet transform, Inversion theorem for wavelet transform. The Discrete wavelet transforms and examples, Orthonormal wavelets and its examples.

UNIT-IV
Refinement equation and examples, Dyadic number, Definition of Multiresolution Analysis (MRA) and examples, Properties of scaling functions and orthonormal wavelets bases, Orthonormalization process, Construction of orthonormal wavelets (Some basic Examples).

UNIT-V
Daubechies wavelets (D4) and some basic examples. Definition of Harmonic wavelets, Orthogonality of Harmonic wavelets and normalization. Approximation of functions in Harmonic wavelets bases.

Text /Reference Books
2. Lokenath Debnath, Wavelet transforms and Their Applications, Birkhauser, Boston
3. K. P. Soman, Insight into Wavelets from Theory to Practice, PHIL
MMA-E403
FLUID DYNAMICS

MM : 100
Sessional : 30
Time : 3 hrs
ESE : 70
L T P
Pass Marks : 40
5 1 0

NOTE: The question paper shall consist of three sections (Sec.-A, Sec.-B and Sec.-C). Sec.-A shall contain 10 objective type questions of one mark each and student shall be required to attempt all questions. Sec.-B shall contain 10 short answer type questions of four marks each and student shall be required to attempt any five questions. Sec.-C shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Kinematics: Lagrangian and Eulerian descriptions, Continuity of mass flow, Circulation, Irrotational and rotational flows, Boundary surface.

UNIT-II
Euler's Equations: General equations of motion, Bernoulli's theorem (Compressible incompressible flows) Kelvin's Theorem (Constancy of circulation).

UNIT-III
Two Dimensional Irrotational Motion: Stream function, Complex potential, Sources, Sinks and doublets circle theorem, Method of images, Theorem of Blasius, Schwartz Christoffel transformation, Jacowski aero-foil and potential flow.

UNIT-IV
Three Dimensional Irrational Motion: Potential flow due to sources, Sinks and Doublets, Stokes stream function, Spherical harmonics and motion of a sphere.

UNIT-V
Real Fluids: Navier-Stokes equations, Dissipation of energy, Diffusion of vorticity, Steady parallel flow between two infinite parallel plates, Through a circular pipe (Hagen-Poiseuille flow), Past a sphere (Stoke's flow).

Text/Reference Books
2. L.M. Milne-Thomson, Hydrodynamics, Dover Publications
MMA-E404
CRYPTOGRAPHY AND NETWORK SECURITY

MM : 100
Time : 3 hrs
L T P
3 1 0

NOTE: Ten questions are to be set taking two questions from each unit. The student has to attempt FIVE questions in all selecting one question from each unit. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

UNIT-I
Introduction to Cryptology, Symmetric Cipher Model, Substitution Techniques, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, Transportation Techniques, Traditional Block Cipher Structure, Data Encryption Standard.

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Symmetric Key Distribution using Symmetric and Asymmetric Encryption, Distribution of Public Keys.

Text/Reference Books
1. William Stallings
2. P. Garrett
3. B. Schneier
4. T. Beth, M. Frisch, G. Simmons

An Introduction to Cryptology, Prentice Hall.
Applied Cryptography, Wiley.
Public key Cryptography, Springer-Verlag.
### MMA-E405

**DISSEPTION**

<table>
<thead>
<tr>
<th>Dissertation Report</th>
<th>Viva-voce/Presentation</th>
<th>Seminar (Internal)*</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td>50</td>
<td>30</td>
<td>20</td>
<td>100</td>
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</tbody>
</table>

**Note:**

1. Marks in the Dissertation shall be awarded jointly by the external and internal examiners, after viva-voce examination.
2. *There shall be a seminar on dissertation work of the candidate to be evaluated by a departmental Committee chaired by H.O.D.*