

11 May 2019

**Master of Science (M. Sc.)
2019-2021**



DELHI TECHNOLOGICAL UNIVERSITY

(Estd. by Govt. of NCT of Delhi vide Act 6 of 2009)

Shahbad Daulatpur, Bawana Road, Delhi-110042

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M.Sc. Program

Preamble

The University offers following M.Sc. programs in Mathematics, Physics, Chemistry and Biotechnology leading to Master degree in different disciplines. Academic curricula are so devised that a student of one discipline can take some courses of other disciplines offering choice based credit system (CBCS). Such flexibility helps a student to develop his core competence together with the interdisciplinary skills in the area of his/her interest.

Structure of two year M.Sc. program

The two year M.Sc. program comprises of courses divided in five distinct areas, namely: Departmental Core Course (DCC), Ability Enhancement Course (AEC), Skill Enhancement Course (SEC), Department Specific Elective (DSE), General Elective (GE). Credits assigned to various components of the M.Sc. curriculum are given in Table-2 and the broad structure of the program is given in Table-3.

Table-1: M.Sc Programs

S. No.	Department	Academic Program	Code
1.	Applied Mathematics	M.Sc. (Mathematics)	MA
2.	Applied Physics	M.Sc. (Physics)	PH
3.	Applied Chemistry	M.Sc. (Chemistry)	CH
4.	Biotechnology	M.Sc. (Biotechnology)	BT

Table-2: Credits of Different Curricular Components

CURRICULAR COMPONENTS		Credits
(a) Foundation Course (Common Courses)		
i.	Communication English (AEC)	4
ii.	Fundamentals of Computers (SEC)	4
	Total	8
(b) Departmental Core Courses (DCC)		
i.	Core Courses	54
ii.	Dissertation	12
	Total	66
(c) Departmental Elective Courses (DSE) / Track-I /Generic Elective (GE)		24
Grand Total		98

Table-3: Course Structure for M.Sc. Program (Maths/Physics)
 For M.Sc. (Physics) Please read Course code as MSPH 101, etc.

FIRST YEAR

First Semester				
S. No.	Subject Code	Course Title	Credits	Category
1.	MSMA 101	Core-1	4	DCC
2.	MSMA 103	Core-2	4	DCC
3.	MSMA 105	Core-3	4	DCC
4.	MSMA 107	Core-4	4	DCC
5.	MSMA 109	Core-5	4	DCC
6.	MSMA 111	Lab-I	2	DCC
		Total	22	
7.	MSHU 113*	Communicative English	4	AEC

**Non CGPA Mandatory Course*

Second Semester				
S. No.	Subject Code	Course Title	Credit	Category
1.	MSMA 102	Core-6	4	DCC
2.	MSMA 104	Core-7	4	DCC
3.	MSMA 106	Core-8	4	DCC
4.	MSMA 108	Core-9	4	DCC
5.	MSMA 110	Core-10	4	DCC
6.	MSMA 112	Lab-2	2	DCC
		Total	22	
7.	MSMA 114*	Fundamentals of Computer	4	SEC

**Non CGPA Mandatory Course*

SECOND YEAR

Third Semester				
S. No.	Subject Code	Course Title	Credit	Category
1.	MSMA 201	Core-11	4	DCC
2.	MSMA 203	Core-12	4	DCC
3.	MSMA 205	Dissertation-I	2	DCC
4.	MSMA xxx	DSE-1/Track-I	4	DSE
5.	MSXX xxx	GE-1	4	GE
6.	MSMA xxx	DSE-2	4	DSE
		Total	22	

Fourth Semester				
S. No.	Subject Code	Course Title	Credit	Category
1.	MSMA 202	Core-13	4	DCC
2.	MSMA 204	Dissertation-II	8	DCC
3.	MSMA xxx	DSE-3/Track-I	4	DSE
4.	MSXX xxx	GE-2	4	GE
5.	MSMA xxx	DSE-4	4	DSE
		Total	24	

Credits in Four Semesters

Total	Core	Generic Electives (GE)	Department Specific Electives (DSE)	Ability Enhancement Courses (AEC)	Skill Enhancement Courses (SEC)
98	66	8	16	4	4

Course Coding

A course is identified by a course code designated by a string of alphanumeric characters and a course title. In a course code, first two letters of the string indicate the Academic Program & next two letters indicate the department offering the course and the last three numbers designate particular course.

Course Number

For all the courses, the first digit corresponds to the level (year) at which a course is normally offered. The last two digits denote the number of the course, which will usually be odd for courses offered in the Odd Semester and even for courses in the Even Semester.

Teaching Engagements

Every course maintains a teaching schedule for which weekly contact hours are decided for delivering lectures (L), engaging tutorials (T) and/or performing practicals (P) to make learning in a course more effective. In the syllabi, the information regarding number of course credits and contact hours per week is denoted as: Credits (L – T – P); 4 (3 – 1–0) and options are tabulated below:

Credits	L	T	P
4	3	1	0
4	4	0	0
4	3	0	2
4	2	1	2
4	2	0	4
4	0	0	8

Weights for Course Evaluation

Evaluation in every course is based on the weights assigned to various components of the course curriculum.

S. No.	Course Type			Examination		Relative Weights				
	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1.	3	1	0	Yes	-	25	-	25	100	-
2.	4	0	0	Yes	0	25	-	25	100	-
3.	3	0	2	Yes	Yes	25	25	25	75	-
4.	2	1	2	Yes	Yes	25	25	25	75	-
5.	2	0	4	Yes	Yes	25	50	25	50	-
6.	0	0	8	-	Yes	-	50	-	-	100

In general, the relative weights assigned to different components of the entire course are as given in subsequent tables.

CWS	Class Work Sessional
MTE	Mid Term Examination
PRE	Practical Examination
PRS	Practical Sessional
ETE	End Term Examination

In addition to the above scheme

Elective Courses / Activities: These are part of Co and Extra-Curricular Activities and must opt for a minimum of 2 to 6 Credits in entire duration of the program.

The Identified MOOC's subjects or any other On-line Courses offered by the Recognized Accredited University enlisted by the University.

OR

The Approved Co and Extra-Curricular Activities as defined by the University.

Publication in category 1 or category 2 journal publication is mandatory outcome of the Track 1. In second year (i.e., III and IV Semesters) Track 1 option is by research work. Candidate will be finally evaluated at the end of

the semester IV on the basis of his/her publication (accepted or published in category 1 or 2 journals).

MASTER OF SCIENCE

Mathematics

I YEAR: First Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1	MSMA-101	Abstract Algebra	DCC	4	3	1	0	3	0	25	-	25	100	-
2	MSMA-103	Real Analysis	DCC	4	3	1	0	3	0	25	-	25	100	-
3	MSMA-105	Ordinary Differential Equations	DCC	4	3	1	0	3	0	25	-	25	100	-
4	MSMA-107	Discrete Mathematics	DCC	4	3	1	0	3	0	25	-	25	100	-
5	MSMA-109	Mathematical Statistics	DCC	4	3	0	2	3	0	25	25	25	75	-
6	MSMA-111	Programming Lab- I	DCC	2	0	0	4	0	2	-	25	-	-	50
Total				22	15	4	6							
7.	MSHU-113	Communicative English*	AEC	4	3	1	0	3	0	25		25	100	

*Non CGPA mandatory course (AEC- Ability Enhancement course).

I YEAR: Second Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1	MSMA-102	Complex Analysis	DCC	4	3	1	0	3	0	25	-	25	100	-
2	MSMA-104	Partial Differential Equations	DCC	4	3	1	0	3	0	25	-	25	100	-
3	MSMA-106	Topology	DCC	4	3	1	0	3	0	25	-	25	100	-
4	MSMA-108	Linear Algebra	DCC	4	3	1	0	3	0	25	-	25	100	-
5	MSMA-110	Numerical Analysis	DCC	4	3	0	2	3	0	25	25	25	75	-
6	MSMA-112	Programming Lab- II	DCC	2	0	0	4	-	2	-	25	-	-	50
Total				22	15	4	6							
7.	MSMA-114	Fundamentals of Computer *	SEC	4	3	0	2	3	0	25	25	25	75	

*Non CGPA mandatory course (SEC- Skill Enhancement course).

II YEAR: Third Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1	MSMA-201	Functional Analysis	DCC	4	3	1	0	3	0	25	-	25	100	-
2	MSMA-203	Operation Research	DCC	4	3	1	0	3	0	25	-	25	100	-
3	MSMA-205	Dissertation-1	DCC	2										
4	MSMA xxx	DSE-1/ Track-1	DSE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
5	MSMA xxx	DSE-2	DSE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
6	MSXX xxx	GE-1	GE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
Total				22	17	5/2	0/6							

*DSE- Department Specific Elective
GE- Generic Elective*

II YEAR: Fourth Semester

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weights (%)				
S. No	Subject Code	Course Title	Subject Area	Credit	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1	MSMA-202	Measure and Integration	DCC	4	3	1	0	3	0	25	-	25	100	-
2.	MSMA-204	Dissertation-II	DCC	8										
3.	MSMA xxx	DSE 3/Track-I	DSE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
4.	MSMA xxx	DSE 4	DSE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
5.	MSXX xxx	GE2	GE	4	3	1/0	0/2	3	0	25	0/25	25	100/75	-
Total				24	20	4/1	0/6							

List of Electives

S. No.	Course Code	Course Title	DSE Details
1.	MSMA- 207	Stochastic process	DSE 1
2.	MSMA- 209	Analysis and Design of Algorithms	
3.	MSMA-211	Number theory	
4.	MSMA-213	Mathematical Modeling and Simulation	
5.	MSMA-215	Calculus of Variation and Optimal Control	
6.	MSMA-217	Graph Theory	DSE 2
7.	MSMA-219	Database Management System	
8.	MSMA-221	Integral Transforms & Equations	
9.	MSMA-223	Cryptography and Coding Theory	
10.	MSMA-225	Classical Mechanics	DSE 3
11.	MSMA-206	Financial Mathematics	
12.	MSMA-208	Data Mining	
13.	MSMA-210	Optimization Techniques	
14.	MSMA-212	Approximation Theory	
15.	MSMA-214	General Relativity and Cosmology	DSE 4
16.	MSMA-216	Finite Element Method	
17.	MSMA-218	Machine Learning	
18.	MSMA-220	Econometrics	
19.	MSMA-222	Univalent Function Theory	
20.	MSMA-224	Fuzzy Sets and Logic	

M.Sc. Mathematics
(Syllabus: Semester I & II)

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|---------------------------------|--|
| 1. Subject Code: MSMA-101 | Course Title: ABSTRACT ALGEBRA |
| 2. Contact Hours: | L-3 T-1 P-0 |
| 3. Examination Duration (Hrs.): | Theory: 3 Hrs. Practical: 0 |
| 4. Relative Weightage: | CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0 |
| 5. Credits: | 4 |
| 6. Semester: | ODD |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | Basic knowledge of Set Theory. |
| 9. Objective: | To impart knowledge of Groups, Rings and their applications. |

10. Details of Course

S.No.	Contents	Contact Hours
1.	Groups, Subgroups, Cyclic groups, Normal subgroups, Quotient groups, Homomorphism, Kernel of Homomorphism, Isomorphism, Fundamental theorems of Homomorphism.	10
2.	Cosets, Lagrange's Theorem for finite groups, Permutation groups, Cayley's Theorem.	6
3.	Centre of a group, Conjugate class, Class Equation, Sylow's Theorems.	7
4.	Ring, Subring, Ideal, Prime and Maximal ideals, Quotient Rings, Ring Homomorphism, Isomorphism, Integral domain, Ring of Polynomials and their properties.	10
5.	Unique Factorization Domain, Unique Factorization Theorem, Principal Ideal Domain, Euclidean Domain, Irreducibility of polynomials.	9
	Total	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	I. N. Herstein, Topics in Algebra (2 nd Edition), Wiley Eastern Limited	2008
2.	Joseph A. Gallian, Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House.	1999
3.	David S. Dummit and Richard M. Foote, Abstract Algebra (3 rd Edition), John Wiley and Sons.	2011
4.	Khanna and Bhamri, A course in Abstract Algebra (5 th Edition), Vikas Publishing House.	2017
5.	N. S. Gopalakrishnan, University Algebra, New Age International Publishers	2004

1. Subject Code: MSMA-103
 2. Contact Hours:
 3. Examination Duration (Hrs.):
 4. Relative Weightage:
 5. Credits:
 6. Semester:
 7. Subject Area:
 8. Pre-requisite:
 9. Objective:
 10. Details of Course

Course Title: Real Analysis
 L-3 T-1 P-0
 Theory: 3 Hrs. Practical: 0
 CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0
 4
 ODD
 DCC
 Some knowledge of calculus
 To impart knowledge of real valued functions,
 Sequences, Metric Spaces and Riemann Integration.

S.No.	Contents	Contact Hours
1.	Review of basic concepts of real numbers, Cantor set, Archimedean Property, Completeness axiom. Sequences and series, convergence, Heine-Borel theorem.	10
3.	Metric spaces, convergence and completeness, compactness, connectedness, (with emphasis on \mathbb{R}^n).	14
4.	Continuity and uniform continuity, Differentiability, mean value theorems	8
5.	Riemann integral and its properties, characterization of Riemann integrable functions. Improper integrals. Sequences and series of functions, uniform convergence. Weierstrass approximation theorem	10
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH	1970
2.	W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill	1983
3.	Mathematical Analysis, Apostol, Narosa pub. House (2 nd Edi.).	2002
4.	K. Ross, Elementary Analysis: The Theory of Calculus, Springer Int. Edition	2004
5.	S. C. Malik, Savita Arora, Mathematical Analysis, New Age International Publisher	2017

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| 1. Subject Code: MSMA-105 | Course Title: Ordinary Differential Equations |
| 2. Contact Hours: | L-3 T-1 P-0 |
| 3. Examination Duration (Hrs.): | Theory: 3 Hrs. Practical: 0 |
| 4. Relative Weightage: | CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: -0 |
| 5. Credits: | 4 |
| 6. Semester: | ODD |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | Some knowledge of calculus and linear algebra |
| 9. Objective: | After the course, one should be able to analyze the ODE. |

10. Details of Course

S.No.	Contents	Contact Hours
1.	Review of Algebraic properties of solutions, General solution of linear equations with constant coefficients using methods of undetermined coefficients and operator method, the method of variation of parameters, Green's function for initial value problems. Existence and Uniqueness of solutions of initial value problems of first and higher order, Singular solutions, Successive Approximation and Picard's theorem.	11
2.	Ordinary and Singular points, Euler equations, Analytic functions, Power series solution, Frobenius method, Fuch's Theorem, Lagrange and Bessel functions and their properties.	8
3.	Algebraic properties of solutions of linear systems, solutions of simultaneous linear equations, the eigen values – eigen vector method of finding solution, fundamental matrix solutions.	7
4.	Strum Liouville theory, Green functions for boundary value problems, Riccati's equation.	8
5.	Phase plane, Paths and Critical Points, Stability of the critical points of non-linear system and their equivalence with the corresponding linearized system.	8
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	Martin Braun, Differential equations and their applications, 4 th edition, Springer	1993
2.	William E. Boyce, Richard C. Dippima, Elementary Differential Equations and Boundary Value Problems, 9ed.	2009
3.	John Polking, Albert Boggess, David Arnold, Differential Equations, Prentice Hall, 2nd Ed.	2017
4.	Earl A. Coddington, Robert Carlson, An introduction to ordinary differential equations, SIAM	1997
5.	S. L. Ross, Introduction to Ordinary Differential Equations, John Wiley, New York	1989
6.	D. A. Sanchez; Ordinary Differential Equations and Stability Theory : An Introduction, Dover Publ. Inc., New	1968

B. Adhikari

1. Subject Code: MSMA-107
2. Contact Hours:
3. Examination Duration (Hrs.):
4. Relative Weightage:
5. Credits:
6. Semester:
7. Subject Area:
8. Pre-requisite:
9. Objective:

Course Title: Discrete Mathematics
 L-3 T-1 P-0
 Theory: 3 Hrs. Practical: 0
 CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: -0
 4
 ODD
 DCC
 NIL

To provide knowledge of combinatorial problems, logic, lattices, Boolean algebra and graph theory.

10. Details of Course

S.No.	Contents	Contact Hours
1.	Basic concepts of set theory, operations on sets, Cartesian products, relations, equivalence relation, equivalence classes, operations on relations, partial order relation, Hasse diagram, functions, recursive functions.	8
2.	Proposition, compound propositions, well-formed formulae, truth tables, tautology, contradiction, equivalence, algebra of proposition, normal forms, theory of inference, predicate logic: predicates, quantifiers, free and bound variables, theory of inference for predicates.	8
3.	Fundamental counting principles, Principle of inclusion, exclusion and pigeonhole, Permutations, Combinations, Recurrence relations, Generating functions.	7
4.	Definition of lattice, Properties of lattices, bounded, complemented, distributive and complete lattice, Boolean Algebra: Definition, properties, Isomorphic structures (in particular, structures with binary operations) Subs algebra, Direct product and homomorphism, Boolean function, Boolean expression, Representation & minimization of Boolean function.	9
5.	Graph terminology, Bipartite graphs, Sub-graphs, Graph isomorphism, Operations on graphs, Eulerian graphs and Hamiltonian graphs, Planar graphs, Euler's formula, Graph colouring, Four colour problem and the chromatic number of a graph, Five colour theorem, traveling salesman problem, Shortest path algorithms. Tree terminology, Spanning tree, Minimal spanning trees, Depth first and breadth first searches.	10
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill	2001
2.	J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill	1993
3.	C. L. Liu, Elements of Discrete Mathematics, 2nd Edition, Tata McGraw-Hill	2000
4.	Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.	2003
5.	Narsingh Deo, Graph theory with Applications to Engineering and Computer Science, PHI	2004

1. Subject Code: MSMA-109 Course Title: Mathematical Statistics
 2. Contact Hours: L-3 T-0 P-2
 3. Examination Duration (Hrs.): Theory: 3 Hrs. Practical: 0
 4. Relative Weightage: CWS: 25 PRS: 25 MTE: 25 ETE: 75 PRE: -0
 5. Credits: 4
 6. Semester: ODD
 7. Subject Area: DCC
 8. Pre-requisite: NIL
 9. Objective: To acquire knowledge on descriptive statistics, random variables, specific probability distributions and their real life applications specifically in science and engineering. Acquaintance with the tools for the large and small sample testing. Estimation of parameters

10. Details of Course

S. No.	Contents	Contact Hours
1.	Descriptive statistics, Mathematical and statistical definitions of probability. Axiomatic approach, Conditional probability, Addition and multiplication theorems, Baye's Theorem. Discrete and continuous random variables, distribution functions. Joint, marginal and conditional distributions.	7
2.	Mathematical expectation. Addition and multiplication theorems of expectation. Properties of variance and covariance. Moment generating and characteristic functions. Chebyshev's inequality and the weak law of large numbers, Correlation and regression	8
3.	Binomial, Poisson, Negative binomial, geometric, hyper geometric and multinomial distributions. Normal, exponential, Weibul, gamma and beta distributions.	10
4.	Large sample theory. Tests of significance. Sampling of attributes and of variables. Exact sampling distributions: χ^2 , t, F and z. ANOVA for one and two-way classification	9
5.	Characteristics of estimators, Methods of estimation: maximum likelihood, minimum variance and least squares. Statistical hypothesis. MP Test and UMP Test. N-P Lemma.	8
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	Meyer, Introductory Probability and Statistical Application, Oxford and IBH Publishing.	2002
2.	Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Science Application, Wiley.	2006
3.	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press.	2009
4.	Gupta and Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons	2010

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List of Experiments (MSMA 109 Mathematical Statistics)

1. Handling of data, Transportation of data to SPSS/R, Splitting and merging of files, Missing values.
2. Pictorial representation of data.
3. Descriptive statistics and Probability Laws.
4. Random variable, Expectation, Correlation and Regression.
5. Distribution curves (Discrete and Continuous).
6. Large sample testing.
7. Chi square test.
8. t, F and z tests.
9. ANOVA.
10. Estimation of parameters.

B. Bhukar 

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|---------------------------------|--|
| 1. Subject Code: MSMA-111 | Course Title: Programming Lab I |
| 2. Contact Hours: | L-0 T-0 P-4 |
| 3. Examination Duration (Hrs.): | Theory: 0 Practical: 2 Hrs. |
| 4. Relative Weightage: | CWS: 0 PRS: 25 MTE: 0 ETE: 0 PRE: 50 |
| 5. Credits: | 2 |
| 6. Semester: | ODD |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | Basic computer knowledge |
| 9. Objective: | To introduce fundamentals of programming using C; Understanding concepts of program development. |

10. Details of Course

S. No.	Contents	Contact Hours
1.	Variables and arithmetic expressions, Data types, constants, relational and logical operators, bitwise, increment and decrement operators	3
2.	if-else, switch, break, continue, loop statements.	3
3.	Call by value arguments, return, extern variables, static variables, register variables, recursion.	5
4.	Pointers and function arguments, pointer arrays, character pointers and functions, multi-dimensional arrays, pointers to functions.	5
5.	Basics of structures, structures and functions, array of structures, pointers to structures. Union, typedef. Standard input and output.	3
6.	Classes and objects. OOPS concepts – inheritance, encapsulation, abstraction, polymorphism.	2
Total		21

Suggested Books:

S. No.	Name of books/authors/publisher	Year of publication/reprint
1.	The C Programming Language, 2 nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI, (ISBN-978 8120305960)	1988
2.	Let Us C, 13 th Edition, Yashavant Kanetkar, BPB Publications, (ISBN: 978-8183331630)	2013
3.	Mastering C, Venugopal K R, Sudeep R Prasad, Edition 1, McGraw Hill Education. (ISBN- 9780070616677)	2006
4.	Programming in ANSI C, Sixth Edition, McGraw Hill Education (India) Private Limited E Balagurusamy (ISBN: 978-1259004612)	2012
5.	Object Oriented Programming with C++, Sixth edition, E. Balagurusamy, McGraw Hill Education (India) Private Limited (ISBN:978-1259029936)	2013



List of Practicals (MSMA 111 Programming Lab D)

1. WAP that creates variables of numeric data types and perform arithmetic operations on them.
2. WAP to declare variables of string datatype and perform different operations on them.
3. Write a program to reverse a number.
4. Compute the sum of first n terms of the following series.
$$S = 1 + 1/2 + 1/3 + 1/4 + \dots$$
5. Check if the given string is palindrome or not.
6. WAP to check if a number is prime or not.
7. WAP to generate Fibonacci series using recursion and iteration.
8. WAP to swap two numbers using pointers.
9. WAP to merge two sorted arrays.
10. WAP to add two complex numbers by passing structure to a function.
11. Create a class Employee that stores employees details. Include the following member functions:
printName() and printSalary().

B. Athikari



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|---------------------------------|--|
| 1. Subject Code: MSMA-113 | Course Title: Communicative English |
| 2. Contact Hours: | L-3 T-1 P-0 |
| 3. Examination Duration (Hrs.): | Theory: 3 Hrs. Practical: 0 |
| 4. Relative Weightage: | CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0 |
| 5. Credits: | 4 |
| 6. Semester: | ODD |
| 7. Subject Area: | AEC |
| 8. Pre-requisite: | NIL |
| 9. Objective: | To enable students to develop communicative skills in English. |

10. Details of Course

S.No.	Contents	Contact Hours
1	Group Discussion; Concept, Principles, Turn-taking strategy, Dos and don'ts; Debate: Concept, characteristics, Nature of topics, Difference between Debate and Group Discussion, Do's and Don'ts.	6
2	Dialogue: Concept, Nature of topics, Difference between Dialogue and Debate; Interview: Concept; Merits of a good interview, Essentials for interviewee, Essentials for interviewers; Presentation: Concept; Characteristics of effective presentation; Target audience; Subsidiary props, Dos and don'ts.	12
3	Phonetics; Concept, Significance and relevance of phonetic proficiency, Speech Sounds and Phonetic Symbols; Organs of Speech; Active Organs, Passive Organs, Speech Mechanism; Air Stream Mechanism; Classification of Speech Sounds: Vowel Sounds, Consonant Sounds, Stress, Syllable; Description of Speech Sounds; Place of articulation, Manner of articulation, State of glottis; Phonetic Transcription of commonly used words and small sentences.	12
4	Types of writing: Descriptive, Expository, Analytical and Argumentative; Letter Writing: Sales Letters and Business Letters; Concept, structure and characteristics; Official Correspondence: Official Correspondence; Memo and Notice; Notice, Memo, Order and Circular; Format, structure and Characteristics; Report Writing: Concept, Types, Structure and Principles of Report Writing; Professional Communication: Writing of CV and Resume; Difference between CV and Resume, Importance of Cover Letter, Statement of Purpose, Newsletters; Good and Bad Newsletters, Minutes of Meeting.	12
	Total	42

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Suggested Books:

S. No.	Name of Books/Authors/Publishers	Year of Publication/ Reprint
1.	Communication Skills in English- Indira Gandhi National Open University. Young Printing Press, Delhi.	2008
2.	Sethi, J. and P.V. Dhamija. A Course in Phonetics and Spoken English. PHI Learning Private Limited, New Delhi.	2009
3.	Sharma Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning Private Limited, New Delhi.	2009
4.	Sinha, K.K. Business Communication. Galgotia Publishing Company, New Delhi.	2002
5.	Tyagi, Kavita and Padma Misra. Basic Technical Communication. PHI Learning Private Limited, New Delhi.	2011
6.	Connor, J.D. O'. Better English Pronunciation. Cambridge University Press, U.K.	2013
7.	Jones, Daniel. English Pronouncing Dictionary. Cambridge University Press, U.K.	2016

B. Alhikani

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|---------------------------------|--|
| 1. Subject Code: MSMA-102 | Course Title: Complex Analysis |
| 2. Contact Hours: | L-3 T-1 P-0 |
| 3. Examination Duration (Hrs.): | Theory: 3 Hrs. Practical: 0 |
| 4. Relative Weightage: | CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0 |
| 5. Credits: | 4 |
| 6. Semester: | EVEN |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | NIL |
| 9. Objective: | To impart knowledge Harmonic functions, Power series expansions, Entire functions, Normal families, Elliptic functions, etc. |

10. Details of Course

S.No.	Contents	Contact Hours
1.	Algebra of complex numbers, the complex plane, polynomials, power series. Transcendental functions.	6
2.	Analytic functions, Cauchy Riemann equations, Mobius transformations, conformal mappings.	8
3.	Cauchy's Integral theorem, Cauchy integral formula, Cauchy's estimate, Power series expansion for a holomorphic function, Entire functions, Liouville's theorem, Morera's theorem.	10
4.	Singularities, Laurent Series, Riemann's removable singularity theorem, Casorati-Weierstrass theorem. Residue Theorem and its applications, evaluation of standard types of integrals by the residue calculus method, Argument principle, Rouché's theorem	10
5.	Maximum modulus theorem, Open mapping theorem, zeros of analytic functions, Identity theorem, Schwartz's lemma.	8
	Total	42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	"Complex Analysis" by L.V. Ahlfors, McGraw Hill, Third Edition.	1979
2.	Functions of One Complex Variable, J.B. Conway, Springer-Verlag,	1973
3.	Churchill, R.V. and Brown, J.W., Complex Variables and Applications, Eighth edition; McGraw Hill International Edition	2009

1. Subject Code: MSMA-104
2. Contact Hours:
3. Examination Duration (Hrs.):
4. Relative Weightage:
5. Credits:
6. Semester:
7. Subject Area:
8. Pre-requisite:
9. Objective:

Course Title: Partial Differential Equations
 L-3 T-1 P-0
 Theory: 3 Hrs. Practical: 0
 CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0
 4
 EVEN
 DCC
 Some knowledge of calculus and ODE
 After the course, one should be able to solve various PDE's.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Origin of various types of PDE's and their classification, Lagrange's method for solving linear PDE of first order, Charpit's method for solving first order nonlinear PDE.	6
2	The method of characteristics for Semi linear, quasi linear and Non-linear equations, Classification of seconds order partial differential equation. Solution of homogeneous and non- homogeneous second order PDE's.	8
3.	Heat equation- solution by the method of separation of variables, Fourier series solution, Applications to one dimensional heat flow, Mean value formula, Properties of solutions.	10
4.	Laplace's equation solution by the method of separation of variables, Fourier series solution, Mean value formulas, Properties of Harmonic functions, Green's functions.	10
5.	Wave equation and its solution using separation of variables, linear advection equation, characteristic methods	8
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	An Elementary Course in Partial Diff. Equations, T. Amarnath, Narosa	2003
2.	Introduction to Partial Differential Equations, K.S. Rao, PHI	2011
3.	Partial Differential Equations: An Introduction, 2nd Edition, Walter A. Strauss, John Wiley & sons	2008
4.	Partial Differential Equations, L.C. Evans, AMS	2010
5.	Linear Partial Differential Equations for Scientists and Engineers, by Tyn Myint-U, Lokenath Debnath, Birkhäuser.	2006



1. Subject Code: MSMA-106
2. Contact Hours:
3. Examination Duration (Hrs.):
4. Relative Weightage:
5. Credits:
6. Semester:
7. Subject Area:
8. Pre-requisite:
9. Objective:

Course Title: Topology
 L-3 T-1 P-0
 Theory: 3 Hrs. Practical: 0
 CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0
 4
 EVEN
 DCC
 Basics of real analysis
 To impart knowledge of Topological Spaces,
 Connectedness, Compact Spaces, Countability
 axioms, etc

10. Details of Course

S.No.	Contents	Contact Hours
1.	Topological spaces, Basis for a topology, The order topology, The product topology on $X \times Y$, The subspace topology, Closed sets and limit points, Continuous function, The product topology.	9
2.	The metric topology, Connected spaces, Connected subspaces of the real line, Components and Local connectedness.	9
3.	Compact spaces, Compact subspaces of the real line, Limit point compactness, Local compactness.	9
4.	Countability axioms, The separation axioms, Normal spaces, Urysohn Lemma, Urysohn metrization theorem, The Tietze extension theorem.	9
5.	The Tychonoff Theorem, Stone-Cech compactification, Complete metric spaces, Compactness in metric spaces.	6
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	"Topology" by James R. Munkres, Prentice Hall of India, (Second edition), New Delhi.	2000
2.	Elements of General topology, S.T. Hu, Holden-Day Inc, San Francisco.	1964
3.	Topology, J.G. Hocking and G.S. Young, Addison-Wesley Pub. Com.	1961
4.	Introduction to Topology and Modern analysis, G.F. Simmons, McGraw Hill International Edition (1963) Singapore.	1963

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|---------------------------------|--|
| 1. Subject Code: MSMA-108 | Course Title: Linear Algebra |
| 2. Contact Hours: | L-3 T-1 P-0 |
| 3. Examination Duration (Hrs.): | Theory: 3 Hrs. Practical: 0 |
| 4. Relative Weightage: | CWS: 25 PRS: 0 MTE: 25 ETE: 100 PRE: 0 |
| 5. Credits: | 4 |
| 6. Semester: | EVEN |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | Some knowledge of Groups and Rings. |
| 9. Objective: | To impart knowledge of vector space, linear transformation, Inner product of vector spaces and their applications. |

10. Details of Course

S.No.	Contents	Contact Hours
1.	Vector Space, Subspaces, Quotient Space, linear dependence and independence, Basis and Dimension, Direct sum, Linear Transformation, Rank And Nullity of a Linear Transformation, Sylvester's Law of Nullity.	9
2.	Algebra of Linear Transformations, Hom(U,V), Dimension of Hom(U,V), Dual Space, Bidual, Matrix of a Linear Transformation, Change of Basis, Equivalent and Similar Matrices.	10
3.	Minimal Polynomials, Invertible linear Transformation, Eigen Values, Eigen Vectors, Cayley-Hamilton Theorem.	7
4.	Diagonalization, Canonical forms, Triangular forms, Jordan canonical form.	7
5.	Inner Product Space, Orthogonality, Orthonormal basis, Gram-Schmidt orthonormalization process, Unitary, Adjoint, Hermitian, Skew Hermitian, Normal Linear Operators.	9
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	Hoffman and Kunze: "Linear Algebra (2 nd Edition)", Pearson.	1971
2.	Gilbert Strang: "Introduction to Linear Algebra (5 th Edition)", Wellesley-Cambridge Press.	2016
3.	Serge Lang: "Linear Algebra (3 rd Edition)", Springer.	2004
4.	I. N. Herstein: "Topics in Algebra (2 nd Edition)", Wiley Eastern Limited	2008
5.	Khanna and Bhamri, A course in Abstract Algebra (5 th Edition), Vikas Publishing House.	2017
6.	N. S. Gopalakrishnan, University Algebra, New Age International Publishers	2004
7.	Linear Algebra (4 th Edition), Schaum's Series	2015

B. Ashwin

1. **Subject Code:** MSMA-110 **Course Title:** Numerical Analysis
 2. **Contact Hours:** L-3 T-0 P-2
 3. **Examination Duration (Hrs.):** Theory: 3 Hrs. Practical: 2 Hrs.
 4. **Relative Weightage:** CWS: 25 PRS: 25 MTE: 25 ETE: 75 PRE: 0
 5. **Credits:** 4
 6. **Semester:** EVEN
 7. **Subject Area:** DCC
 8. **Pre-requisite:** Some knowledge of calculus and linear algebra
 9. **Objective:** After the course, one should be able to solve various real-life problems computationally.

10. Details of Course

S. No.	Contents	Contact Hours
1.	Fixed point iteration, Bisection method, Newton Raphson method, secant & Regula Falsi method, Convergence analysis, determination of Multiple roots, Newton Raphson for simultaneous nonlinear equations.	7
2.	Vector and Matrix norms, ill conditioned equations, Gauss elimination method, LU decomposition, Jacobi & Gauss Seidel iterative methods and their convergence, relaxation methods.	8
3.	Jacobi method, Given's method, Householder's method, Eigenvalues and Eigenvectors of tridiagonal matrix, power method.	8
4.	Interpolation, Lagrange interpolation formula, Newton's divided difference, Splines, Least Square method.	6
5.	Taylor's series method, Difference operator, differentiation using interpolating polynomials, Finite difference methods, Newton Cotes formulas, Simpson's rule, Gauss Quadrature, Richardson's extrapolation.	7
6.	Euler's method, Modified Euler method, Runge Kutta method, multistep methods. Finite difference method, solution of nonlinear BVP.	6
Total		42

Suggested Books:

S.No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	Numerical Methods for Scientific and Engineering Computation M. K. Jain & S. R. K. Iyengar, New Age International Publishers.	2005
2.	Elementary Numerical Analysis, R. S. Gupta, Cambridge University Press	2015
3.	A first course in numerical methods, Ascher U.M.	2013
4.	Applied numerical methods for engineers & Scientist, S.S. Rao, PHI	2001

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List of Practicals for Numerical Analysis Course using MatLab (MSMA-110 Numerical Analysis)

1. Newton Raphson's method and its convergence
2. Comparison between convergence of various methods to find root of a nonlinear equation
3. Gauss Elimination and LU decomposition
4. Gauss Seidel and Gauss Jacobi
5. Finding eigen values using power method, Jacobi method
6. Lagrange and splines methods for interpolation
7. Newton cotes methods for numerical integration
8. Gauss Quadrature, Richardson's extrapolation.
9. Euler's method for IVP.
10. Runge Kutta method for IVP
11. Finite difference methods for solving BVP
12. Solving non-linear BVP

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|---------------------------------|---|
| 1. Subject Code: MSMA-112 | Course Title: Programming Lab II |
| 2. Contact Hours: | L-0 T-0 P-4 |
| 3. Examination Duration (Hrs.): | Theory: 0 Practical: 2 Hrs. |
| 4. Relative Weightage: | CWS: 0 PRS: 25 MTE: 0 ETE: 0 PRE: 50 |
| 5. Credits: | 2 |
| 6. Semester: | EVEN |
| 7. Subject Area: | DCC |
| 8. Pre-requisite: | Basic computer knowledge |
| 9. Objective: | To introduce fundamentals of programming using Python; Understanding concepts of program development. |

10. Details of Course

S. No.	Contents	Contact Hours
1.	Installing and Running Python, Introducing Different IDEs for Python like Spyder and PyCharm, Arithmetic Operators, Variables, Expressions and Statements in Python.	3
2.	Function Calls, Parameters and Arguments, Logical Operators, Conditional and Alternative Execution, Infinite Recursion and Stack Diagrams, Iterations in Python.	4
3.	Immutable Strings, String Methods and Comparison, Mutable Lists, List Operations and Methods,	2
4.	Concept of Dictionary and Looping, Reverse Lookup, Immutable Tuples, Tuples as Return Values, Variable Length Tuples.	3
5.	Concepts of Namespaces and scope. Error handling using try and except. Create your own exceptions.	3
6.	Filenames and Paths, Persistence, Reading and Writing, Catching Exceptions, Databases, Pipes	3
7.	Attributes, Mutable Objects, Classes and Functions, Pure Functions, Modifiers, Classes and Methods, Inheritance	3
Total		21

Suggested Books:



S. No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	Think Python, Allen B. Downey, O'Reilly, ISBN – 978-9352134755	2016
2.	Introduction to Computation and Programming Using Python with Application to Understanding Data, Gutttag John V., PHI, ISBN – 978-8120352926.	2016
3.	Introducing Python, Bill Lubanovic, O'Reilly. ISBN – 978-93-5110-878-8	2015

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List of Experiments (MSMA 112 PROGRAMMING II)

1. WAP that creates variables of numeric data types and perform arithmetic operations on them.
2. WAP to declare variables of string datatype and perform different operations on them.
3. WAP to create, insert and delete Lists in Python.
4. WAP to create, insert and delete Dictionaries in Python.
5. WAP to create, insert and delete Sets and Tuples in Python.
6. Write a menu driven program that performs as demonstrated below:
"Enter the numbers on which you want to perform the operation: 12 34
Select the operation from the following menu:
1. Addition
2. Subtraction
3. Multiplication
4. Division
What is your choice for operation: 1
Output = 46"
7. WAP to print Fibonacci series using for loop.
8. WAP to print all prime numbers less than 10,000 using while loop.
9. Create a function search_list which takes a list of values as arguments and search a particular number in the list.
10. WAP for division of two numbers where denominator is 0. This will throw an exception. Now handle the exception using try and except.
11. Python based small project. E.g. text based adventure games, video games, simple web applications etc.

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 BADHUKAI 

1. Subject Code: MSMA-114 Course Title: Fundamentals of Computers
 2. Contact Hours: L-3 T-0 P-4
 3. Examination Duration (Hrs.): Theory: 3 Hrs. Practical: 0
 4. Relative Weightage: CWS: 25 PRS: 25 MTE: 25 ETE: 75 PRE: 0
 5. Credits: 4
 6. Semester: EVEN
 7. Subject Area: SEC
 8. Pre-requisite: NIL
 9. Objective: To enable students to learn basic fundamentals of computers, programming and software applications.

10. Details of Course

S.No.	Contents	Contact Hours
1	Definition and Need for Operating System, Main Functions of Operating System, Popular Operating Systems like Windows and Linux, Basic Commands in Windows and Linux.	10
2	Introduction to C Programming, Variables, Constants, Type Declaration, Operators: Logical, Arithmetic and Relational, Decision Control: If-Else Statements, Loop Control: For, While and Do-While, Case Control: Switch Statements, Functions, Recursion, Arrays.	12
3	Basics of MATLAB, Mathematica and SPSS.	12
4	MS Office Skills like Word, Excel and PowerPoint, LaTeX: General Structure of LaTeX File, Images, Tables and Equations in LaTeX, Beamer Presentations.	8
Total		42

Suggested Books:

S. No.	Name of Books/Authors/Publishers	Year of Publication/Reprint
1.	P.K.Sinha, Computer Fundamentals, 6 th Edition, BPB Publications.	2003
2.	Dennis Ritchie, The C Programming Language, 2 nd Edition, Prentice Hall.	1990
3.	Joan Lambert, Microsoft Office 2016, 1 st Edition, Microsoft Press.	2015
4.	Stefan Kottwitz, LaTeX Cookbook, Packt Publishing.	2015
5.	Stormy Attaway, Matlab: A Practical Introduction to Programming and Problem Solving.	2016
6.	Stefan Wolfram, The Mathematica Book, Wolfram Media Inc.	2004
7.	Keith McCormick, SPSS Statistics for Data Analysis and Visualization, Wiley.	2017

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List of Experiments (MSMA 114 Fundamentals of Computers)

1. Write a program to find the area of geometric shapes like triangle, circle, square and rectangle.
2. Write a program to reverse a 4-digit number.
3. Write a program to find the factorial of a given number.
4. Write a program to print the Fibonacci series for a given number.
5. Write a program to generate all prime numbers up to a given number.
6. Write a program to multiply two square matrices of order 3.
7. Write a program to calculate the sum, difference, multiplication and division of digits of a 5-digit number with the help of function.
8. Write a program to find the GCD of two numbers using function.
9. Write a program to find the minimum and maximum element of an array.
10. Write a program to copy the contents of one file to another.

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B. Adhikari