DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRAPATI SAMBHAJINAGAR-431004.

SUB- CAMPUS DHARASHIV.

NAAC Re- Accredited 'A+' Grade

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme

As Per National Education Policy-2020

SUBJECT: MATHEMATICS

(Out Come Based Credit System)

Effective from Academic Year 2023-24

DEPARTMENT OF MATHEMATICS

(Autonomous)

Dr. Babasaheb Ambedkar Marathwada University, Sub- Campus, Dharashiv.

M.Sc. Ist Year Syllabus

Head
Department of Mathematics
Dr.Babasaheb Ambedkar Marathwada
University Sub-Campus, Dharashiv.

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./University Deptt./NEP/15/2023

It is hereby inform to all concerned that, the syllabi prepared by the Departmental Committee and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Department of BAMU, Aurangabad.	Semester
1.	M.Sc.Chemistry specialization Inorganic Chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry	Ist and IInd Semester
2.	M.Sc.Statistics	Ist and IInd Semester
3.	M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Physics	Ist Semester
5.	M.Sc.Food Technology	Ist and IInd Semester
6.	M.Sc.Drug Intermediates Technology	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester
11.	M.Sc.Artificial Intelligence.	Ist to IVth Semester
12.	M.Sc.Biochemistry	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus, ★
Aurangabad-431 004. ★
REF.NO.SU/NEP/2023/ 8743-51 ★
Date:- 08.08.2023. ★
★★★★★

Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **Head of the Department, All Departments, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad.**
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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PREAMBLE

As Per the decision and directives of UGC and Government of Maharashtra (NEP-2020) the Post Graduate program in Mathematics that is 2 year/1 Year Post Graduate program is designed which will be implemented in the department of Mathematics Dr. Babasaheb Ambedkar Marathwada University ,Chhatrapati Sambhajinagar, sub-camp Dharashiv. from the academic year 2025-26. While Preparing this program the discussion with all the stake holders, resource persons and experts is taken into account. The program is aimed to develop knowledgeable and skilful human resources for local, national and international needs. The program caters the abstractness as the applicability of Mathematics to the learners.

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After Successful completion of this post graduate programme in Mathematics of 88 credits

Programme Outcomes (Pos):
The student will:

PO 1:- enter in the areas of current and advanced fields of Mathematics

PO 2:- develop analytical, scientific and critical thinking.

PO 3:-be able to apply Mathematical techniques to solve real life problems

PO 4:-be able to undertake research in mathematics and allied disciplines.

PO 5:-be employable in government, Scientific & Academic Institutions

Private sector autonomous bodies and industries.

Programme Educational Objectives (PEO):-

PEO 1:- To introduce a core and advanced branches of Mathematics

PEO 2:-To inculcate computational and numerical skills.

PEO 3:-To undertake advance research.

PEO 4:-To develop soft skills related to the subject

Programme Specific Objectives (PSO):-

PSO 1:- To understand and develop the skills in various mathematical analysis techniques.

PSO 2:-To develop mathematical modelling skill

PSO 3:- To equip students with latest mathematical software's.

PSO 4:-To develop problem solving and numerical skills.

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Two Year Post- Graduate Program
Course and Credit Distribution of Two years/PG/Master's Degree Program With Entry & Exit Option
Faculty of Science & Technology

Year/ level	Sem.	Major Subject		RM	OJT/FP	RP	Credit	Degree
		DSC Mandatory	DSE (Elective)					
First Year 6.0	I	3(4) + 2 = 14	4	4			22	PG Diploma (after 3 years Degree)
	II	3(4) + 2 = 14	4		4		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
Second year 6.5	III	3(4) + 2 = 14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4) = 12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	08			10	44	
Cum. Cr. For 2 year PG Degree		54	16	4	4	10	88	
2 Year – 4 sem. PG Degree(88 credits) after three year UG Degree or 1 year- 2 sem. PG Degree(44 Credits) after four year UG degree								
8.0			Course work Min.12 credits 3(4)		Training in teaching/ Education/ pedagogy:4	16+Ph.D. Work		Ph.D. in Mathematics

Note- DSC (Discipline Specific Core) is based on specialization in Mathematics

ABBREVIATION:

Major : Comprising Mandatory- is based on specialization

DSE : Discipline Specific Elective

OJT : On –the- Job Training

FP : Field Project (Corresponding to the Major(Core) Subject

RP : Research Project (Corresponding to the Major (Core) Subject

Intership/ Apprenticeship – (Corresponding to the Major(Core) Subject

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AS PER NEP 2020

Illustrative Credit distribution structure for Two Years P. G. Programme with Multiple Entry and Exit options

(Discipline Specific Core)

Class :- M.Sc. First Year
Semester :- I
Subject :- Mathematics

Table I: Scheme of Teaching and Examination for First Semester M.Sc. Mathematics Programme

Course Type	Course Code	Course Name	Credits			Teaching		
			Theory	Practical	Total	Theory	Practical	Total
Major	SAS475001T	Algebra	4	-	4	4	-	4
	SAS475011T	Real Analysis	4	-	4	4	-	4
	SAS475021T	Complex Analysis	4	-	4	4	-	4
Skill	SAS475031P	Latex Typesetting	-	2	2	-	4	4
Elective	Select any One							
	SBS475041T	Differential Equation	4	-	4	4	-	4
	SBS475051T	Descrete Mathematics						
	SBS475061T	Fourier Analysis						
	SBS475071T	Number Theory						
	SBS475081T	Graph Theory						
		NPTEL/SWAYAM/MOOC						
Research	SRS475091T	Research Methodology	4	-	4	4	-	4
Total			20	2	22	20	4	24

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: Algebra **Credits: 4**

Course Code: SAS475001T **Marks: 100**

Course Objective: To introduce the basic concepts of abstract algebra.

Course Outcome: The students will be able to understand the concepts of the group and ring theory.

Contents:

Unit 1: Groups, Definitions and Examples, Subgroups, Cosets and Normal Subgroups, Homomorphisms, Normalizer, Cetralizer and Class Equation, Symmetric Groups.

Unit II: Direct Products, Automorphisms, Sylow's Theorems, Applications of Sylow's Theorenis, Series of Groups, Finite Abelian Groups, Groups of Small Order.

Unit III: Rings, Definitions and Examples, Ideals and Isomorphism Theorems, Direct Product of Rings.

Unit IV: Rings of Polynomials, Field of Fractions, Prime Ideals and Maximal Ideals, Factorization in Integral Domains.

Recommended Books:

1. Algebra, VivekSahai and VikasBist (Narosa Publishing House, 2006) (Chapter 2 and 3)

Reference Books:

1. Topies in Algebra, I. N. Herstein (John Wiley & Sons, 2003)

2. Abstract Algebra, David S. Dummit and Richard M. Foote (John Wiley & Sons, 2014)

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: Real Analysis **Credits: 4**

Course Code: SAS475011T **Marks: 100**

Course Objective: The objective of this paper is to learn basics of mathematical analysis.

Course Outcome: The students will be able to Analyze existence of Riemann integral, Calculate the convergence, Recall and use convergence criteria, Solve various problems in functions of several variables.

Contents:

Unit 1: Definition and existence of Riemann-Stieltjes integral, Properties of the integral, Integration and Differentiation. The fundamental theorem of calculus, Examples.

Unit II: Integration of vector valued functions. Rectifiable curve. Examples Sequences and series of functions. Point wise and uniform convergence. Cauchy criterion for uniform convergence. Weierstrass M-test, uniform convergence and continuity, uniform convergence and Riemann-Stielljes integration. Examples.

Unit III: Uniform convergence and Differential, The Stone Weierstrass theorem, Examples. Power series, Abel's and Taylor's theorems, Uniqueness theorem for power series.Examples.

Unit IV: Functions of several variables, Linear transformations, Derivatives in an open subset of R, Chain rule, Examples.

Recommended Book:

1.Walter Rudin, Principles of Mathematical Analysis, (3rd Edition) MoGraw Hill, Kogakusha 1976.

Reference Books:

1. T. M. Apostol, mathematical Analysis, Narosa, New Delhi, 1985.

2. J. C. Burkill and H. Burkill, A second course in Mathematical Analysis, Cambridge University Press, 1970.

3. S. L. Lang. Analysis- I and II, Addison Wesley, 1969.

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: Complex Analysis **Credits: 4**

Course Code: SAS475021T **Marks: 100**

Course Objective: To get familiar with complex number system, functions of complex variables, Metric spaces, Analytic Functions and their properties.

Course Outcome: The students will be able to Handle complex numbers and functions of complex variables, Handle metric spaces and topology of complex number system, Decide analyticity of function of complex variable, find Cauchy-Riemann equations, and decide Harmonic functions and also handle Mobius transformations, Apply Cauchy's theorem and integral formula, Classify singularities and find residues.

Contents:

Unit 1: The Complex number system: The field of complex numbers, Rectangular and polar representation of complex numbers; Intrinsic function on the complex field; The Complex plane.

Power Series: Power series maps, the exponential function, other, Trigonometric and Hyperbolic functions, the Logarithmic functions.

Unit II: Metric spaces and Topology of C: Definition and examples of metric spaces; connectedness, sequence and completeness, compactness; continuity; Uniform convergence.

Unit III: Holomorphic Functions: Introduction, Cauchy-Riemann Equations, Harmonic Functions.

Bilinear transformations: Linear transformations, Bilinear transformations/ Mobius transformations

Unit IV: Complex Integration: The index of a closed curve; Cauchy's theorem and integral formula; Gaursat's Theorem; Singularities: Classification of singularities; Residues; The argument principle.

Recommended Books:

1. John B. Conway: Functions of one complex variable, Narosa Publishing House, 2002. (Chapter 1 to 5)

2. J. V. Deshpande, Complex Analysis, Tata McGraw-Hill 1989. (Chapter 2, 6 and 7)

Reference Books:

1. Herb Silverman: Complex Variables, Haughton Mifflin Company Boston, 1975.

2. Ruel V. Churchill, Complex variables and applications, MeGraw-Hill Publishing Company 1990.

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Course Type: Skill **Contact Hours: 30 (4 per week)**

Course Name: Latex Typesetting **Credits: 2**

Course Code: SAS475031P **Marks: 50**

Course Objectives: To introduce Latex Typesetting.

Course Outcome: The students will be able to Use of basic tex in mathematical typing and Develop skills in mathematical typesetting.

Contents:

Practical I: Installation of Latex

Practical II: Creating a document

Practical III: Creating Mathematical formulae

Practical IV: Creating documents with subscript, superscript & fractions

Practical V: Creating documents with Greek letters, Calligraphic letters

Practical VI: Creating documents with delimiters, multiline formula and accents.

Practical VII: Creating documents with spacing and changing style in math mode.

Practical VIII: Creating documents by defining commands and environment.

Practical IX: Creating documents with figures and tables.

Practical X: Creating bibliography and citation in documents.

Practical XI: Creating documents with document class, books, slides and letters.

Practical XII: Creating presentation using Beamer.

Recommended Book:

Laslie Lamport, Latex, a document preparation system, Pearson, 2008.

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Differential Equations **Credits: 4**

Course Code: SBS475041T **Marks: 100**

Course Objectives: To introduce the nonlinear 1" order ODE, method of approximate solutions. existence and uniqueness theorems, various systems of 1" order ODEs

Course Outcome: The students will be able to Solve first order ordinary nonlinear differential equations with initial condition by using Picard's methods of successive approximation, Handle continuation of solution. Existence of solutions for differential equations, linear system of Differential Equations, periodic, adjoint and inhomogeneous system of differential equations

Contents:

Unit I: Existence, uniqueness and Continuation of solutions: Introduction, Method of successive approximations for the initial value problem y' f (x,y), y(xg) yo, The Lipschitz condition. Peano's existence theorem, maximal and minimal solutions.

Unit II: Continuation of solutions, Existence theorems for system of differential equations: Picard-Lindelof theorem, Peano's existence theorem, Dini's derivatives, differential inequalities.

Unit III: Linear systems: Introduction, superposition principle, preliminaries and Basic results, Properties of linear homogeneous system, Theorems on existence of a fundamental system of solutions of first order linear homogeneous system, Abel-Liouville formula.

Unit IV: Adjoin system, Periodic linear system, Floquet's theorem, Inhomogeneous linear systems, applications.

Recommended Books:

1. E. A. Codington: An Introduction to Ordinary Differential Equations. Prentice-Hall international, Inc. Englewood Cliffs (1961). Chapter 6: Article 485.

2. Shair Ahmad and M. Rama Mohana Rao: Theory of Ordinary Differential Equations with Applications in Biology and Engineering, Affiliated East-West Press (1999)

3. P. Hartman: Ordinary differential Equations, 2nd edition, SIAM, (2002.)

4. W. T. Reid: Ordinary Differential Equations, John Wiley, New York, (1971).

5.E. A. Codington and N. Levinson: Theory of Ordinary Differential Equations, McGraw-Hill, New York, (1955).

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Discrete Mathematics **Credits: 4**

Course Code: SBS475051T **Marks: 100**

Course Objective: To introduce the basic concepts of logic, semi-groups, monoids, Lattice and Boolean algebra.

Course Outcome: The students will be able to understand the concepts of logic, semi-groups, monoids, Lattice and Boolean algebra.

Contents:

Unit I: Formal Logic: Statements, symbolic representation, tautologies. Semi groups andmonoids: Definitions and examples of semi groups and Monoids

Unit II: Homomorphism of semi groups and monoids, congruence relation and quotient semi groups, Sub semi groups and submonoids, direct products, basic homomorphism theorem.

Unit III: Lattices: Lattices as partially ordered sets, their properties, lattices as algebraic systems, sub lattices, direct products and homomorphism, some special lattices e.g. complete, complemented and distributive lattices.

Unit IV: Boolean algebras, Boolean algebras as lattices, various Boolean identities, the switching algebra example, sub algebra, direct product and homomorphism, join-irreducible elements

Recommended Books:

1. J. P. Tremblay and R. Manohar: Diserete Mathematical structures with Applications to Computer science, MeGraw-Hill Book Co., 1997. (Chapter 1, 3 and 4)

Reference Books:

1. Elements of Discrete Mathematics, C. L. Liu (McGraw-Hill Book Co. 2000)

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Fourier Analysis **Credits: 4**

Course Code: SBS475061T **Marks: 100**

Course Objectives: To introduce the mathematical theory and techniques of Fourier series, Fourier transform and its applications

Course Outcome: The students will be able to represent periodic functions in the form of Fourier series, apply Fourier transform technique to obtain solutions of various problems in applied mathematics, physics, engineering, etc.

Contents:

Unit 1: Fourier Series I: Definition of Periodic functions and Fourier Series, Euler's formulae, Fourier Series of functions with arbitrary periods, Even and odd functions, Half range Expansions.

Unit II: Fourier Series II: Complex form of Fourier Series, Approximation and Parseval's Identity, Fourier Series Representation Theorem, convergence of Fourier Series.

Unit III: Fourier Transform: Introduction, Fourier Integral Formulas, Definition of Fourier Transform and Examples, Basic properties of Fourier Transform.

Unit IV: Applications: Applications of Fourier Transform to Ordinary Differential Equations, Solution of Partial Differential Equations and Integral Equations.

Recommended Books:

1. Nakhle H. Asmar, Parctial Differential Equations with Fourier Series and Boundary Value Problems (2nd Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education in South Asia) (2012). ISBN: 978-81-317-8819-6.[Unit-1 & Unit-11]

2 Lokenath Debnath&Damba Bhatta, Integral Fransforms and their application (2nd Ed), Chapman & Hall/CRC (2007). [Unit-III & Unit-IV] ISBN-10:-1-58488-575-0, ISBN-13: 978-1-58488-575-7

3. George Bachman, Lawrence Narichi and Edward Beckenstein, Fourier and Wavelet Analysis, Springer, 2000. ISBN: 978-81-8128-276-7

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Number Theory **Credits: 4**

Course Code: SBS475071T **Marks: 100**

Course Objective: To introduce the basic concepts of Number Theory.

Course Outcome: The students will be able to understand the concepts of Diophantine Equation, Number theoretic functions and Cogruences.

Contents:

Unit I: Divisibility. Notation and Some Interesting Problems, Euclid's Algorithm, Theorems of Lame and Kronecker, Least Common Multiple, Linear Diophantine Equation

Unit II: Prime Numbers, Mersenneand Fermat Numbers, Some functions of Number theory, Integral Part Function, The Euler Function, The Mobius Function

Unit III: Congruences. Fermat's Theorem, System of Residues, Wilson's Theorem

Unit IV: Linear Congruence, Simultaneous Linear Congruence, Quadratic Congruence, Quadratic Residues

Recommended Books:

1. Number Theory. S G Telang(Tata MeGraw-Hill Edition, Sixth Edition, 2007) (Chapter 1,2, 5, and 6)

Reference Books:

1. An Introduction to Theory of Numbers, Ivan Niven, H. S. Zuckerman, H.I.. Montgomery (John Wiley & Sons, Inc., 1991)

2. Elementary Nunther Theory. David M. Burton (Tata McGraw-Hill Edition, Sixth Edition, 2007)

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Graph Theory **Credits: 4**

Course Code: SBS475081T **Marks: 100**

Course Objective: To introduce the basic concepts of Graph Theory.

Course Outcome: The students will be able to understand the concepts of Walk, Path, Circuit, Trees, Cutsets, Eulerian and Hamiltonian Graphs.

Contents:

Unit 1: Basic Definitions, Subgraphs and Complements, Walks, Trails, Paths, and Circuits, Connectedness and Components of Graph, Operations on Graphs, Special Graphs.

Unit II: Cut-Vertices, and Separable Graphs, Isomorphisms and 2-Isomorphisms, Trees, Spanning Trees and Cospanning Trees, k-Trees, Spanning k-Trees and Forests, Rank and Nullity.

Unit III: Fundamental Circuits, Cutsets, Cuts, Fundamental Cutsets, Spanning Trees, Circuits and Cutsets, Eulerian Graphs, Hamiltonian Graphs.

Unit IV: Matrices of Graph, Incidece Matrix, Cut Matrix, Circuit Matrix, Orthogonality Relation, Sumatrices of Cut, Incidence and Circuit Matrices, Unimodular Matrices, Adjacency Matrix

Recommended Books:

1. Graphs: Theory and Algorithms, K. Thulastraman and M. N. S. Swamy (John Wiley & Sons, Inc., 1991, 2014) (Chapter 1, 2, 3 and 6)

Reference Books:

1. Introduction to Graph Theory, Douglas B. West (Prentice-Hall, Inc., 2001)

2. Introduction to Graph Theory, Richard J. Trudeau (Dover Publications, Inc. New York, 1993)

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Course Type: Research **Contact Hours: 60 (4 per week)**

Course Name: Research Methodology **Credits: 4**

Course Code: SRS475091T **Marks: 100**

Course Objective: To introduce the Research Methodology.

Course Outcome: The students will be able to Analyze qualitative and quantitative data, Develop Skills in mathematical writing, Identifying Research tools used in research.

Contents:

Unit 1: Objective Motivation, Types of Research, Significance of research, Research Methods, Methodology, Scientific methods.

Unit II: Quantitative Data Analysis, Defining Data, Data Coding, Interpretation and evaluating the data, Qualitative Data Analysis, Analyzing data, computer aided evaluation.

Unit III: Mathematical Sentences, Describing Functions, Forms of argument, Induction, Existence and definitions

Unit IV: Research Tools: Scopus, Science direct, Springer link, ZMATH, Mathscinet, Web of science, ORCID, Jstor, Google scholar, Impact factor, h-index, i10 index, Research Gate, and arXiv.

References Books:

1. C.R Kothari, Research Methodology: Methods and Techniques, New age International Publishers, 2004

2. B. J. Oates. Researching Information Systems and Computing, Sage Publications, 2007

3. F. Vivaldi, Mathematical Writing, Springer, 2014

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Class :- M.Sc. First Year
Semester :- II
Subject :- Mathematics

Table II: Scheme of Teaching and Examination for Second Semester M.Sc. Mathematics Programme

Course Type	Course Code	Course Name	Credits			Teaching		
			Theory	Practical	Total	Theory	Practical	Total
Major	SAS475502T	Linear Algebra	4	-	4	4	-	4
	SAS475512T	General Toplogy	4	-	4	4	-	4
	SAS475522T	Measure And Integration	4	-	4	4	-	4
Skill	SAS475532P	MATLAB Programming	-	2	2	-	4	4
Elective	**Select any One**							
	SBS475542T	Advanced Differential Equation	4	-	4	4	-	4
	SBS475552T	Advanced Descrete Mathematics						
	SBS475562T	Integral Transform						
	SBS475572T	Advanced Complex Analysis						
	SBS475582T	Advanced Graph Theory						
		NPTEL/SWAYAM/MOOC						
Research	SMS475592P	On Job Training/ Field Project	4	-	4	4	-	4
Total			20	2	22	20	4	24

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: Linear Algebra **Credits: 4**

Course Code: SAS475502T **Marks: 100**

Course Objective: To introduce the basic concepts of linear algebra.

Course Outcome: The students will be able to understand the concepts of Vector Spaces, Linear Transformations and Canonical Forms.

Contents:

Unit 1: Abstract Vector Spaces, Introduction, Definitions and Examples, Subspaces, Homomorphisms and Isomorphisms, Linear Dependence and Independence, Inner Product Spaces

Unit II: Linear Transformations, Introduction, Definitions, Examples, and Preliminary Results, Products of Linear Transformations, Linear Transformations as Matrices

Unit III:, Hermitian Ideas, Quotient Spaces, Invariant Subspaces, Linear Transformations from one space to another.

Unit IV: The Jordan Canonical Form, Introduction, Generalized Nullspaces, The Jordan Canonical Form, Exponentials, Solving Homogeneous Systems of Linear Differential Equations.

Recommended Books:

1. Matrix Theory and Linear Algebra, I. N. Herstein and David J. Winter (Macmillan Publishing Company, New York, 1989) (Chapter 8, 9 and 10)

Reference Books:

1. Topics in Algebra. 1. N. Herstein (John Wiley & Sons, 2003)

2. Linear Algebra, Vivek Sahai and Vikas Bist (Narosa Publishing House, Forth Ed, 2017)

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: General Topology **Credits: 4**

Course Code: SAS475512T **Marks: 100**

Course Objective: To introduce the concepts of general topology.

Course Outcome: The students will be able to apply the concepts like open sets, closed sets, continuous functions, Hausdorffness, regularity, normality, compactness and connectedness in abstract analysis.

Contents:

Unit 1: Topological spaces, Basis for a topology, The order topology, The product topology on XXY, The subspace topology, closed sets and limit points, Continuous functions, The product topology, The metric topology, The quotient topology

Unit II: Corineered spaces. Connected subspaces of the real line, Components and local connectedness. Compact spaces, Compact subspace of the real line, Limit point compactness, Local compactness

Unit III: The countability axioms, The separation axioms, Normal spaces, The Urysohn lemma

Unit IV: Complete inetric spaces, Compactness in metric spaces, Baire spaces

Recommended Books:

1. Topology, James R. Munkres (PHI Learning Private Limited, 2011) (Chapters 2, 3, 4, & and 8)

Reference Books:

1. General Topology. Stephen Willard (Addison-Wesley Publishing Company, 1970)

2.Introduction to topology and modern analysis, G. F. Simmons (Tata McGraw-Hill Edition 2004)

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Course Type: Major **Contact Hours: 60 (4 per week)**

Course Name: Measure and Integration **Credits: 4**

Course Code: SAS475522T **Marks: 100**

Course Objective: To introduce the Measure theory, Lebesgue Integral and Mathematical inequalities.

Course Outcome: The students will be able to apply basic facts from Riemann Integration theory and explains length and measurer as a set, Calculate integration of simple functions of real variable and integration of series, Calculate differentiation and integration

Contents:

Unit 1: Measure on the real line. Lebesgue outer measure, measurable sets. Regularity. Measurable functions. Horal and Lebegue measurability Examples.

Unit II: Integration of functions of a Real variable. Integration of a simple function. Integration of non-negative functions. The general integral. Integration of series. Examples.

Unit III: Riemann and Lebesgue Integrals, Differentiation. The four derivative, Functions of bounded variations. Lebesgue's differentiation theorem, Examples.

Unit IV: Abstract Measure spaces. Measures and outer measures Extension of a measure. Uniqueness of the extension.Completion of a measure spaces. Integration with respective to a measure. Examples.

Recommended Books:

1. G. de Barra. Measure Theory and Integration. Wiley Eastern Ltd. 1981. Reprint 2003.

Reference Books:

1. P. K. Jain and P. V. Gupta, Lebesgue Measure and Integration, New Age International (P) Ltd. Publication New Delhi. 1986 (Reprint 2000)

2. P. R. Halmos, Measure Theory, Von No strand, Princeton 1950

3. R. G. Bartle, The elements of Integration, John Wiley, New York 1966.

4. L. K Rana, An Introduction to measure and Integration, Narosa, Delhi 1997.

Head
Department of Mathematics
Dr.Babasaheb Ambedkar Marathwada
University Sub-Campus, Dharashiv.

Course Type: Major **Contact Hours: 30 (4 per week)**

Course Name: MATLAB Programming **Credits: 2**

Course Code: SAS475532P **Marks: 50**

Course Objective: To introduce the MATLAB programming language to solve numerical problems

Course Outcome: The students will be able to writing of script and function, Writing Input output functions in MATLAB language, Use of looping statements in MATLAB language

Contents:

1. **Practical I:**Script file for drawing a circle of unit radius.
2. **Practical II:**Program for solving simultaneous equations.
3. **Practical III:**Function for finding factorial of a given number.
4. **Practical IV:** Program for finding eigen values and eigen vectors.
5. **Practical V:**Program for finding 4th term in Fibonacci sequences.
6. **Practical VI:**Program for finding solution using Guass elimination method.
7. **Practical VII:**Program for LU,QR,CHolesky and SVD factorization
8. **Practical VIII:** Program for interpolation.
9. **Practical IX:** Program for numerical integration.
10. **Practical X:** Program for solution of ODE.

Recommended Books:

1. Getting Started with MATLAB 7, Rudra Pratap. OXFORD Press.

2. Brain D. Hahn Dan: essential MATLAB for engineers and Scientists, 3rd Edition Valentine. Gunnar Backstrom: practical Mathematics Using Matlab.

3. Applied Numerical Methods Using MATLAB, Won Young Yang, Tae-Sang chung, John Morris, A John Wiley and Sons. Inc. Publication.

4. Solving ODE's with Maltab, L.F. Shampine, 1 Gladwell, S. Thompson, Cambridge University Press.

Head
Department of Mathematics
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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Advanced Differential Equation **Credits: 2**

Course Code: SBS475542T **Marks: 50**

Course Objective: To introduce the concepts of general 2nd order ODE, some transformations and the methods of solutions, some oscillatory properties of solutions of differential equations, Sturm-Liouville boundary value problems

Course Outcome: The students will be able to Transform second order O.D.E. in to another form, Use comparison theorem for the determination of zeros of solutions, Handle number of zeros of solution of differential equation and oscillatory and non-oscillatory differential equations, Solve Sturm-Liouville boundary value problem and find corresponding eigen values and eigen functions

Contents:

Unit I: Preliminaries, transformations, Lagrange Identity, Green's formula, Riccati equations, Prufer Transformation, variation of constants, method of reduction of order

Unit II: Theorems of strum: Sturm's first comparison theorem, Sturm's separation theorem.

Unit III: Number of zeros, Non oscillatory equations, Nonoscillation theorems.

Unit IV: Sturm-Liouville boundary Value Problems: definition, eigenvalues, eigenfunctions, orthogonality.

Recommended Books:

1. Philip Hartman: Ordinary differential Equations, 2nd Edition SIAM, 2002.

2. W. T. Reid: ordinary differential Equations, John Wiley N.Y. (1971).

3. E. A. Coddington and N. Levinson: Theory of Ordinary differential Equation, McGraw-Hill, New York. (1955).

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Advanced Discrete Mathematics **Credits: 4**

Course Code: SBS475552T **Marks: 100**

Course Objective: To introduce the basic concepts of logic, semi-groups, monoids, Lattice and Boolean algebra.

Course Outcome: The students will be able to understand the concepts of logic, semi-groups, monoids, Lattice and Boolean algebra.

Contents:

Unit 1: Definition of (undirected) graph, paths, circuits, cycles and subgraphs, degree of a vertex connectivity, planar graphs and their properties.

Unit II: Trees, rulers formula for connected planar graphs. Complete graphs, Kuratowski's theorem (statement only) spanning trees, cut sets, fundamental cut-sets and cycles, minimal spanning trees and Kruskal's (statement only) algorithm, matrix representation of graphs,

Unit III: Euler's theorem on the existence of Eulerian paths and circuits, directed graphs, in degree and out degree of a vertex, weighted undirected graphs, strong connectivity, directed trees, search trees,

Unit IV: Introductory computability theory: Finite state machines and their transition table diagrams, equivalence of finite state machines, reduced machines, homomorphism, finite automata, acceptors, no-deterministic finite automata.

Recommended Books:

1. J. P. Tremblay and R. Manohar: Discrete Mathematical structures with Applications to Computer science, McGraw-Hill Book Co., 1997. (Chapter 5 and 6)

Reference Books:

1. Elements of Discrete Mathematics, C. L. Liu (MeGraw-Hill Book Co. 2000)

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Course Type: Elective | **Contact Hours: 60 (4 per week)**

Course Name: Integral Transforms | **Credits: 4**

Course Code: SBS475562T | **Marks: 100**

Course Objective: To introduce the operational transform techniques, the latest mathematical technique of wavelet analysis.

Course Outcome: The students will be able to use the operational transform techniques to solve certain problems in physical, engineering, chemical, biological and social sciences, handel analysis and synthesis of functions in wavelet system and constructcertain wavelet systems, solve certain discrete differential equations.

Contents:

Unit I: Hankel Transform:- Introduction, definitions and basic properties of Gamma function, Beta function, Bessel differential equation. Definition and elementary properties of the Hankel transforms, operational properties of Hankel transforms, Applications of Hankel transforms in the solution of partial differential equations.

Unit II: The Mellin Transform:- Definition and Elementary properties of the Mellin transform. Mellin transforms of derivatives and integrals, Convolution theorems for the Mellin transforin. Applications.

Unit III: Continuous time-frequency representation of signals, Definition of Windowed Fourier Transform (WFT or STFT), Continuous Wavelet Transform, admissibility condition, Fourier transform of wavelet transform, Parseval's relation and inversion theorem, Properties wavelet transform.

Unit IV: Z-Transform: Definition of Z-transform, Inversion of the Z-transform, Application to the Solutions of finite difference equations.

Recommended Books:-

1. Lokenath Debnath & Damba Bhatta, Integral Fransforms and their application (2nd Ed), Chapman & Hall/CRC (2007), ISBN-10:-1-58488-575-0, ISBN-13: 978-1-58488-575-7

2. 1. N. Sneddon, The use of integral transforms, Tata Me Graw Hill Publishing Company Ltd.

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Advanced Complex Analysis **Credits: 4**

Course Code: SBS475572T Marks: 100

Course Objective: To become familiar with the spaces of analytic functions, Entire functions and their properties.

Course Outcome: The students will be able to Handle compactness and convergence in the space of Analytic functions, Compare Harmonic and Analytic functions, Distinguish Differentiable, Analytic and Entire functions, Deal with univalent functions through class S, Class T functions

Contents:

Unit I: Compactness and convergence in the space of Analytic functions: Spaces of analytic functions; The Weierstrass factorization theorem; factorization of the sine function; The gamma function and The Riemann zeta function.

Unit II: Harmonic functions: Basic properties of Harmonic functions; Harmonic functions on a dick; and comparison with analytic function: Poisson integral formula and positive harmonic functions.

Unit III: Entire functions: Jensen's formula; The Poisson-Jenson formula; The genus and order of an entire function and Hadamard factorization Theorem.

Unit-IV: Univalent functions: the class S; the class T; Bieberbach conjucture and sub class of S.

Recommended Books:

1. John B. Conway: Functions of one complex variable, Narosa Publishing House, 1980. (Chapter 7, 8 & 9)

2. Herb Silverman: Complex Variables Houghton Mifflin Company Boston 1975. (Chapter 10 & 12)

Reference Books:

1. J. V. Deshpande; Complex Analysis, Tata MeGraw-Hill 1989.

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Course Type: Elective **Contact Hours: 60 (4 per week)**

Course Name: Advanced Graph Theory **Credits: 4**

Course Code: SBS475582T **Marks: 100**

Course Objective: To introduce the basic concepts of Graph Theory.

Course Outcome: The students will be able to understand the concepts of Graphs and Vector Spaces, Directed Graphs and Planar graphs.

Contents:

Unit I: Graphs and Vector Spaces, Groups and Fields, Vector Spaces, Vector Space of a Graph. Dimensions of Circuit and Cutset Subspaces, Relationship between Circuit and Cutset Subspaces, Orthogonality of Circuit and Cutset Subspaces.

Unit II: Directed Graphs, Basic Definitions and Concepts, Graphs and Relations, Directed Trees, Directed Eulerian Graphs, Directed Spnning Trees, Directed Euler Trails. Directed.Hamiltonian Graphs

Unit III: Planar Graphs, Euler's Formula, Kuratowski's Theorem and other Characterizations of Planarity, Dual Graphs, Planarity and Duality.

Unit IV: Connectivity or Vertex Connectivity, Edge Connectivity, Graphs with Prescribed Degrees, Menger's Theorem, Matchings, Matchings in Bipartite Graphs, Matchings in General Graphs.

Recommended Books:

1. Graphs: Theory and Algorithms, K. Thulasiraman and M. N. S. Swamy (John Wiley & Sons, Inc., 1991, 2014) (Chapter 4, 5, 7 and 8)

Reference Books:

1. Introduction to Graph Theory, Douglas B. West (Prentice-Hall, Inc., 2001)

2.Introduction to Graph Theory, Richard J. Trudeau (Dover Publications, Inc. New York, 1993)

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Course Type: Research **Contact Hours: 60 (4 per week)**

Course Name: On Job Training/Field Project **Credits: 4**

Course Code: SMS475592T **Marks: 100**

Course Objective: To enhance the communication skills, soft skills, leadership qualities, reseatch skills for career in industry and academies.

Course Outcome: The students will learn independently as well as team, leadership qualities, acquire relevant knowledge for professional career.

Contents: Industry Visit. Seminars, Group Discussions, Quiz Competitions, Role Play, Debate Competitions, Poster Presentation Competition, Celebration of Pi Day, National Mathematics Day, Science Day, etc.

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