

Progressive Education Society's
Modern College of Arts, Science and Commerce
(Autonomous), Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of

Syllabus For

B.Sc. (Mathematics)

(Based on NEP 2020 framework)

(To be implemented from the Academic Year 2023-24)

Eligibility

As per the eligibility circular of SPPU

Credit System :

As per the GR No. एनईपी-2022/प्र.क्र.09/विशी -3/शिकाना dated : 20 April 2023

Credit Framework

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree-Honours Or Bachelor's Degree-Honours with Research	160	176	8	4

Pattern of examination :

Continuous Internal Examination :

10 M : Field work / Practical

30 M : Online Objective examination / Practical

End Semester Examination : 60 M descriptive Examination

End Semester Examination Question Paper Pattern :

Mode : Descriptive

Total Marks : 60

Total questions : 5 : 12 Mark each

Each question contains either 3 or 4 marks questions with maximum 2 option questions

Standard of passing

< 40 % marks : Fail

Separate passing for Internal and External examination.

CIE passing : 16 marks and above

ESE passing : 24 marks and above

ATKT rules

FY to SY progression : 70 % credits should be completed

SY to TY progression : 50 credits should be completed

Award of Class :

"O" : Outstanding : Grade point 10 : % 80-100

"A+" : Excellent : Grade point 9 : % 70-79

"A" : Very Good : Grade point 8 : % 60-69

"B+" : Good : Grade point 7 : % 55-59

"B" : Above Average : 6 : % 50-54

"C" : Average : Grade point 5 : % 45-49

"P" : Pass : Grade point 4 : %40-44

"F" : Fail : Grade point 0 : % 0-39

"Ab" : Absent : Grade Point 0

Scoring :

CIE Score	ESE Score	Result
<40%	< 40%	Fail
<40 %	>=40%	Fail
>=40%	<40 %	Fail
>=40%	>=40%	Pass

Semester 1 (First Year) Level 4.5

Course Type	Course	Course Code	Course / Paper Title	Hours / Week	Credit	CI A	ESE	Total
Major Mandatory (4 + 2)	Major Paper 1 (Theory)	23ScMatU1101	Algebra	2	4	40	60	100
	Major Paper 2 (Practical)	23ScMatU1102	Lab course on 23ScMat1101	4	2	20	30	50
Major Electives	-							
Minor	-							
OE (2 + 2)	Theory	23ScMatU1401	Fundamentals of Mathematics	2	4	40	60	100
		23CoCopU1402	Democracy, Election and Governance	2				
VSC (2)	Major Specific Practical I	23ScMatU1501	Lab Course on Logic	4	2	20	30	50
SEC (2)	Skill Paper 1 (Practical)	23ScMatU1601	Lab Course on Analytical Geometry	4	2	20	30	50
AEC(2),	MIL	23CpCopU1701 / 23CpCopU1702	MIL-I (Hindi) / MIL-I (Marathi)	2	2	20	30	50
VEC (2)	EVS Theory	23CoCopU1801	Environment Science I	2	2	20	30	50
IKS (2)	Major Specific Theory	23ScMatU1901	Ancient Indian Mathematics	2	2	20	30	50
CC (2)	CC-I Course	23CoCopU1001	Online Course Based on Yoga	2	2	20	30	50
Total				28	22	220	330	550

Semester 2 (First Year) Level 4.5

Course Type	Course	Course Code	Course / Paper Title	Hours /Week	Credit	CIA	ES E	Total
Major Mandatory (4 + 2)	Major Paper 3 (Theory)	23ScMatU2101	Calculus	2	4	40	60	100
	Major Paper 4 (Practical)	23ScMatU2102	Lab Course on 23ScMat2101	4	2	20	30	50
Major Electives	-							
Minor	Minor Paper I (Practical)	23ScMatU2201	Lab Course on Linear Algebra	4	2	20	30	50
OE (2 + 2)	Theory	23ScMatU2401	Business Mathematics	2	4	40	60	100
		23CoCopU2402	Fundamentals of Music	2				
VSC (2)	Major Specific Practical II	23ScMatU2501	Lab Course on Discrete Mathematics	4	2	20	30	50
SEC (2)	Skill Paper 1I (Practical)	23ScMatU2601	Lab Course on Computational Geometry	4	2	20	30	50
AEC(2),	English Theory	23CoCopU2703	English Communication Skills I	2	2	20	30	50
VEC (2)	EVS Theory	23CoCopU2801	Environment Science II	2	2	20	30	50
IKS (2)								
CC (2)	CC-II Course	23CoCopU2001/ 23CoCopU2011/ 23CoCopU2021/ 23CoCopU2031/ 23CoCopU2041/ 23CoCopU2051/ 23CoCopU2061/ 23CoCopU2071	Physical Education / Cultural Activities,/ NSS/ NCC/ Fine Arts/ Applied Arts/ Visual Arts/ Performing Arts	2	2	20	30	50
Total				30	22	220	330	550

Semester 3 (Second Year) Level 5

Course Type	Course	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4)	Major Core Paper 5 (Theory)	23ScMatU3101	Multivariate Calculus	4	4	40	60	100
	Major Paper 6 (Practical)	23ScMatU3102	Lab Course on 23ScMat3101	4	4	40	60	100
	Theory	23ScMatU3901	Ancient Indian Mathematics	2				
Major Electives	-							
Minor (4)	Minor Paper II (Theory + Practical)	23ScMatU3301	Discrete Mathematics (T+P)	2	4	40	60	100
				4				
OE (2)	Theory	23ScMatU3401	Financial Mathematics	2	2	20	30	50
VSC (2)	Major Specific Practical III	23ScMatU5101	Lab Course on Computer Oriented Numerical Methods	4	2	20	30	50
SEC (2)	--		--	--	--	--	--	--
AEC(2)	Theory	23CoCop3703	English Communication Skills II	2	2	20	30	50
VEC (2)	--		--	--	--	--	--	--
IKS (2)	--		--	--	--	--	--	--
FP/CEP (2)	FP –I	23ScMatU3002	Field Project - I	4	2	20	30	50
CC(2)	CC III	23CoCop3001	Fitness	2	2	20	30	50
Total				32	22	220	330	550

Semester 4 (Second Year) Level 5

Course Type	Course	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4)	Major Core Paper 7 (Theory)	23ScMatU4101	Linear Algebra	4	4	40	60	100
	Major Paper 8 (Practical)	23ScMatU4102	Lab Course on 23ScMat4101	4	4	40	60	100
			Lab Course on Scilab	4				
Major Electives	-							
Minor (4)	Minor Paper III (Theory + Practical)	23ScMatU4301	Elementary Calculus (T+P)	2	4	40	60	100
				4				
OE (2)	Theory	23ScMatU4401	Basics of Operations Research	2	2	20	30	50
VSC (2)	--		--	--	--	--	--	--
SEC (2)	Skill Paper III (Practical)	23ScMatU4601	Lab Course on Vector Calculus	4	2	20	30	50
AEC(2),	Theory	23CoCop4701/ 23CoCop4702	MIL-II (Hindi) / MIL-II (Marathi)	2	2	20	30	50
VEC (2)	--		--	--	--	--	--	--
IKS (2)	--		--	--	--	--	--	--
FP / CEP(2)	CEP –I	23ScMatU4003	Community Engagement Project	4	2	20	30	50
CC(2)	CC-4	23CoCop4001	Health and Wellness	2	2	20	30	50
Total				32	22	220	330	550

Semester 5 (Third Year) Level 5.5

Course Type	Course	Course Code	Course / Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	Major Core Paper 9 (Theory)	23ScMatU5101	Real Analysis	4	4	40	60	100
	Major Paper 10 (Theory)	23ScMatU5102	Abstract Algebra	4	4	40	60	100
	Major Paper 11 (Practical)	23ScMatU5103	Lab Course on 23ScMat5101 & 23ScMat5102	4	2	20	30	50
Major Electives	Elective I (Theory + Practical)	23ScMatU5201	Operations Research (T+P)	2	4	40	60	100
				4				
	Elective II (Theory + Practical)	23ScMatU5202	Metric Spaces (T+P)	2	4	40	60	100
				4				
Minor (4)	Minor Paper IV (Theory + Practical)	23ScMatU5301	Ordinary Differential Equations (T+P)	2	4	40	60	100
				4				
OE (2)	--		--	--	--	--	--	--
VSC (2)	Major Specific Practical IV	23ScMatU5501	Lab Course on Latex	4	2	20	30	50
SEC (2)	--		--	--	--	--	--	--
AEC(2),	--		--	--	--	--	--	--
VEC (2)	--		--	--	--	--	--	--
IKS (2)	--		--	--	--	--	--	--
FP / CEP(2)	FP –II	23ScMatU5002	Field Project - II	4	2	20	30	50
Total				38	22	220	330	550

Semester 6 (Third Year) Level 5.5

Course Type	Course	Course Code	Course / Paper Title	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4 + 4 + 2)	Major Core Paper 12 (Theory)	23ScMatU6101	Complex Analysis	4	4	40	60	100
	Major Paper 13 (Theory)	23ScMatU6102	Differential Equations	4	4	40	60	100
	Major Paper 14 (Practical)	23ScMatU6103	Lab Course on 23ScMat6101 & 23ScMat6102	4	2	20	30	50
Major Electives	Elective III (Theory + Practical)	23ScMatU6201	Number Theory (T+P)	2	4	40	60	100
				4				
	Elective IV (Theory+Practical)	23ScMatU6202	Laplace Transforms and Fourier Series (T+P)	2	4	40	60	100
				4				
Minor (4)	Minor Paper V (Theory+Practical)	23ScMatU6301	Numerical Methods and its applications (T+P)	2	4	40	60	100
				4				
OE (2)	--		--	--	--	--	--	--
VSC (2)	--		--	--	--	--	--	--
SEC (2)	--		--	--	--	--	--	--
AEC(2),	--		--	--	--	--	--	--
VEC (2)	--		--	--	--	--	--	--
IKS (2)	--		--	--	--	--	--	--
FP / CEP(2)	--		--	--	--	--	--	--
OJT(4)	OJT	23ScMatU6004	On Job Training	8	4	40	60	100
Total				38	22	220	330	550

OE : Open Elective

AEC: Ability Enhancement Course

VEC: value Education Courses

CC : Co-Curricular Courses

IKS : Indian Knowledge System

OJT : On Job Training

FP : Field Project

VSC : Vocational Skill Courses

Semester 5 (Third Year) Level 5.5

Progressive Education Society's

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**Third Year of B. Sc. Mathematics
(2023 Course under NEP 2020)**

Course Code: 23ScMatU5101

Course Name: Real Analysis

Teaching Scheme: TH: 4 Lectures/Week

Examination Scheme: CIA: 40 Marks

Credit : 4

End-Sem: 60 Marks

Prerequisites: Concepts of Differential Calculus, Integral Calculus

Course Objectives: The aim of this course is to study

- 1) To develop understanding of the real number system and the concepts of limits and sequences.
- 2) To study the behavior of sequences and series, including convergence, divergence, and the various tests used to determine convergence
- 3) To understand the applications of continuity, differentiability, and integrability of functions through Riemann integral, fundamental theorems and the Mean Value Theorem.
- 4) To study the behavior of sequences and series of functions, including convergence, divergence, and the various tests used to determine convergence
- 5) To provide understanding of the Improper integral by their properties and applications.

Course Outcomes: On completion of the course, student will be able to understand

- 1) Students will be able to prove the theorems and concepts in real analysis, including the properties of limits, sequences, series, and functions.
- 2) Students will be able to apply various convergence tests to sequences and series, determining whether they converge or diverge and how this impacts the behavior of functions.
- 3) Students will develop the ability to apply and distinguish between Riemann solving problems involving both integrals and understanding their advantages and limitations in various contexts.
- 4) Students will be able to evaluate the convergence or divergence of improper integrals by using appropriate limits. Also students can grasp the physical or geometric significance of improper integrals in real-world contexts, such as computing areas under curves with infinite domains
- 5) Students will gain the ability to examine the convergence of function series, understanding the differences between pointwise and uniform convergence

Course Contents:

Chapter 1	Sequences of Real Numbers	12 Lectures
	• Definition of sequence and subsequence • Convergent sequences • Divergent sequences, • Limit superior, Limit inferior • Cauchy sequences.	
Chapter 2	Series of Real numbers	12 Lectures
	• Convergent and divergent series • Series with non-negative terms • alternating series, Conditional and Absolute convergence • Tests of absolute convergence	
Chapter 3	Riemann Integral	12 Lectures
	• Definition and existence of Riemann integral • Properties of Riemann integral • Fundamental theorem of integral calculus	
Chapter 4	Improper Integrals	12 Lectures
	• Definition of improper integral of first kind, second kind and third kind • Tests of convergence • absolute and conditional convergence	
Chapter 5	Sequences and series of functions	12 Lectures
	• Point wise and uniform convergence of sequences of functions • convergence and uniform convergence of series of functions,	
	Total Lectures	60 Lectures

Reference Books:

1. R. R. Goldberg, Methods of real analysis, Oxford & I. B. H. Publications, 1970.

2. First course in mathematical analysis, D. Somasundaram, B Chaudhari, Narosa Publishing house 2009.
3. Shanti Narayan and Mittal - A course of Mathematical Analysis, Revised edition, S. Chand and Co.(2002).
4. Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015.
5. S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publications,Third Edition,(2008).
6. Robert, G. Bartle, Donald Sherbert - Introduction to real analysis, Third edition, John Wiley and Sons.

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Third Year of B. Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5102

Course Name: Abstract Algebra

Teaching Scheme: TH: 4 Hours/Week

Credit: 04

Examination Scheme: CIA: 40 Marks

End-Semester: 60 Marks

Prerequisites:

- Basic Knowledge of sets, permutations, functions and types of functions

Course Objectives:

To Study

- Concept of different types of groups and their subgroups
- Normal subgroups and factor groups
- Permutation groups and alternating groups
- Group and ring homomorphism and isomorphism
- Rings, Integral domains
- Euclidean domains, Principal ideal domains, Unique factorisation domain

Course Outcomes:

On completion of the course, student will be able to:-

- Understand various types of groups
- Guess subgroups of given order of finite group
- Represent a finite group by the permutation group
- Homomorphism and isomorphism of groups and rings
- Divisibility and factorization in integral domains

Course Contents:

Chapter 1	Groups and Subgroups	8 lectures
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	• Introduction and examples • Binary Operations • Groups • Subgroups • Cyclic groups • Generating sets and Cayley tables	
Chapter 2	Permutations, Cosets and Factor groups	12 lectures
	• Groups of permutations • Orbits, Cycles and Alternating Groups • Cosets and Lagrange theorem • Normal subgroups • Factor groups • Direct products and finitely generated abelian groups	
Chapter 3	Group Homomorphisms	12 lectures
	• Homomorphisms • First isomorphism theorem and its applications • Cayley's theorem • Group action on a set	
Chapter 4	Introduction to Rings	8 lectures
	• Definition and examples • Properties of rings • Subrings • Polynomial rings	
Chapter 5	Integral Domains and Factor rings	6 lectures
	• Definition and examples • Fields • Characteristic of a rings • Ideals • Factor rings • Prime ideals and Maximal ideals	
Chapter 6	Ring Homomorphisms	8 lectures
	• Definition and examples • Properties of ring homomorphisms • The field of quotients • Fundamental theorem	

Chapter 7	Divisibility and factorization	6 lectures
	• Ring of Gaussian integers • Euclidean domain • Principal ideal domain • Unique factorization theorem • Irreducibility criteria	
Total		60 lectures

Reference Books:

1. A first course in Abstract algebra by John B. Fraleigh, Pearson, (7th edition) 2002.
2. Contemporary abstract Algebra by Joseph A. Gallian, Chapman and Hall/CRC, 2020.
3. Topics in Algebra by I. N. Herstein, John Wiley & Sons (3rd edition), 1996
4. Basic Abstract Algebra by Jain and Bhattacharya, Cambridge University Press (2nd edition), 2003.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5103

Course Name: Lab Course on 23ScMatU5101& 23ScMatU5102

Teaching Scheme: TH: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites:

- Concepts of Differential Calculus, Integral Calculus

Course Objectives: The aim of this course is

- To develop understanding of the real number system and the concepts of limits and sequences.
- To study the behavior of sequences and series of real numbers and functions, including convergence, divergence, and the various tests used to determine convergence
- To provide understanding of the Improper integral by their properties and applications.
- Concept of different types of groups and their subgroups
- Normal subgroups and factor groups
- Permutation groups and alternating groups
- Group and ring homomorphism and isomorphism
- Rings, Integral domains
- Euclidean domains, Principal ideal domains, Unique factorisation domain

Course Outcomes: On completion of the course, student will able to understand

- Students will be able to apply various convergence tests to sequences and series of real numbers, determining whether they converge or diverge and how this impacts the behavior of functions.
- Students will develop the ability to apply and distinguish between Riemann integral solving problems. Students will be able to evaluate the convergence or divergence of improper integrals by using appropriate limits.
- Students will gain the ability to examine the convergence of function series, understanding the differences between pointwise and uniform convergence.
- Understand various types of groups.
- Guess subgroups of given order of finite group
- Represent a finite group by the permutation group
- Homomorphism and isomorphism of groups and rings
- Divisibility and factorization in integral domains

Course Contents:

Practical 1: Limit of sequence of real numbers

Practical 2: Convergence of sequence of real numbers

Practical 3: Divergence of sequence of real numbers

Practical 4: Tests for convergence of series of real numbers

Practical 5: Riemann integral

Practical 6: Improper Integrals

Practical 7: Sequence and series of functions

Practical 8: Groups and Subgroups

Practical 9: Permutations

Practical 10: Cosets and factor groups

Practical 11: Homomorphism of groups

Practical 12: Rings and subrings

Practical 13: Ideals and factor rings

Practical 14: Ring homomorphisms

Practical 15: Divisibility and factorization in domains

Reference Books:

1. R. R. Goldberg, Methods of real analysis, Oxford & I. B. H. Publications, 1970.
2. First course in mathematical analysis, D Somasundaram, B Chaudhari, Narosa Publishing house 2009.
3. Shanti Narayan and Mittal - A course of Mathematical Analysis, Revised edition, S. Chand and Co.(2002).
4. Ajit Kumar and S.Kumaresan, A Basic Course in Real Analysis, CRC Press, Second Indian Reprint 2015.
5. S.C. Malik and Savita Arora - Mathematical Analysis , New Age International Publications, Third Edition,(2008).
6. A first course in Abstract algebra by John B. Fraleigh, Pearson, (7th edition) 2002.
7. Contemporary abstract Algebra by Joseph A. Gallian, Chapman and Hall/CRC, 2020.
8. Topics in Algebra by I. N. Herstein, John Wiley & Sons (3rd edition), 1996
9. Basic Abstract Algebra by Jain and Bhattacharya, Cambridge University Press (2nd edition), 2003.

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Third Year of B. Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5201

Course Name: Operations Research

Teaching Scheme: TH: 4 Lectures/Week

Examination Scheme: CIA: 20 Marks

Credit : 2

End-Sem: 30 Marks

Prerequisites: Formulation of linear programming problem and graphical method

Course Objectives: The aim of this course is

- To study a quantitative approach for effective decision making
- To study modeling of real life problems
- To study how to apply the Simplex Method, graphical methods and other optimization techniques to solve linear programming problems, including recognizing infeasibility and unboundedness.
- To gain proficiency in solving transportation problems using methods like the North-West Corner Rule, Least Cost Method, and Vogel's Approximation Method, and understand how to find the optimal solution using the MODI method.
- To understand the structure of the Assignment Problem and learn to apply the Hungarian Method to solve assignment problems efficiently, both for balanced and unbalanced cases.

Course Outcomes: On completion of the course,

- Students will be able to formulate real-world problems as linear programming models, translating objectives and constraints into mathematical expressions.
- Students will gain the skill to apply different methods such as Simplex and Big-M methods.
- Students will comprehend the concept of duality in LPP, understanding the relationship between primal and dual problems. Also they will learn how duality can be used for sensitivity analysis and economic interpretation.
- Students will develop the ability to solve transportation problems using different methods, including the North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, and the MODI Method, and interpret the results for optimal distribution and cost minimization and maximization
- Students will gain expertise in solving assignment problems using the Hungarian Method, ensuring the optimal assignment of tasks to resources while minimizing total cost or maximizing efficiency in real-world applications

Course Contents:

Chapter 1	The Simplex Method	12 Lectures
	• Basic Definitions • Simplex Method • Big-M Method	
Chapter 2	Duality in Linear Programming Problem	04 Lectures
	• Definition of the dual problem • Primal dual relationship	
Chapter 3	Transportation Model	10 Lectures
	• Definition of the Transportation model • The Transportation Algorithms • MODI method for optimal solution	
Chapter 4	The Assignment Model	04 Lectures
	• Hungarian method • Maximization case • Travelling salesman problem	
	Total Lectures	30 Lectures

Reference Books:

1. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmillan India Ltd.
2. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
3. S. D. Sharma, Operations Research, Kedar Nath Ram Nath and Company, Thirteenth edition 2001.
4. Hira and Gupta, Operation Research (Twentieth Edition 2009), S. Chand and Company Ltd., New Delhi.

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Course Code: 23ScMatU5201(P)
Course Name: Lab Course on Operations Research

Teaching Scheme: TH: 4 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisites: Formulation of linear programming problem and graphical method

Course Objectives: The aim of this course is

- To study a quantitative approach for effective decision making
- To study modeling of real life problems
- To study how to apply the Simplex Method, graphical methods and other optimization techniques to solve linear programming problems, including recognizing infeasibility and unboundedness.
- To gain proficiency in solving transportation problems using methods like the North-West Corner Rule, Least Cost Method, and Vogel's Approximation Method, and understand how to find the optimal solution using the MODI method.
- To understand the structure of the Assignment Problem and learn to apply the Hungarian Method to solve assignment problems efficiently, both for balanced and unbalanced cases.

Course Outcomes: On completion of the course,

- Students will be able to formulate real-world problems as linear programming models, translating objectives and constraints into mathematical expressions.
- Students will gain the skill to apply different methods such as Simplex and Big-M methods.
- Students will comprehend the concept of duality in LPP, understanding the relationship between primal and dual problems. Also they will learn how duality can be used for sensitivity analysis and economic interpretation.
- Students will develop the ability to solve transportation problems using different methods, including the North-West Corner Rule, Least Cost Method, Vogel's Approximation Method, and the MODI Method, and interpret the results for optimal distribution and cost minimization and maximization
- Students will gain expertise in solving assignment problems using the Hungarian Method, ensuring the optimal assignment of tasks to resources while minimizing total cost or maximizing efficiency in real-world applications

Course Contents:

- Practical 1: Formulation of Linear Programming Problem (LPP)
- Practical 2: Standard and canonical form of linear programming problem
- Practical 3: Graphical Method
- Practical 4: Basic solutions of linear programming problem
- Practical 5: Simplex method using slack variables
- Practical 6: Big-M method
- Practical 7: Types of solutions
- Practical 8: Duality in linear programming problem
- Practical 9: Initial basic feasible solutions of transportation problem(NWCM and LCEM)
- Practical 10: Vogel's Approximation Method (VAM)
- Practical 11: Modified Distribution method (MODI)
- Practical 12: Maximization in transportation problem
- Practical 13: Hungarian method
- Practical 14: Assignment problem with restricted value
- Practical 15: Maximization in assignment problem

Reference Books:

1. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmillan India Ltd.
2. Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
3. Hira and Gupta, Operation Research (Twentieth Edition 2009), S. Chand and Company Ltd., New Delhi.
4. S. D. Sharma, Operations Research, Kedar Nath Ram Nath and Company, Thirteenth edition 2001.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5202

Course Name: Metric Spaces

(Section - I)

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites: Basic knowledge of

- Limit, continuity of a function of one variable.
- Distance formulae in $\mathbb{R}^n$
- Sets and inequalities in $\mathbb{R}$.

Course Objectives : To study

- Metric in general set.
- Open and closed sets.
- Continuity in metric space.
- Completeness, compactness and connectedness.
- Metric Topology

Course Outcome : On completion of this course, student will be able to

- Define metric on a general set.
- Check continuity in metric space and also in $\mathbb{R}$.
- Use the concepts to study courses in analysis.
- Understand the concept of topological spaces

Course Contents :

Chapter 1	Introductory concepts	10 lectures
	• Definition and examples of metric spaces. • Open and closed spheres. • Limit points, Interior points, Isolated points. • Open and closed sets, Closure of a set. • Boundary points, Distance between sets and diameter of a set. • Continuous functions on metric spaces.	
Chapter 2	Completeness	5 lectures
	• Convergent sequences. • Cauchy sequences. • Complete spaces. • Dense sets	
Chapter 3	Compactness and Connectedness	12 lectures
	• Compact spaces. • Continuous functions and compact spaces. • Separated sets. • Disconnected and connected sets.	
Chapter 4	Introduction to Topology	03 lectures
	• Definition with examples • Metric topology	
Total No. of Lectures		30 lectures

Reference Books:

1. Metric Spaces by Pawan K. Jain and Khalil Ahmad, Narosa Publishing House, (Second Edition), 2004.
2. Topology of metric spaces by S. Kumaresan, Narosa Publishing House, 2005.
3. Methods of Real Analysis by R. R. Goldberg, Oxford and I.B.H. publications, 1970.
4. A first course in Mathematical Analysis by D. Somasundaram and B. Choudhary, Narosa Publishing House, 1996.
5. Real mathematical analysis by C C. Pugh, Springer publication (2nd edition), 2010.

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(2023 Course under NEP 2020)

Course Code: 23ScMatU5202

Course Name: Metric Spaces

(Section -II)

Teaching Scheme: 4 Hours/ Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites: Basic knowledge of

- Limit, continuity of a function of one variable.
- Distance formulae in $\mathbb{R}^n$
- Sets and inequalities in $\mathbb{R}$.

Course Objectives : To study

- Metric in general set.
- Open and closed sets.
- Continuity in metric space.
- Completeness, compactness and connectedness.
- Metric Topology

Course Outcome : On completion of this course, student will be able to

- Define metric on a general set.
- Check continuity in metric space and also in $\mathbb{R}$.
- Use the concepts to study courses in analysis.
- Understand the concept of topological spaces

Course Contents:

Practical 1: Metric spaces

Practical 2: Open and closed spheres

Practical 3: Limit points and Interior points

Practical 4: Isolated points and Boundary points

Practical 5: Closure of a set

Practical 6: Sequential continuity in metric spaces

Practical 7: Convergent and Cauchy sequences

Practical 8: Completeness

Practical 9: Compactness

Practical 10: Connectedness

Practical 11: Continuous functions on compact and connected sets

Practical 12: Topology

Practical 13: Metric topology

Practical 14: Applications of metric topology

Practical 15: Topological spaces

Reference Books:

1. Metric Spaces by Pawan K. Jain and Khalil Ahmad, Narosa Publishing House, (Second Edition), 2004.
2. Topology of metric spaces by S. Kumaresan, Narosa Publishing House, 2005.
3. Methods of Real Analysis by R. R. Goldberg, Oxford and I.B.H. publications, 1970.
4. A first course in Mathematical Analysis by D. Somasundaram and B. Choudhary, Narosa Publishing House, 1996.
5. Real mathematical Analysis by C.C. Pugh, Springer publication (2nd edition), 2010.

Progressive Education Society's
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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5301

Course Name: Ordinary Differential Equations
(Section - I)

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites:

- Derivative, Integration.

Course Objectives:

To Study

- Differential equations, Order and degree of differential equation.
- Homogeneous linear differential equation.
- Non-homogeneous differential equation.

Course Outcomes:

On completion of the course, student will be able to:-

- Find order and degree of differential equations.
- Find the Wronskian of differential equations.
- Find solutions of homogeneous, Pfaffian, exact differential equations.
- Solve Bernoulli's equation.
- Find solution of homogeneous differential equations with constant coefficients.
- Find solution of non-homogeneous differential equations.

Course Contents:

Chapter 1	Differential equation: Their formation and solution	7 lectures
	• Differential equation. • Ordinary differential equations • Order of a differential equation • Degree of a differential equation • Linear and nonlinear differential equations. • Solution of a differential equation • Definition: general solution, particular solution, singular solution • Formation of differential equation • The Wronskian • Linearly dependent and independent set of functions • Existence and uniqueness theorem	
Chapter 2	Equations of first order and first degree	10 lectures
	• Introduction • Separation of variables • Homogeneous equations • Pfaffian differential equation • Exact differential equation • Integrating factor • Linear differential equation • Bernoulli's equation • Applications of equations of first order and first degree	
Chapter 3	Linear differential equation with constant coefficient	8 lectures
	• The auxiliary equations. Distinct roots, repeated roots, complex roots. • Determination of complementary solution • Determination of particular solution	
Chapter 4	Non-Homogeneous Differential Equations	5 lectures
	• Method of undetermined coefficients • Method of variation of parameters • Method of reduction of order • Use of known solution to find another	
	Total Lectures	30 lectures

Reference Books:

1. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
2. Elementary Differential Equations by Rainville and Bedient, Macmillan Publications, 1952.
3. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.
4. Integral Calculus by Shanti Narayan, S. Chand and Co., 1987.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU5301

Course Name: Ordinary Differential Equations
(Section - II)

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites:

- Derivative, Integration.

Course Objectives:

To Study

- Differential equations, Order and degree of differential equation.
- Homogeneous linear differential equation.
- Non-homogeneous differential equation.

Course Outcomes:

On completion of the course, student will be able to:-

- Find order and degree of differential equations.
- Find the Wronskian of solutions of differential equations.
- Find the solution of homogeneous, Pfaffian, exact differential equations.
- Solve Bernoulli's equation.
- Find solution of homogeneous differential equations with constant coefficients.
- Find solution of non-homogeneous differential equations.

Course Contents:

Practical 1: Classification of differential equation

Practical 2: Solution of differential equations

Practical 3: Linear dependence and independence of set of functions

Practical 4: Existence and uniqueness of solutions

Practical 5: Separation of variables

Practical 6: Solution of homogeneous equations

Practical 7: Exact differential equations

Practical 8: Integrating Factor

Practical 9: Linear differential equation

Practical 10: Bernoulli's equation

Practical 11: Linear differential equation with constant coefficient

Practical 12: Method of undetermined coefficient

Practical 13: Method of variation of parameter

Practical 14: Method of reduction of order

Reference Books:

1. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
2. Elementary Differential Equations by Rainville and Bedient, Macmillan Publications, 1952.
3. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.
4. Integral Calculus by Shanti Narayan, S. Chand and Co., 1987.

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Second Year of B.Sc. Mathematics
(2023 Course under NEP 2020)
Course Code :23ScMatU5501 **Course Name : Lab Course on Latex**

Teaching Scheme: PR: 4 Hours/Week
Examination Scheme: CIA : 20 Marks

Credit : 02
End-Sem : 30 Marks

Pre-requisite Courses:

- Basic knowledge of Latex
- Basic knowledge of document structuring and mathematical typesetting

Course Objectives: To study:

- LaTeX document preparation system.
- LaTeX syntax, environments, and document structuring.
- Create professional documents, reports, presentations, and articles using LaTeX.
- How to format mathematical equations, tables, lists, and references effectively.
- Document formatting, including resume writing, presentations, and report writing.

Course Outcomes: On completion of the course, students will be able to:

- Install and configure LaTeX.
- Use basic and advanced LaTeX syntax to create well-structured documents.
- Format mathematical expressions, equations, and matrices in LaTeX.
- Create tables, lists, figures, and references in LaTeX.
- Develop professional articles, reports, resumes, and presentations using LaTeX.
- Apply appropriate document structuring techniques for different types of documents.

Course Contents

- Practical 1 : An introduction to Latex**
- Practical 2 : Page layout**
- Practical 3 : Environments**
- Practical 4 : Lists**
- Practical 5 : Tables**
- Practical 6 : Equations**
- Practical 7 : Formulae**
- Practical 8 : Matrices**
- Practical 9 : References**
- Practical 10 : Figure, Photos and Videos**
- Practical 11 : Article and Resume**
- Practical 12 : Research paper and Report**
- Practical 13 : Examination**

Practical 14 : Presentation

Practical 15 : Devnagari typing

Reference Books :

1. Latex Manual - <https://texdoc.org/serve/latex2e.pdf/0>
2. Latex Tutorial - <https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf>
3. "The LaTeX Companion" by Frank Mittelbach, Michel Goossens, and Johannes Braams, Addison-Wesley (2004).
4. "More Math into LaTeX" by George Grätzer, Springer (2007).
5. "A Guide to LaTeX" by Helmut Kopka and Patrick Daly, Addison-Wesley (2003).

Semester 6 (Third Year) Level 5.5

Progressive Education Society's

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Third Year of B.Sc.

(2023 Course under NEP 2020)

Course Code: 23ScMatU6101

Course Name: Complex Analysis

Teaching Scheme: TH: 4 Lectures/Week

Credit: 04

Examination Scheme: CIA: 40 Marks

End-Semester: 60 Marks

Prerequisites: Basic Knowledge of

- Complex algebra.
- One variable and several variable Calculus.

Course Objectives: The aim of this course is to study.

- Continuity, Differentiability of functions of complex variables.
- Exponential, logarithmic, trigonometric, hyperbolic functions.
- Analytic functions, harmonic functions and relation between them.
- Contour integrals.
- Series and power series.
- Residues and poles.

Course Outcomes: On completion of this course, student will be able to: -

- Check whether the given function is analytic.
- Prove identities involving elementary functions.
- Evaluate contour integrals and improper integrals.
- Find Laurent series expansion of complex functions.
- Classify singular points of complex functions.
- Apply Cauchy residue theorem to solve line integrals.

Course Contents:

Chapter 1	Analytic functions	12 lectures
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	• Polar form, exponential form and roots of complex numbers • Functions of complex variable, limits and continuity • Derivatives, differentiation formulae • Cauchy Riemann equations, sufficient condition for differentiability, Polar coordinates • Analytic functions and harmonic functions.	
Chapter 2	Elementary functions	12 lectures
	• Exponential and logarithmic functions. • Branches and derivatives of logarithmic function. • Some identities involve logarithms, complex exponent. • Trigonometric and hyperbolic functions. • Inverse trigonometric and inverse hyperbolic functions.	
Chapter 3	Integrals	12 lectures
	• Definite integral of functions. • Contours, contour integral. • Upper bound for moduli of contour integrals • Anti-derivatives, examples • Statement of Cauchy Goursat theorem, Simply and multiply connected domains. • Cauchy integral formula • Derivatives of analytic functions • Liouville's theorem and fundamental theorem of algebra.	
Chapter 4	Series	12 lectures
	• Convergence of sequences and series. • Examples based on Taylor's series and Laurent's series. • Absolute and Uniform convergence of power series. • Continuity of sums of power series. • Integration and differentiation of power series. • Multiplication and division of power series.	
Chapter 5	Residues and Poles	12 lectures

	• Isolated singular points, residues • Cauchy Residue theorem, residue at infinity • Types of isolated singular points • Residue at poles. • Zeros and poles. • Evaluation of improper integrals	
Total No. of Lectures		60

Reference Books:

1. Complex analysis and applications by J. W. Brown and R. V. Churchill, International student edition 8th edition 2009.
2. Complex variables with applications by S. Ponnusamy and H. Silverman, Birkhauser, 2006.
3. Functions of one complex variable by J. B. Conway Narosa publication second edition 1978.
4. Complex analysis by P. Duraipandian S. Chand company 2008.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6102

Course Name: Differential Equations

Teaching Scheme: TH: 4 Hours/Week

Credit: 04

Examination Scheme: CIA: 40 Marks

End-Semester: 60 Marks

Prerequisites:

- Derivative, Integration, Exact differential equations, Integrating factor, Partial derivatives, Continuity, Analytical geometry

Course Objectives:

To Study

- Second order linear differential equations
- Power series solution of first and second order linear differential equations
- System of first order and first degree differential equations
- First order partial differential equations

Course Outcomes:

On completion of the course, student will be able to:-

- Find the general solution of linear differential equations with constant coefficients.
- Find the solution of non - homogeneous differential equations.
- Find the solutions of differential equations using power series.
- Find the solution of a system of first order differential equations.
- Solve simultaneous differential equations of the first order and first degree in three variables
- Solve first order linear and non-linear partial differential equations
- Find an integral surface passing through given curve

Course Contents:

Chapter 1	Linear Differential Equations with constant coefficients	7 lectures
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	• The auxiliary equations. Distinct roots, repeated roots, complex roots, particular solution • The operator $1/f(D)$ • The operator $1/(D^2+a^2)$ acting on $\sin ax$ and $\cos ax$ with proofs.	
Chapter 2	Non-Homogeneous Differential Equations	8 lectures
	• Method of undetermined coefficients • Method of variation of parameters • Method of reduction of order • The use of known solution to find another	
Chapter 3	Power series solutions	8 lectures
	• Review of power series • Linear equations and power series • Convergence of power series • Ordinary points and regular singular points	
Chapter 4	System of first order equations	7 lectures
	• Linear system • Homogeneous linear systems with constant coefficients	
Chapter 5	Ordinary differential equations in three variables	12 lectures
	• Curves and surfaces in three dimensions • Simultaneous differential equations of the first order and first degree • Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ • Orthogonal trajectories of a system of curves on a surface • Pfaffian differential forms and equations • Solution of Pfaffian differential equations in three variables	
Chapter 6	First order partial differential equations	18 lectures

	• Genesis of first order partial differential equations • Classification of integrals • Linear equations of the first order • Compatible systems • Charpit's method • Jacobi's method • Integral surfaces through given curve: The Cauchy problem • Solving the Cauchy problem for quasi-linear and non-linear partial differential equations	
	Total Lectures	60 lectures

Reference Books:

1. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
2. An elementary course in Partial Differential Equations by T. Amarnath, Narosa Publishing House (2nd edition), 2008.
3. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.
4. Partial Differential Equations by W. E. Williams, Clarendon Press, Oxford, 1980.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6103

Course Name: Lab course on 23ScMatU6101 and 23ScMatU6102

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30

Prerequisites:

- Complex algebra.
- One variable and several variable calculus.
- Derivative, integration, exact differential equations, integrating factor, partial derivatives

Course Objectives: The aim of this course is to study

- Analytic functions, harmonic functions and relation between them.
- Contour integrals.
- Series and power series.
- Residues and poles.
- Second order linear differential equations.
- Power series solution of first and second order linear differential equations.
- System of first order and first degree differential equations.
- First order partial differential equations.

Course Outcomes:

On completion of the course, student will be able to:-

- Evaluate contour integrals and improper integrals.
- Find Laurent series expansion of complex functions.
- Classify singular points of complex functions.
- Apply Cauchy residue theorem to solve line integrals.
- Find the general solution of linear differential equations with constant coefficients.
- Find solutions of differential equations using power series.
- Find the solution of a system of first order differential equations.
- Solve simultaneous differential equations of the first order and first degree in three variables
- Solve first order linear and non-linear partial differential equations

Course Content:

Practical 1: Analytic functions I
Practical 2: Analytic functions II
Practical 3: Integrals I
Practical 4: Integrals II
Practical 5: Series
Practical 6: Power series
Practical 7: Residues and singularities
Practical 8: Linear differential equations with constant coefficients
Practical 9: Non-homogeneous differential equations
Practical 10: Power series solutions
Practical 11: System of first order equations
Practical 12: Partial differential equations
Practical 13: Pfaffian differential equations
Practical 14: First order linear partial differential equations
Practical 15: First order non-linear partial differential equations

Reference Books:

1. Complex analysis and applications by J. W. Brown and R. V. Churchill, International student edition 8th edition 2009.
2. Complex variables with applications by S. Ponnusamy and H. Silverman, Birkhauser.
3. Functions of one complex variables by J. B. Conway Narosa publication second edition 1978.
4. Complex analysis by P. Duraipandian S. Chand company 2008.
5. Ordinary and Partial Differential Equation by M. D. Raisinghania, S. Chand and company LTD, 2009.
6. An elementary course in Partial Differential Equations by T. Amarnath, Narosa Publishing House (2nd edition), 2008.
7. Differential Equations: Theory, Technique and Practice by George F. Simmons and Steven G. Krantz, Tata McGraw-Hill, 2007.

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Second Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6201

Course Name: Number Theory

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites:

- Basic knowledge of number systems, divisibility in integers and prime numbers.

Course Objectives:

To Study

- The properties of prime numbers.
- The application of congruences.
- The applications of arithmetic functions.

Course Outcomes:

On completion of the course, student will be able to understand

- The Euclidean algorithm and fundamental theorem of arithmetic.
- The use of Euler's and Fermat's theorem.
- The use of the Mobius inversion formula and the law of quadratic reciprocity.

Course Contents:

Chapter 1	Divisibility	8 Hours
	• Division algorithm. • Greatest common divisor and its properties. • Euclidean algorithm. • Fundamental theorem of Arithmetic. • Sieve of Eratosthenes, prime numbers and properties of primes.	
Chapter 2	Theory of Congruences	8 Hours
	• Properties of congruences. • Linear congruences. • Fermat's theorem, Wilson's theorem. • Chinese remainder theorem.	
Chapter 3	Arithmetic functions	
	• Arithmetic functions and examples. • Mobius inversion formula. • Euler's function and Euler's theorem.	
Chapter 4	Quadratic Reciprocity	
	• Legendre symbol and examples. • Properties of Legendre symbols. • Quadratic residues and its properties. • Law of Quadratic reciprocity.	
Total Lectures		30

Reference Books:

1. Elementary Number Theory by David M. Burton, McGraw Hill, (7 th edition), 2010.
2. An Introduction to Theory of Numbers by I. Niven, H. Zuckerman and H.L. Montgomery, John Wiley and Sons, (5 th edition), 2008.
3. Elements of Number Theory by John Stillwell, Springer, 2003.

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Second Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6201

Course Name: Number Theory

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites:

- Basic knowledge of number systems, divisibility in integers and prime numbers.

Course Objectives:

To Study

- The properties of prime numbers.
- The application of congruences.
- The applications of arithmetic functions.

Course Outcomes:

On completion of the course, student will be able to understand

- The Euclidean algorithm and fundamental theorem of arithmetic.
- The use of Euler's and Fermat's theorem.
- The use of Mobius inversion formula and the law of quadratic reciprocity.

Course Contents:

Practical 1: GCD

Practical 2: Application of Fundamentals Theorem of Arithmetic and Sieve of Eratosthenes.

Practical 3: Properties of primes

Practical 4: Congruences

Practical 5: Fermat's theorem

Practical 6: Wilson's theorem

Practical 7: Chinese Remainder theorem

Practical 8: Arithmetic functions

Practical 9: Euler's theorem

Practical 10: Legendre symbols

Practical 11: Quadratic residues and properties

Practical 12: Quadratic reciprocity Law

Practical 13: Miscellaneous problem set I (Congruence, GCD, Fermat's theorem)

**Practical 14: Miscellaneous problem set II (Chinese Remainder theorem,
Wilson's theorem, Euler's theorem)**

Practical 14: Miscellaneous problem set III (Legendre symbols, Quadratic residues and properties)

Reference Books:

1. Elementary Number Theory by David M. Burton, McGraw Hill, (7 th edition), 2010.
2. An Introduction to Theory of Numbers by I. Niven, H. Zuckerman and H.L. Montgomery, John Wiley and Sons, (5 th edition), 2008.
3. Elements of Number Theory by John Stillwell, Springer, 2003.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6202

Course Name: Laplace Transforms and Fourier Series
(Section - I)

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites: Basic knowledge of

- Functions and linear transformations.
- Calculus.

Course Objectives: To study

- Laplace transformation of functions and convolution theorem.
- Simple techniques of evaluation of improper integrals.
- Solution of differential equations using Laplace transform
- Fourier series of piecewise continuous functions.

Course Outcomes:

On completion of the course, student will be able to -

- Evaluate improper integrals
- Solve differential equations
- Obtain Fourier series expansion of piecewise continuous functions.

Course Contents:

Chapter 1	The Laplace Transform	10 lectures
	• Definition, Laplace transform of functions • Properties of Laplace transform • Laplace transforms of derivatives and integrals	
Chapter 2	The Inverse Laplace Transform	10 lectures
	• Definition, Inverse Laplace transform • Properties of inverse Laplace transform • Inverse Laplace transforms of derivatives and integrals • Convolution theorem, evaluation of integrals	
Chapter 3	Fourier Series	10 lectures
	• Definition of Fourier series. • Fourier series of even and odd functions	
Total No. of Lectures		30 lectures

Reference Books:

1. Schaum's Outline Series, Theory and Problems of Laplace transforms by Murray R. Spiegel 1986
2. Differential equations by G. F. Simmons and S. G. Krantz, Tata McGraw Hill (sixth edition), 2009.
3. The Laplace Transform-Theory and Applications by Joel L. Schiff, Springer Verlag New York, 1999.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6202

Course Name: Laplace Transforms and Fourier Series

(Section -II)

Teaching Scheme: 4 Hours/ Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisites: Basic knowledge of

- Functions and linear transformations.
- Calculus.

Course Objectives: To study

- Laplace transformation of functions and convolution theorem.
- Simple techniques of evaluation of improper integrals.
- Solution of differential equations using Laplace transform
- Fourier series of piecewise continuous functions.

Course Outcomes:

On completion of the course, student will be able to -

- Evaluate improper integrals
- Solve differential equations
- Obtain fourier series expansion of piecewise continuous functions.

Course Contents:

Practical 1: Laplace transforms of elementary functions

Practical 2: Gamma function

Practical 3: Laplace transforms of piecewise continuous functions

Practical 4: Functions of exponential order

Practical 5: First shift property and Second shift property

Practical 6: Laplace transform of derivatives and integration

Practical 7: Laplace transform of multiplication and division by t

Practical 8: Unit step function and Dirac Delta function

Practical 9: Evaluation of integral using Laplace transform

Practical 10: Inverse Laplace transform using properties

Practical 11: Inverse Laplace transform using division and multiplication by s

Practical 12: Convolution Theorem for Inverse Laplace transform

Practical 13: Fourier series of piecewise continuous functions

Practical 14: Fourier series of even and odd functions

Practical 15: Applications of Laplace transforms and Fourier series

Reference Books:

1. Schaum's Outline Series ,Theory and Problems of Laplace transforms by Murray R. Spiegel 1986
2. Differential equations by G. F. Simmons and S. G. Krantz, Tata McGraw Hill (sixth edition), 2009.
3. The Laplace Transform-Theory and Applications by Joel L. Schiff , Springer Verlag New York, 1999.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6301 Course Name: Numerical Methods and its applications
(Section - I)

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Semester: 30 Marks

Prerequisite Course: Equations, Functions, Polynomials and Differential Equations.

Course Objectives: To Study

- Methods for solution of algebraic and transcendental equations, and a system of linear equations.
- Curve fitting using a line, a parabola, a power function and an exponential function.
- Polynomial approximation and interpolation.
- Numerical differentiation and integration.
- Numerical methods to solve ordinary differential equations of first degree and first order.

Course Outcomes: On completion of the course, student will be able to:-

- Find the approximate real root of the equation and solve a system of linear equations numerically.
- Approximate a known or unknown function by a polynomial with desired accuracy.
- Find numerical differentiation and evaluate definite integrals numerically.
- Solve first order and first degree Ordinary Differential Equations.

Course Contents:

Unit 1	Numerical Solutions of Equations	06 lectures
	• Bisection method. • Regula falsi method. • Newton-Raphson method.	
Unit 2	Numerical Interpolation	10 lectures
	• Operators Δ, ∇, E and their relations • Differences: forward, backward, divided • Fundamental theorem of difference calculus • Newton-Gregory formula for Forward/Backward interpolation. • Lagrange's interpolation formula.	
Unit 3	Numerical Integration	08 lectures
	• General quadrature formula. • Trapezoidal rule. • Simpson's $1/3^{\text{rd}}$ rule. • Simpson's $3/8^{\text{th}}$ rule.	
Unit 4	Applications	06 lectures
	• Euler's method • Euler's modified method • Largest eigenvalue using power method	

Reference Books:

1. Introductory Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India Fifth Edition, 2012.
2. Finite differences and Numerical Analysis by H.C. Saxena, S. Chand, 2010.
3. A textbook of Computer Based Numerical and Statistical Techniques by A. K. Jaiswal and Anju Khandelwal, New Age International Publishers, 2009.
4. Linear Algebra and Its Applications by David C. Lay, Steven R. Lay, Judi J. McDonald, Sixth Edition, 2022.

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Third Year of B.Sc. Mathematics
(2023 Course under NEP 2020)

Course Code: 23ScMatU6301 Course Name: Numerical methods and its applications
(Section -II)

Teaching Scheme: 4 Hours/ Week Credit: 02
Examination Scheme: CIA: 20 Marks End-Semester: 30 Marks

Prerequisite Courses: Equations, Functions, Polynomials and Differential Equations.

Course Objective: To study

- Solution of equations
- Solution of the system of linear equations.
- Curve fitting.
- Polynomial approximation and interpolation.
- Numerical differentiation and integration.
- Solving ordinary differential equations

Course Outcomes: On completion of the course, students will be able to: -

- Find approximate real root of an equation
- Solve a system of linear equations numerically.
- Approximate a function by a polynomial with desired accuracy.
- Interpolate an equally spaced and unequally spaced data.
- Find numerical differentiation and integration.
- Solve ordinary differential equations numerically.

Course Contents:

- Practical 1: Bisection method**
- Practical 2: Regula Falsi method and Secant method**
- Practical 3: Newton Raphson Method**
- Practical 4: Iteration Method**
- Practical 5: Operators and their relations**
- Practical 6: Newton's forward interpolation formula**
- Practical 7: Newton's Backward interpolation formula**
- Practical 8: Lagrange's interpolation formula**
- Practical 9: Newton's Divided difference formula**
- Practical 10: Numerical Differentiation**
- Practical 11: Numerical Integration 1**
- Practical 12: Numerical Integration 2**
- Practical 13: Runge Kutta method**
- Practical 14: Gauss elimination method**
- Practical 15: Least square method / Curve fitting**

Reference Books:

- 1) Introductory Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India Fifth Edition, 2012.
- 2) Finite differences and Numerical Analysis by H.C. Saxena, S. Chand, 2010.
- 3) A textbook of Computer Based Numerical and Statistical Techniques by A. K.Jaiswal and Anju Khandelwal, New Age International Publishers, 2009.
- 4) Computer oriented Numerical Methods by V. Rajaraman, PHI Learning Private Limited, New Delhi, Third Edition, 2011.
- 5) Numerical Methods by E Balagurusamy, Tata McGraw Hill Education Private Limited, New Delhi, Reprint 2012.