

**PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR
UNIVERSITY, SOLAPUR**



Name of the Faculty: Science & Technology

New Education Policy 2020

Syllabus: Mathematics

Name of the Course: M. Sc. I (Sem.- I & II)

(Syllabus to be implemented from June २०२३)

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

Revised Syllabi of M.Sc. I in Mathematics (NEP-2020)

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

M. Sc. program in Mathematics consists of 88 credits. Credits of a course are specified against the title of the course.

M.Sc. I Mathematics Course

Sem	Course Type	Course code	No. of Credits	Course Title
I	Major Mandatory	DSC -1	4	Group and Ring Theory
		DSC- 2	4	Real Analysis
		Lab-1	2	Mathematics Practical -1
		Lab-2	2	Mathematics Practical -2
	Major Elective	DSE- 1 (Any one)	4	(A)Number Theory
				(B)Advanced Calculus
				(C)Introduction to Probability Theory
				(D)NPTEL/SWAYAM MOOC's
	Lab-3	2	Mathematics Practical -3	
Research Methodology	RM	4	Research Methodology	
II	Major Mandatory	DSC -3	4	Field Extension Theory
		DSC- 4	4	General Topology
		Lab-4	2	Mathematics Practical-4
		Lab-5	2	Mathematics Practical -5
	Major Elective	DSE- 2 (Any one)	4	(A)Complex Analysis
				(B)Classical Mechanics
				(C)Fuzzy Mathematics
				(D)NPTEL/SWAYAM MOOC's
	Lab-6	2	Mathematics Practical -6	
OJT/FP	OJT/FP	4	OJT/In-house project/ Internship/ Apprenticeship	

M.Sc. Mathematics (NEP-2020)

Course Structure M.Sc. Part-I (Mathematics) w.e.f. June 2023

M.Sc. MATHEMATICS SEMESTER-I

Paper Code	Title of the Paper	Credits	Contact hours/week			Distribution of Marks for Examination					
			Th (L)	Pr	Total	Internal		External		Total	
						Th	Pr	Th	Pr	Th	Pr
DSC-1	Group and Ring Theory	4	4	--	4	20	--	80	--	100	--
DSC-2	Real Analysis	4	4	--	4	20	--	80	--	100	--
Lab-1	Mathematics Practical -1 (Ordinary Differential Equations-I)	2	--	4	4	--	10	--	40	--	50
Lab-2	Mathematics Practical -2 (Ordinary Differential Equations-II)	2	--	4	4	--	10	--	40	--	50
DSE-1	(A)Number Theory	4	4	--	4	20	--	80	--	100	--
	(B)Advanced Calculus										
	(C)Introduction to Probability										
	(D)NPTEL/SWAYAM MOOC's										
Lab-3	Mathematics Practical -3 (Basic Latex)	2	--	4	4	--	10	--	40	--	50
RM	Research Methodology in Mathematics	4	4	--	4	20	--	80	--	100	--
Total for Semester-I		22	16	12	28	80	30	320	120	400	150

M.Sc. MATHEMATICS SEMESTER-II

Paper Code	Title of the Paper	Credits	Contact hours/week			Distribution of Marks for Examination					
			Th (L)	Pr	Total	Internal		External		Total	
						Th	Pr	Th	Pr	Th	Pr
DSC-3	Field Extension Theory	4	4	--	4	20	--	80	--	100	--
DSC-4	General Topology	4	4	--	4	20	--	80	--	100	--
Lab-4	Mathematics Practical-4 (Measure Theory-I)	2	--	4	4	--	10	--	40	--	50
Lab-5	Mathematics Practical -5 (Measure Theory-II)	2	--	4	4	--	10	--	40	--	50
DSE-2	(A)Complex Analysis	4	4	--	4	20	--	80	--	100	--
	(B)Classical Mechanics										
	(C)Fuzzy Mathematics										
	(D)NPTEL/SWAYAM MOOC's										
Lab-6	Mathematics Practical -6 (Advanced Latex)	2	--	4	4	--	10	--	40	--	50
OJT/FP	OJT/In-house project/ Internship/ Apprenticeship	4	4	--	4	20	--	80	--	100	--
Total for Semester-II		22	16	12	28	80	30	320	120	400	150

Evaluation Scheme:

Each theory paper will have 100 marks out of which 80 marks will be for Term End examination and 20 marks for Internal Assessment. The candidate has to appear for internal evaluation of 20 marks and external evaluation (University Examination) of 80 marks for each theory paper.

Each practical paper will have 50 marks out of which 40 marks will be for Term End examination and 10 marks for Internal Assessment. The candidate has to appear for internal evaluation of 10 marks and external evaluation (University Examination) of 40 marks for each practical paper.

Internal Evaluation:

- In case of theory papers internal examinations will be conducted by department / school.
- In case of practical papers 10 marks shall be for internal test, which will be conducted by the department / school.

External Evaluation (End of Term University Examination):

I) Nature of Theory question paper:

- 1) Each Theory paper is of 80 marks.
- 2) Each Theory paper will be of 3 hours duration
- 3) There shall be 7 questions each carrying 16 marks.
- 4) Students have to attempt **five questions**.
- 5) Q.No.1 is **compulsory** and shall contain 16 objective type sub-questions each carrying 1 mark.
- 6) Q.No.2 is **compulsory** and shall contain 4 short answer type sub-questions each carrying 4 marks.
- 7) Students have to attempt **any three** questions from Q. NO. 3 to Q. No. 7.
- 8) Q. NO. 3 to Q. No. 7 shall contain 2 long answer type sub-questions (10+6 or 8+8 marks)

II) Nature of Practical question paper: (End of Term Examination)

For Sem-I and II: Practical examination will be conducted for 30 marks and is of two hours duration. There shall be 05 questions each of 10 marks, of which student has to attempt any 03 questions. VIVA will be for 5 marks and 5 marks shall be for day-to-day journal.

Paper Code: DSC-1

Group and Ring Theory

Unit I: Groups (15 L)

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

Unit II: (15 L)

Zassenhaus lemma, G- sets, Conjugate classes, P- Subgroups, Sylow theorems, class equation.

Unit III: (15 L)

UFD, PID, Euclidean domain, arithmetic in Euclidean domains

Unit IV: Polynomial ring

(15 L)

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

Recommended Books:

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

Reference Books :-

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

2.Joseph A. Gallian, Contemporary Abstract Algebra, Narosa Pub.

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

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

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

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

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

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

Paper Code: DSC-2

Real Analysis

Unit I: Riemann Integration: (15 L)

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

Unit II: Riemann – Stieltjes integral: (15 L)

The fundamental theorem of Calculus, Mean Value theorem of integral Calculus, Second Mean Value theorem. Definition and existence of the integral, a condition of integrability

Unit III: Multivariable differential calculus: (15 L)

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

Unit IV :Implicit functions and Extremum problems. (15 L)

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

Recommended Books :-

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

Reference Books :-

1. Burkill and Burkill A second course Mathematical Analysis, Cambridge University Press (1970)
2. Walter Rudin, Principles of Mathematical Analysis(3rd Ed)MC Graw Hill
3. A Basic Course in Real Analysis , Ajit Kumar & S.Kumaresan, CRC press
4. Introduction to Real Analysis.Robert G.Bartle,Donald R,Sherbert, Wiley India Pvt ltd.
5. R. R. Goldberg, Methods of Real Analysis

Paper Code: Lab-1
Mathematics Practical-1
Ordinary Differential Equations-I

Unit I: Linear Equations with constant coefficients:

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

Unit II: Linear Equations with variable coefficients:

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

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Recommended Books :

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

Reference Books :

1. Theory of ordinary differential equations by E.A. Coddington and Levinson (1955) McGraw Hill, New York
2. Elementary differential equations by E.D. Rainvills (1964) The Macmillan company, New York.
3. Ordinary Differential equations by G. Birkoff and G.G.Rota John Willey and Sons.
4. Differential Equations with Applications and Historical note by G.F. Simmons (1972) MacGraw Hill, Inc. New York.
5. Ordinary Differential Equations by Somasundaram, Narosa pub.

Paper Code: Lab-2
Mathematics Practical-2
Ordinary Differential Equations-II

Unit I: Linear Equations with regular singular points:

The Euler equation, second order equations with regular singular points, second order equations with regular singular points –general case, the Bessel's equation.

Unit II: Existence and uniqueness of solutions:

The method of successive approximations, The Lipschitz condition.

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Recommended Books :

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

Reference Books :

1. Theory of ordinary differential equations by E.A. Coddington and Levinson (1955) McGraw Hill, New York
2. Elementary differential equations by E.D. Rainvills (1964) The Macmillan company, New York.
3. Ordinary Differential equations by G. Birkoff and G.G.Rota John Willey and Sons.
4. Differential Equations with Applications and Historical note by G.F. Simmons (1972) MacGraw Hill, Inc. New York.
5. Ordinary Differential Equations by Somasundaram, Narosa pub.

Paper Code: DSE-1

(A) Number Theory

Unit I:

Review of divisibility, the division algorithm, Greatest common divisor, Euclidean algorithm, Diophantine equation $ax + by = C$, Primes and their distribution, Fundamental Theorem of Arithmetic, the Goldback Conjecture. (15 L)

Unit II:

Congruences, Properties of Congruences, Linear congruences, Special divisibility tests, Fermat's theorem, Fermat's factorization method, Little theorem, Wilsons theorem. (15 L)

Unit III:

Number theoretic functions, the functions τ and σ , The Mobius Inversion formula, the greatest integer function, Eulers Generalization of Fermats theorem, Euler's phi function, Euler's theorem, properties of phi function. (15 L)

Unit IV:

Primitive roots, order of an integer modulo n , primitive roots for primes, composite numbers having primitive roots, the theory of Indices. (15 L)

Recommended book:

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

Reference Books :

1. S.B.Malik : Basic Number theory Vikas publishing House.
2. George E.Andrews : Number theory, Hindusthan Pub. Corp.(1972)
3. Nisen Zuckerman : An Introduction to theory of numbers.
4. Hari Kishan : Number Theory , Pragati edition.
5. Pundir : Number Theory, Pragati edition.

Paper Code: DSE-1

(B)Advanced Calculus

Unit I:

Limit of functions, limit theorems, Continuous functions, Combinations of Continuous functions, Continuous functions on intervals, Uniform Continuity, Monotone and Inverse functions. (15 L)

Unit II:

Sequence of functions: Point wise convergence, uniform convergence, Cauchy criterion for uniform convergence, consequence of uniform convergence, Interchange of limits. (15 L)

Unit III:

Infinite Series, Absolute convergence, grouping of series, rearrangement of series, Tests for absolute convergence: limit comparison test II, Root Test, Ratio test, Integral test, Raabe's test. (15 L)

Unit IV:

Test for non-absolute convergence: alternating series test, Dirichlet Test, Abel's test, series of functions, tests for uniform convergence, Cauchy criterion, Weierstrass M-Test. (15 L)

Recommended Books:

1. Introduction to Real Analysis, R.G.Bartle and Donald R. Sherbert, WILEY India edition, Fourth edition.

Reference Books:

1. Burkill and Burkill A second course Mathematical Analysis, Cambridge University Press
2. Walter Rudin, Principles of Mathematical Analysis(3rd Ed)MC Graw Hill
3. A Basic Course in Real Analysis , Ajit Kumar & S.Kumaresan, CRC press
4. Methods of Real Analysis, Richard R. Goldberg, Oxford & IBH Publication
5. Mathematical Analysis, 2nd ed., S. C. Malik and Savita Arora, New Age international ltd.

Paper Code: DSE-1

(C)Introduction to Probability Theory

Unit I :

Sets and classes, limit of a sequence of sets, Sample Space and Events, Axioms of Probability, Sample Spaces having Equally Likely Outcomes, Conditional Probabilities, Bayes Formula and Independent Events. (15 L)

Unit II :

Random Variables, Distribution Functions, Discrete Random Variables, Expected Value, Moment Generating Functions, Expectation of a Function of a Random Variable, Variance, Discrete distributions: uniform, binomial, geometric, negative binomial, hyper geometric, Poisson, Continuous distributions, uniform, exponential, gamma, beta, normal : Probability density function (pdf) and expectations. (15 L)

Unit III:

Joint Distribution Functions, Independent Random Variables, Sums of Independent Random Variables, Conditional Distributions: Discrete Case and Continuous Case, Joint Probability Distribution of Functions of Random Variables, Expectation of Sums of Random Variables, Covariance, Variance of Sums, and Correlations, Conditional Expectation, Joint Moment Generating Functions. (15 L)

Unit IV:

Problems on Chebyshev's and other inequalities, Modes of Convergence of random variables, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem. (15 L)

Recommended Books:

1. Sheldon Ross, A First Course in Probability, PRENTICE HALL India.
2. Vijay k. Rohatgi, a. K. Md. Ehsanes saleh, An Introduction to Probability and Statistics, second edition, Wiley series.

Reference Books:

1. Murray R. Spiegel, Schaum's Outline of Probability and Statistics.
2. J.S. Milton & J.C. Arnold, Introduction to Probability and Statistics.
3. H.J. Larson , Introduction to Probability Theory and Statistical Inference.
4. S.M. Ross , Introduction to Probability and Statistics for Engineers and Scientists.
5. P. Halmos , Measure Theory (for algebra of sets)

Paper Code : DSE-1 (D)

- **Any NPTEL/ SWAYAM MOOCs Course (Selected SWAYAM course should be on PG syllabus with prior approval from department/school)**

Paper Code: Lab-3

Mathematics Practical-3

Basic LaTeX

Unit I: Introduction to LaTeX, Installation of LaTeX, Layout Design, LaTeX input files, Understanding Latex compilation Basic Syntax, Input file structure, document classes, packages (Geometry, Hyperref, amsmath, amssymb, algorithms, algorithmic graphic, color), page styles.

Unit II: Typesetting Mathematical formulae: fractions, Integrals, sums, products, Fancy Header, tables, Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation, Writing equations, Matrix, Tables, arrays, Inline math formulas and displayed equations, Math symbols and fonts, Delimiters, matrices, arrays, Typesetting Producing Mathematical Graphics. Table of contents, index, hypertext, pdf pages, geometry, fancy header and footer, Verbatim, itemize and enumerate, boxes, equation number. Creating Tables, Inserting figures, enumeration list, itemized list, font effects, and inserting equations.

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Reference Books:

1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.
2. Learning LATEX by Doing, Andre Heck, 2002. 3
3. The Latex companion, M. Carter, B.vanBrunt, second edition, Addison wisely, Pearson Education

Paper Code: RM

Research Methodology in Mathematics

Unit I:

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India (15 L)

Unit II:

Mathematical Writing: What Is a Theorem?, Proofs, The Role of Examples, Definitions, Notation, Words versus Symbols, Displaying Equations, Parallelism, Dos and Don'ts of Mathematical Writing. Writing a Paper: Audience, Organization and Structure, Title, Author List, Date, Abstract, Key Words and Subject Classifications, the Introduction, Review of Literature, Computational Experiments, Tables, Citations, Conclusions, Acknowledgements, Appendix and Reference List. (15 L)

Unit III:

Quality indices of research publication: citations, i10 index, impact factor, H- index, science citation index, Using web for literature review: Google Scholar, Scopus, Math Sci Net., Research Journals indexed in UGC CARE, Scopus, SCI etc (15 L)

Unit IV :

Latex –Basic Typesetting of Mathematics, Typesetting Theorems, writing a research article : title, author , abstract, keywords, subject classifications, introduction, preliminaries, theorem, results, proofs, conclusion, acknowledgement, bibliography. (15 L)

Recommended Books

1. Research Methodology, Methods and Techniques by C.R.Kothari, New Age International publisher (Second revised edition)
2. Higham Nicholas J., Handbook of writing for the mathematical sciences, SIAM, 1961
3. Write Mathematics Right, L. Radhakrishna, Narosa Publication

Reference Books:

1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.
<https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf>
2. Stegmann J., How to evaluate journal impact factors, Nature, 390(6660), (1997), 550-550.
3. Kaltenborn K. F. and Kuhn K, The journal impact factor as a parameter for the evaluation of researchers and research, Revista Espanola de Enfermedades Digestivas, 96(7), (2004), 460-476.
4. Garfield E., The evolution of the Science Citation Index, International Microbiology, 10, (2007), 65-69. DOI: 10.2436/20.1501.01.10

Paper Code: DSC-3

Field Extension Theory

Unit –I (15 L)

Introduction to Extension fields, field adjunctions, Algebraic and Transcendental elements, Simple extensions, Finite extensions, Algebraic extensions, Roots of Polynomials, Multiple roots.

Unit II

Splitting field, Uniqueness of Splitting field, Separable elements, Separable extensions, Perfect field, the elements of Galois theory, Automorphism of Fields, Fixed fields.

(15 L)

Unit III

Group of Automorphisms of a field K relative to subfield F of K , Normal extension, Galois group, Fundamental theorem of Galois theory.

(15 L)

Unit IV

Finite fields and its applications, Constructible real numbers, Solvability by radicals.

(15 L)

Recommended Books :

1. Herstein I.N. : Topics in Algebra, Wiley Eastern Ltd., Second ed. 1993.
2. J.B. Fraleigh : A first course in Abstract Algebra, Narosa Pub.Co.

References :

1. P.B.Bhattacharya, S.K.Jain and S.R. Nagpaul. Basic Abstract Algebra (2nd Edition) Cambridge University, Press Indian Edition 1997.
2. M.Artin Algebra, Prentice-Hall of India 1991
3. N.Jacobson, Basic Algebra Vols I and II Freeman 1988 (Kalse Published by Firncustan Publishing Compay.)
4. S.Lang Algebra 3rd edition. Addison-Westely 1993
5. O.S. Luther and I.B.S. Passi, Algebra Vol. I-Groups. Vol. II-Rings, Narosa Publishing House (Vol 1-1996 Vol. II 1- 1999)
6. D.S.Malik & N.Mordeson and M.K.Sen, Fundametnals of Abstract Algebra, Mc. Graw Hill International Edition, 1997
7. Joseph Galian , Contemporary Abstract Algebra.

Paper Code: DSC-4

General Topology

Unit –I: (15L)

Definition and examples of topological spaces, closed sets, closure, dense sets, Neighborhood, Interior, Exterior, Boundary, accumulation points, and derived sets, Bases, sub-bases, Relative topology.

Unit –II: (15 L)

Continuous functions and homeomorphism, Compact sets and connected sets,

Unit –III: (15L)

Separation Axioms: T_0 , T_1 , T_2 , T_3 , $T_3\frac{1}{2}$, T_4 - Their characterizations and basic properties.

Unit IV: (15 L)

First and Second countable spaces, Lindeloff spaces, separable spaces, second countability and separability.

Recommended Books :-

1. Perwin W.J.: Foundations of General Topology, Academic Press (1964)

Reference Books :

1. Munkres J. R. :- Topology – A first course, prentice Hall of India (200)
2. Joshi K. D. : Introduction to General Topology – Wiley Eastern (1983)
3. Willard S : General Topology, Adisson Weseley (1970)

Paper Code: Lab-4

Mathematics Practical-4

Measure Theory-I

Unit I. Lebesgue Measure: Outer measure, G_δ set, F_σ set, Measurable sets, Lebesgue measure, non-measurable sets.

Unit II. Measurable functions: Measurable functions and their properties, Littlewood's three principles (statement only), Egoroff's theorem

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Recommended Books :

1. Royden H.L.: Real Analysis , Printice Hall of India.
2. I.K. Rana : An Introduction to Measure and Integration, Narosa (1997)

Reference Books :

1. Berberian, S.K. Measure and Integration, McMillan N.Y.1965
2. G. De. Barra, Measure and Integration

Paper Code: Lab-5

Mathematics Practical-5

Measure Theory-II

Unit I. Lebesgue Integral: Lebesgue integral of a bounded function over a set of finite measure, the Lebesgue integral of a non-negative measurable function, Fatou's Lemma, the general Lebesgue integral, convergence in measure.

Unit II. Differentiation and Integration: Differentiation of monotone functions, function of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions.

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Recommended Books :

1. Royden H.L.: Real Analysis , Printice Hall of India.
2. I.K. Rana : An Introduction to Measure and Integration, Narosa (1997)

Reference Books :

1. Berberian, S.K. Measure and Integration, McMillan N.Y.1965
2. G. De. Barra, Measure and Integration

Paper Code: DSE-2

(A)Complex Analysis

Unit I: (15 L)

Power Series, Analytic functions, Power series representation of analytic functions, Mobius transformations, Cross Ratio, Zeros of analytic function, Liouville's theorem.

Unit II: (15 L)

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

Unit III: (15 L)

Isolated singularities, characterization of isolated singularities, Laurent series expansion, Residue theorem, Evaluation of definite integrals, Argument principle, Rouché's theorem.

Unit IV: (15 L)

Maximum Modulus theorems, Schwarz's lemma, Hurwitz's theorem, Montel theorem, Riemann mapping theorem.

Recommended Books :

1. J.B. Conway -Functions of complex variable (second edition) Narosa (1980)

Reference Books :

1. L.V. Ahlfors : Complex Analysis, McGraw Hall (1979)
2. H.Silverman : Complex Variables, Hanton Mifflin (1975)
3. N.Levinson and R M.Redheffer : Complex Variables, Tata McGraw Hill (1980)
4. Remmert : Complex Function Theory, Springer Verlag
5. Dennis G.Zill , Patrik D. Shanahan : A first course in Complex Analysis, Jones and Bartlett Publishers.

Paper Code: DSE-2
(B)Classical Mechanics

Unit I : (15 L)

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

Unit II (15L)

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

Unit III (15L)

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

Unit IV (15 L)

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

Recommended Books:

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

Reference Books:

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

Paper Code: DSE-2

(C)Fuzzy Mathematics

Unit I:

Motivation. Fuzzy set as a generalization of a characteristic function of a set, Different notations describing a fuzzy set. (15L)

Unit II :

Algebra of fuzzy sets, "Venn diagrams", Level cuts, decomposition theorems, image and inverse image of a fuzzy set under a function. (15L)

Unit III:

Extension principle, Triangular norm and co-norm, their characterization theorems. (15L)

Unit IV:

Fuzzy arithmetic: Fuzzy numbers, their characterizations, their relation-ships with closed intervals of real numbers, Lattice of fuzzy numbers. (15L)

Recommended Books:

1. Klir George J. and Yuan Bo. Fuzzy Sets and Fuzzy Logic, Theory and Applications, Prentice Hall of India Pvt.Ltd, New Delhi 1997

Reference books :

1. Kaufmann A and Gupta M. M. Introduction to Fuzzy Arithmetics, Van Nostrand.
2. Ross Timothy J.,Fuzzy logic with Engineering Applications, McGraw Hill Inc. 1995
3. Lowen R., Fuzzy Set Theory, 1996
4. Zimmerman H.J.,Fuzzy Set Theory and Its Applications 1997.
5. Pedrycz, W. and Gomide F.: An introduction to Fuzzy Sets Analysis and Design. The MIT Press, Massachusetts 1998.

Paper Code: DSE-2(D)

- Any NPTEL/ SWAYAM MOOCs Course

(Selected SWAYAM course should be on PG syllabus with prior approval from department/school)

Paper Code: Lab-6

Mathematics Practical-6

Advanced Latex

Unit I : Producing Mathematical Graphics, Table of contents, generating new commands, Figure handling, Numbering, List of figures, List of tables, Generating index, Beamer class (Classes: article, book, report, beamer, slides), beamer theme, frames, slides, pause, overlay, transparent, handout stands presentation mode.

Unit II: Applications to: Writing Resume, Writing question paper, Writing articles/ research papers, Presentation using beamer.

Practical Assignments 1 to 5 on Unit I and Practical Assignments 6 to 10 on Unit II.

Reference Books:

1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.
2. Learning LATEX by Doing, Andre Heck, 2002. 3
3. The Latex companion, M. Carter, B.van Brunt, second edition, Addison wisely, Pearson Education

Equivalence of Papers of M.Sc. I SEM I

Paper Code	Old Paper	Paper Code	Equivalent paper
HCT 1.1	Algebra I	DSC-1	Group and Ring Theory
HCT 1.2	Real Analysis I	DSC-2	Real Analysis
HCT 1.3	Differential Equations	----	No Equivalence
HCT 1.4	Classical Mechanics	----	No Equivalence
SCT 1.1	Number Theory	DSE-1(A)	Number Theory

Equivalence of Papers of M.Sc.I SEM II

Paper Code	Old Paper	Paper Code	Equivalent paper
HCT 2.1	Algebra II	DSC-3	Field Extension theory
HCT 2.2	Real Analysis II	----	No Equivalence
HCT 2.3	General Topology	DSC-4	General Topology
SCT 2.1	Complex Analysis	DSE-2 (A)	Complex Analysis
OET 2.1	Fundamentals in Mathematics	--	No Equivalence