પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-૨૦૨૦ અંતર્ગત મેથેમેટિક્સ વિષય સેમેસ્ટર-૫નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજુરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન,૨૦૨૫ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.

નોંધ: ક્રમાંક/બીકેએનએમયુ/એકેડેમિક/૨૧૩/૨૦૨૫ તા.૨૬/૦૫/૨૦૨૫નાં પરિપત્રમાં મેથેમેટિક્સ વિષયનાં ચેરપર્સન દ્વારા અત્રેની યુનિવર્સિટીને મળેલ ઈમેઈલ મુજબ મેથેમેટિક્સ વિષયનાં સેમેસ્ટર-૦૫માં માઇનોર-૦૪ અને માઇનોર-૦૫નાં અભ્યાસક્રમમાં ફેરફાર કરવામાં આવેલ છે.

Bhakta Kavi Narsinh Mehta University Junagadh.

30/7/2025

ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૪૧૪/૨૦૨૫
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,
સરકારી પોલીટેકનિક કેમ્પસ,
ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,
ખડીયા, જૂનાગઢ-૩૬૨૨૬૩
તા.૩૦/૦૭/૨૦૨૫

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાનાઃ-

- માન.કુલપતિશ્રી/ કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થેઃ

- સીસ્ટમ મેનેજરશ્રી, આઇ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)

BHAKTA KAVI NARSINH MEHTA UNIVERSITY

JUNAGADH

BOARD OF STUDIES

FACULTY OF SCIENCE

SYLLABUS FOR MATHEMATICS (HONOURS)

PROGRAMME (SEMESTER- V)

EFFECTIVE FROM JUNE, 2025

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors) Mathematics as per NEP-2020
Faculty of Science
Effective from June 2025
Subject: Mathematics
SEMESTER- V

SUMMARY OF THE SYLLABUS

Sem No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs./WEEK	SEE Marks	CCE Marks	Total Marks	Exam Duration
Sem-5	1	Major-11	**AB. Alg-1 & Complex Ana-1**	5.5	4	4 Hrs/WEEK	50	50	100	2 HOURS
	2	Major-12	**Real Analysis-1 (Seq + Series+ Reiamnn Integration)**	5.5	4	4 Hrs/WEEK	50	50	100	2 HOURS
	3	Major-13	**Introduction to Programming in 'C' (Practical Based Course)**	5.5	4	8 HOURS/ BATCH/WEEK	50	50	100	3 HOURS
	4	Minor-4	**Essential Mathematics for Competitive Examinations (For Chemistry & Physics Students)**	5.5	4	4 Hrs/WEEK	50	50	100	2 HOURS
	5	Minor-4	**Optimization (Practical based course) (Applied Mathematics-1)**	5.5	4	8 HOURS/ BATCH/WEEK	50	50	100	3 HOURS
	6	Minor-5	**Fundamentals of Partial Differential Calculus (For Chemistry & Physics Students)**	5.5	4	4 Hrs/WEEK	50	50	100	2 HOURS
	7	Minor-5	**Introduction to SAGE (FOSS) {Practical Based Course} (Applied Mathematics-2)**	5.5	4	8 HOURS/ BATCH/WEEK	50	50	100	3 HOURS
				Total	**20**					

Course Level	5.5		**Internal Marks**	50
Programme	B.Sc Mathematics.(Hons.)		**External Marks**	50
Semester	V		**Practical Internal**	--
Category of Course	Major Course-11		**Practical External**	--
Course Credit	04		**Prac.External Exam Duration**	--
Teaching Hours	04 Hours/Week		**Total**	100
Course Code			**Exam Duration**	2 HOURS
Course Title	**ABSTRACT ALGEBRA-1 & COMPLEX ANALYSIS-1**			

Course Objectives: By the end of the course, students will be able to:

- Understand the concept of binary operations and their fundamental properties.
- Define and analyze group structures, subgroups, cyclic groups and their properties.
- Explore permutation groups, transpositions, cycles,and symmetric groups.
- Investigate even and odd permutations and their significance in algebraic structures.
- Apply Lagrange's theorem in finite group theory to analyze group order and structure.
- Construct and interpret normal subgroups and quotient groups with real world applications.
- Understand the principles of complex numbers and functions of complex variables.
- Study limits, continuity and differentiability of complex functions with theoreticalfoundations.
- Examine harmonic and entire functions to explore their analytical properties.
- Apply Cauchy-Riemann conditions, integral theorems and contour integration in complex analysis problems.

Course Learning Outcomes: Upon completing the course, students will be able to:

- Demonstrate proficiency in binary operations and fundamental algebraic structures.
- Identify and classify different types of groups and analyze their subgroup structures.
- Perform computations with permutation groups, cycles and symmetric groups.
- Distinguish between even and odd permutations and their role in group properties.
- Apply Lagrange's theorem to compute and analyze the order of subgroups.
- Solve problems involving cosets, normal subgroups and quotient groups.
- Compute limits and analyze the continuity and differentiability of complex functions.
- Demonstrate an understanding of harmonic and entire functions in mathematical applications.
- Utilize Cauchy-Riemann equations to establish analyticity in complex functions.
- Apply contour integration, Cauchy-Goursat theorem and integral formulas to solve complex analysis problems.

Course Contents

Sem	Unit No.	Topics	Teaching Hours
		Abstract Algebra-1	
5	1	Definition of a binary operation, Fundamental properties like associativity, commutativity, identity, inverses of a binary operation, Definition of a group, Properties & Examples of Groups, Definition and properties of subgroups, Cyclic groups and generators, Cyclic Subgroup & Its Properties.	**14**
	2	Permutation Groups, Transposition, Cycle, Even & Odd Permutations, Symmetric Groups, Inverse of Permutation, Alternative Group & Its Universal Property. Cosets& Its Properties, Lagrange's theorem & its applications in finite group theory, Normal subgroup and quotient group.	**18**
		Complex Analysis-1	
	3	Introduction to complex numbers, Functions of complex variables, limits, Theorems on limits, Continuity and differentiability of complex functions, harmonic functions, Entire functions and analytic functions.	**16**
	4	Cauchy Riemann conditions in Cartesian and polar form. Definite integral contours, line integrals Cauchy-Goursat theorem**(without proof),** Cauchy's integral formula.	**12**

Suggested Reading:

Books on Abstract Algebra

1. Abstract Algebra, Dr. I. H. Sheth, NiravPrakashan, Ahmedabad ISBN: 9788120339323
2. Contemporary Abstract Algebra – Joseph A. Gallian ISBN: 9780367651785
3. Topics in Algebra – I.N. Herstein ISBN: 9780471368793
4. Basic Abstract Algebra – P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul ISBN: 9780521466295
5. Algebra– Michael Artin ISBN: 9780132413770
6. University Algebra- N. S. Gopalkrishnan, Wiley Eastern Ltd. ISBN: **9780852263389**

Books on Complex Analysis:

1. Complex Variables and Applications, Fifth Edition,R. V. Churchill and J. W. Brown.,McGraw Hill Publishing Company. ISBN: 9780071263283
2. Complex Analysis – Lars Ahlfors ISBN: 9780070006577
3. Functions of One Complex Variable – John B. Conway ISBN: 9780387907173
4. **Visual Complex Analysis** – Tristan Needham ISBN: 9780192868916
5. Complex Analysis – T.K. Manoharan ISBN: 9788120345179
6. Complex Analysis: An Introduction to the Theory of Analytic Functions – P.K. Jain & Khalil Ahmad ISBN: 9788122427637

Suggested E learning: https://onlinecourses.nptel.ac.in

Course Level	5.5		**Internal Marks**	50
Programme	B.Sc Mathematics.(Hons.)		**External Marks**	50
Semester	V		**Practical Internal**	--
Category of Course	Major Course--12		**Practical External**	--
Course Credit	04		**Prac. External Exam Duration**	--
Teaching Hours	04 Hours/Week		**Total**	100
Course Code			**Exam Duration**	2 HOURS
Course Title	**REAL ANALYSIS-1 (SEQ.+SERIES+REIMANN INTEGRATION)**			

Course Objectives:

- Define sequences and analyze their boundedness, monotonicity and convergence criteria.
- Utilize the Sandwich theorem, Bolzano-Weierstrass theorem and Cauchy's theorems to evaluate sequences.
- Distinguish between different types of series (geometric, p-series) and apply convergence tests effectively.
- Interpret the results of tests like Comparison test, D'Alembert's ratio test, Raabe's test and Alternating Series test.
- Define Riemann sums, upper/lower R-integrals and analyze their connection to integration theory.
- Investigate the algebraic properties and applicability of R-integrable functions.
- Demonstrate how differentiation and integration are interconnected via primitive functions.
- Understand and utilize mean value theorems to solve integral-based problems.
- Establish connections between sequence limits, infinite series summations and definite integration.
- Solve theoretical and applied problems using rigorous mathematical reasoning.

Course Learning Outcomes: After successfully completing the course, a student will be able to….

- To understand bounded, monotonic, and convergent sequences.
- To use the Bolzano-Weierstrass theorem and Cauchy's theorem to analyze sequences.
- To determine whether a series converges or diverges by using standard tests.
- To apply tests like the ratio test, root test and comparison test effectively.
- To explain the role of Riemann sums and R-integrals in defining integrals.
- To apply algebraic operations to integrable functions and study their behavior.
- To use differentiation and integration to solve mathematical problems.
- To apply mean value results to analyze the behavior of functions in integration.
- To understand how limits, summation, and integration interact mathematically.
- To solve complex mathematical problems using logical reasoning and structured approaches.

Course Content

Unit	Topics	Teaching Hours
1	**Sequences** Definition of a sequence, Bounded sequences, Monotonic sequences, Limit point of a sequence, Limits Inferior and Superior, Convergence of a sequence, Cauchy's sequence, General principle of convergence of a sequence, Algebra of sequences, Sandwich theorem, Subsequence, Bolzano-Weierstrass Theorem, Cauchy's First and Second theorems on limit (without proof) related examples.	**18**
2	**Infinite Series** Definition of a series, Convergence of a series (divergent series, absolutely & conditionally convergent of a series), Geometric series, p-series, Comparison test, Cauchy's Root test, D'Alembert's Ratio test, Raabe's test, Logarithmic Test, Alternating series. (All the tests without proof).	**12**
3	**Reimann Integration** Partitions and Riemann sums, Upper and lower R-integrals, Darboux's theorem (without proof), R-integrability, The integral as limit of sums, Algebra of R-integrable functions, Some classes of integrable functions, Properties of integrable function, Properties of R-integrable function	**18**
4	**Primitive** Continuity, Differentiability of the primitive, Fundamental theorem of integral calculus, Mean value theorems of integral calculus and related examples.	**12**

Suggested References:

1. **A Basic Course in Real Analysis**, Ajit Kumar & S. Kumaresan, CRC Press, ISBN 9781482216370.
2. **A Course of Mathematical Analysis**, Shanti Narayan & P K Mittal, S. Chand Publication, ISBN 9788121904728.
3. **Principles of Real Analysis**, S. C. Malik, New Age International Publishers, 4th Edition, ISBN 9789385923852, 9385923854.
4. **Mathematical Analysis**, S. C. Malik and Savita Arora, 7th Edition, New Age International, ISBN : 9789360740900.
5. **Foundations of Mathematical Analysis**, S. Ponnusamy, CBS Publishers, 2012 Edition, ISBN 9780817682910.
6. **Problems in Mathematical Analysis I: Real Numbers, Sequences and Series**, W. J. Kaczor, M. T. Nowak, American Mathematical Society, Indian Edition, ISBN 9780821848548 **(For problems and exercises of Unit I and Unit II).**

Suggested E-learning:Visit https://onlinecourses.nptel.ac.in for suitable courses.

Course Level	5.5		**Internal Marks**	--
Programme	B.Sc. Mathematics (HONORS)		**External Marks**	--
Semester	V		**Practical Internal**	50
Category of Course	Major Course– 13		**Practical External**	50
Course Credit	4		**Prac. External Exam Duration**	3 Hours
Teaching Hours	8 Hours/Batch/Week		**Total (SEE+CCE)**	100
Course Code			**Exam Duration**	3 Hours
Course Title	**Introduction to Programming in "C" (Practical Based Course)**			

Course objectives: This course aims to introduce students to the fundamentals of programming using the C language, enabling them to develop structured and efficient programs, especially for mathematical problems and purpose. This course has following list of objectives:

- Understand the basic structure of a C program and its components.
- Declare and initialize variables of different data types (e.g., int, float, char, double) to perform basic arithmetic operations using C.
- Write, compile and execute simple C programs.
- Understand the use of several inbuilt C-keywords like printf, scanf, getch etc.
- Understand, identify and correct common programming errors and utilize basic debugging strategies to fix issues in C programs and also use comments to improve readability of code.
- Grasp the concepts of algorithms, data representation, program flow and the role of a compiler and linker in the software development process.
- Apply different types of operators (arithmetic, relational, logical, assignment) and understand operator precedence and associativity to construct and evaluate complex expressions.
- Demonstrate the use of pre and post increment/decrement operators.
- Implement conditional logic using if-else and nested if-else statements.
- Construct iterative solutions by using while, do-while and for loops.
- Control loop execution using break and continue statements.
- Implement the Euclidean algorithm for finding the greatest common divisor (GCD).
- Define and call user-defined functions and pass arguments and return values from them.
- Understand the concept of recursion and be able to write and analyze simple recursive functions.
- Declare, initialize and manipulate one and two-dimensional arrays and perform operations on matrices, such as addition, multiplication and transpose.
- Implement iterative methods like the Bisection method, Newton Raphson method, False position method and Secant method to solve transcendental equations.
- Define and use macros for constant and simple operations.

- Finally, apply structured programming principles to analyze problems, design algorithms and translate them into a working C code.

Course Learning Outcomes: After completion of the course, student will be able to do the following:

- Explain the basic structure of a C program.
- Write, compile and execute simple C programs.
- Identify and correct syntax errors in C code and make use of comments to improve code readability.
- Declare and initialize variables of different data types and perform basic arithmetic operations using C operators.
- Use compound assignment operators and demonstrate the use of pre and post increment/decrement operators.
- Students will be able to utilize formatted input and output functions printf, scanf etc.
- Implement conditional logic using if-else and nested if-else statements.
- Construct iterative solutions using while, do-while and for loops.
- Control loop execution using break and continue statements.
- Implement the Euclidean algorithm for finding the greatest common divisor (GCD).
- Define and call user-defined functions and pass arguments to functions and return values.
- Implement simple recursive user defined functions.
- Declare, initialize and manipulate one and two-dimensional arrays and perform operations on matrices such as addition, multiplication and transpose.
- Implement iterative methods like the Bisection method, Newton Raphson method, False position method and Secant method to solve transcendental equations.
- Define and use macros for constants and simple operations.
- Utilize preprocessor directives for code manipulation.

Practical Number	Title / Aim of Practical
1.	**Understanding the basic structure of a C program:** ***(i)*** Write a C program to print "Hello, everyone." ***(ii)*** Write a program to get the following output in separate lines. I am learning C. But I am a student of Mathematics. ***(iii)*** WAP to print above output 5 times well indented by using only one printf() command. (Use escape sequences \n and \t) ***(iv)*** While writing a C program, commit spelling mistakes in the keywords learnt so far and understand and note down the type of errors generated during compile and run procedure. (Ask students to note it down.) ***(v)*** WAP in which you declare an integer variable inside the main() function but don't use it in any printf() statement or operation. Compile the program and observe if the

	compiler issues any warnings about an unused variable. **Note:**Explain the role of main(), printf() and scanf() functions and header files. Also ask students to use comments in their program wherever required, for better clarity of codes.
2.	**Data types, variables, constants and operators (I) :** ***(i)*** Write a program that takes two integer inputs from the user and performs all five basic arithmetic operations (+, -, *, /, %) on them. Print the results with descriptive labels. Ex.: Sum: 15 + 28 = 43 ***(ii)*** Write a program that takes two floating point inputs from the user and performs all four basic arithmetic operations (+, -, *, /) on them. Print the results with descriptive labels. ***(iii)*** Write a program that declares a character variable, assigns it a letter and then prints the character along with its ASCII value.
3.	**Data types, variables, constants and operators (II) :** ***(i)*** Write a program that declares a pair of integer variables and then demonstrates the use of compound assignment operators (+=, -=, *=, /=, %=) by performing these operations and printing the value after each operation. ***(ii)*** Write a program to demonstrate the pre and post increment and decrement operators (++k, --k, k++, k--) by using and printing them within a printf() statement. Ex.: Post increment: the value of variable is 25, then becomes 26. ***(iii)*** List down all the different data types along with their format specifier. Also make a list of all the operators along with their order of precedence.
4.	**Data types, variables, constants and operators (III):** ***(i)*** Write a program that prompts the user to enter an integer and then reads and prints the entered integer using scanf() with the %d format specifier. Use %4d, %04d, %-4d also and see what happens. ***(ii)*** Write a program that prompts the user to enter a floating point number and then reads and prints the entered number using scanf() with the %f, %.4f format specifiers.
5.	**Control flow with conditional statements (I) :** ***(i)*** Write a program to take an integer input from the user and display whether it is even or odd. ***(ii)*** Write a program that takes three integer inputs from the user and prints the largest of the three numbers using nested if-else statements. ***(iii)*** Write a program that takes a year as input from the user and checks if it is a leap year. (Note: A leap year is divisible by 4, but not by 100 unless it is also divisible by 400). **Note:** Use of conditional operator can be discussed here.
6.	**Control flow with conditional statements (II) :** ***(i)*** Write a program that takes the coefficients a, b, c of a quadratic equation $ax^2 + bx + c = 0$ as inputs and calculates and prints the roots and nature of the roots (real and distinct, real and equal or imaginary). ***(ii)*** Write a program that takes the purchase amount and quantity of two or more articles

	as input. If the total purchase amount is greater than a certain threshold (e.g., 500, 1000), apply a discount (e.g., 5%, 10%) and print the final purchase amount. Use an if-else statement for multiple offers.
7.	**Control flow with loops (I) :** ***(i)*** WAP to print first *n* terms of the sequence 1, 3, 5, … using a while loop. ***(ii)*** WAP to print first *n* terms of the sequence 5, 8, 11, … using a do-while loop. ***(iii)*** WAP to print first *n* terms of the sequence 3, 6, 12, 24, … using a for loop.
8.	**Control flow with loops (II) :** ***(i)*** Write a program to print sum of all integers in a given range. ***(ii)*** Write a program to print factorial of a given integer. ***(iii)*** WAP to generate and print all combinations of 1, 2, 3, 4 using for loops.
9.	**Control flow with loops (III) :** ***(i)*** Write a program that takes an integer input from the user and calculates and displays the sum of its digits. ***(ii)*** Write a program that takes an integer input from the user and prints its reverse. Also check if the number is a palindrome ? ***(iii)*** Write a program that finds all 3 digit Armstrong numbers and prints them.
10.	**Control flow with loops (IV) :** ***(i)*** Write a program that iterates from 1 to *n* and prints all numbers which are not multiples of 3. (Use continue keyword) ***(ii)*** Write a program to print all prime numbers within a given range. (Use break keyword) ***(iii)*** Write a program that takes two positive integers as inputs and finds their GCD using the Euclidean algorithm. **Note:**Use of goto keyword will be illustrated later.
11.	**User defined functions (I) :** ***(i)*** Write a program that defines a function factorial() that takes a non-negative integer as an argument and returns its factorial. Use this function to obtain ^nP_r and ^nC_r. ***(ii)*** Write a program to print all prime numbers within a given range by using a user defined function say, prime() which takes an integer as input and decides whether that integer is a prime or not.
12.	**Recursive UDF (II) :** ***(i)*** Write a program that calculates the factorial of a non-negative integer using a *recursive* UDF approach. Display the output. ***(ii)*** Write a program that generates the n^{th} Fibonacci number using a *recursive* function. Display the output. ***(iii)*** Implement a function gcd() that calculates the GCD of two integers *a* and *b* by using the Euclidean algorithm *recursively*. Display the output.
13.	**One dimensional array :** ***(i)*** Write a program to declare an integer array of size 5, initialize it with some values and then print each element along with its index. Now input 5 integer values from

	user and store them in the above array and again print each element of this array along with its index. Also, print the sum and average of all elements of this array. ***(ii)*** Write a program to reverse the elements of an integer array without using a dummy array.
14.	**Two dimensional array (I) :** ***(i)*** (a) Write a program to declare a 2 dimensional integer array of order 3×4, initialize it with some values and then print all its elements in matrix format. (b) Now update the elements of this array by taking suitable inputs from user and again print each element of this array along with its index. (c) Print the sum and average of all elements of this array. (d) Also calculate and print sum of elements of each row and each column of this array. ***(ii)*** Write a program to find the transpose of a given 2D integer array and display it in matrix form.
15.	**One and two dimensional arrays (II) :** Write a program to add and multiply two matrices of suitable order.
16.	**Solving transcendental equations – iterative methods (I) :** Write a program to obtain a root of the given transcendental equation by Bisection method. Print all iterations in a tabular form. **Note:**Also illustrate the use of goto keyword in this practical.
17.	**Solving transcendental equations – iterative methods (II) :** Write a program to obtain a root of the given transcendental equation by Newton Raphson method. Print all iterations in a tabular form.
18.	**Solving transcendental equations – iterative methods (III) :** Write a program to obtain a root of the given transcendental equation by False position method. **Note:**Also illustrate the use of goto keyword in this practical.
19.	**Solving transcendental equations – iterative methods (III) :** Write a program to obtain a root of the given transcendental equation by Secant method. **Note:**Also illustrate the use of goto keyword in this practical.
20.	**Macros and preprocessor directives :** ***(i)*** Write a program involving macro constant value of π in preamble to obtain surface area of a sphere by taking radius as input from the user. ***(ii)*** Write a program by using macro definition to check if an integer is even ? ***(iii)*** Write a program that defines macros for basic arithmetic operations: ADD(a, b), SUBTRACT(a, b), MULTIPLY(a, b). ***(iv)*** Write a program involving macro definition to obtain bigger of the two given numbers. ***(v)*** Write a macro definition to test whether a given character is an alphabet or not. ***(vi)*** Write a macro definition with arguments for calculation of simple interest and amount.

Suggested References:

1. Let us C by YashavantKanetker, 14th edition, BPB Publications, New DelhiISBN 978-8183331630
2. C Programming Absolute Beginner's Guide by Greg Perry and Dean Miller, Pearson edu. ISBN 978-0789751980
3. Programming in C by Stephen G. Kochan, 4th edition, Addison Wesley Professional. ISBN 978-0321776419
4. The C Programming Languageby Brian W. Kernighan and Dennis M. Ritchie, Pearson education. ISBN 978-0131103627
5. Expert C Programming: Deep C Secretsby Peter Van Der Linden, Pearson education. ISBN 9780131774292
6. Numerical Method byV.N. Vedamurthy and N. Ch. S. N. Iyengar, 1st Edition, Vikas Publishing House Pvt. Ltd., ISBN 978-8125906308

Suggested E-learning: Visit https://nptel.ac.in/courses for suitable courses.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Minor Course-4 for the students of who have opted Major Chemistry or Major Physics as per NEP-2020
Faculty of Science
Effective from June 2025
Subject: Mathematics
SEMESTER- V

Course Level	5.5		**Internal Marks**	50
Programme	B.Sc. (Hons.) Chemistry/Physics		**External Marks**	50
Semester	V		**Practical Internal**	-
Category of Course	Minor Course-4 for B.Sc. (Hons) with Chemistry/ Physics		**Practical External**	-
Course Credit	4		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total (SEE+CCE)**	100
Course Code			**Exam Duration**	2 Hours
Course Title	**Essential Mathematics for Competitive Examinations**			

Course Objectives:

- To strengthen fundamental arithmetic operations and number sense required for quick calculations.
- To develop proficiency in solving problems related to percentages, profit & loss and simple & compound interest.
- To enable students to tackle problems involving time, work, speed, distance and related concepts.
- To build a strong understanding of ratio, proportion and partnership concepts.
- To introduce foundational algebraic concepts and their application in solving equations.
- To train students in interpreting and analyzing data presented in various graphical and tabular formats.
- To enhance problem-solving speed and accuracy through practice with simplification, approximation and number series.
- To familiarize students with basic Mensuration concepts for calculating areas and volumes of common geometric shapes.
- To introduce the fundamental principles of permutation, combination and probability.
- To develop strategic thinking for attempting quantitative aptitude questions effectively under timed conditions.

Course Learning Outcomes: Upon successful completion of this course, students will be able to:

- Perform arithmetic operations (addition, subtraction, multiplication, division) efficiently and accurately, including decimals and fractions.
- Calculate percentages, profit/loss, simple interest and compound interest for various scenarios.
- Solve problems on time & work, pipes & cisterns, time & distance, boats & streams and trains.
- Apply concepts of ratio, proportion, average, mixtures &alligation and partnership to solve practical problems.

- Solve linear and quadratic equations and compare variables based on given conditions.
- Interpret and analyze data from bar graphs, pie charts, line graphs and tables to answer related questions accurately.
- Identify patterns in number series and apply simplification and approximation techniques to complex calculations.
- Calculate the area and volume of basic 2D and 3D geometric shapes (e.g. square, rectangle, circle, cylinder, cone, sphere).
- Apply the basic principles of permutation, combination and probability to solve introductory problems.
- Manage time effectively during quantitative aptitude tests and employ shortcut methods for faster problem-solving.

COURSE CONTENT

Unit No.	Title of the Unit and the Topics	Teaching Hours
1	**Basic Arithmetic and Number System** • **Number System:** Classification of numbers (Natural, Whole, Integers, Rational, Irrational, Real, Prime, Composite, Even, Odd), Divisibility rules, LCM and HCF, Fractions and Decimals. • **Simplification and Approximation:**BODMAS Rule, Square roots and Cube roots, Percentage to fraction conversion, Approximation techniques. • **Averages:**Basic concept and formula, Weighted average, Problems related to average age, speed. • **Ratio and Proportion:**Basic concepts, types of ratios, Compound ratio, Inverse ratio, Proportion (direct, inverse), Problems on age. • **Percentages:**Definition and calculation of percentages, Percentage increase/decrease, Applications in daily life.	**15**
2	**Commercial Mathematics** • **Profit and Loss:**Cost Price, Selling Price, Marked Price,Profit/Loss percentage, Discount, Successive discounts. • **Simple and Compound Interest:**Formulas for Simple Interest (SI), Formulas for Compound Interest (CI), Difference between SI and CI, Applications involving installments. • **Partnership:**Introduction to partnership, Calculation of profit/loss sharing based on investment and time. • **Mixtures and Alligations:**Rule of Alligation, Problems on mixing different quantities. • **Data Sufficiency:**Understanding the concept, Solving questions where you need to determine if the given data is sufficient to answer the question.	**15**
3	**Time, Work, Speed & Mensuration**	**15**

	• **Time and Work:**Work done by individuals and groups, Pipes and Cisterns, Efficiency based problems. • **Time, Speed and Distance:**Basic formulas (Distance = Speed x Time), Average speed, Problems on trains (relative speed), Boats and Streams (upstream/downstream speed). • **Mensuration (Basic 2D and 3D):**2D Shapes: Area and Perimeter of Square, Rectangle, Triangle, Circle, Rhombus, Trapezium, Parallelogram, 3D Shapes: Surface Area and Volume of Cuboid, Cube, Cylinder, Cone, Sphere. • **Clocks and Calendars:**Basic concepts of angle between hands of a clock, finding day of the week for a given date.	
4	**Algebra, Data Interpretation & Advanced Topics** • **Basic Algebra:**Linear Equations in one and two variables, Quadratic Equations: Factorization method, Quadratic formula, Comparing roots, Algebraic identities (basic). • **Number Series:**Identifying patterns (arithmetic progression, geometric progression, differences, squares, cubes, alternate patterns, mixed patterns), Finding missing terms or wrong terms. • **Data Interpretation (DI):** Types of DI: Tabular Data, Bar Graphs, Pie Charts, Line Graphs, Solving questions involving percentages, ratios, averages and comparisons based on given data sets. • **Permutation, Combination, and Probability (Basic):** Permutation: Arrangement of objects, Combination: Selection of objects, Probability: Basic concepts, events, sample space and simple probability problems.	**15**

REFERENCE BOOKS:

1. **Quantitative Aptitude for Competitive Examinations** Author: Dr. R.S. Aggarwal Publishing House: S. Chand Publishing ISBN: 978-9355012326
2. **Magical Book on Quicker Maths** Author : M. Tyra Publishing House: BSC Publishing Co Pvt Ltd ISBN: 978-9381577227
3. **Fast Track Objective Arithmetic** Author : Rajesh Verma Publishing House: Arihant Publications ISBN: 978-9326197298

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Syllabus of B.Sc. (Honors) Mathematics as per NEP-2020
Faculty of Science
Effective from June 2025
Subject: Applied Mathematics
SEMESTER- V

Course Level	5.5		**Internal Marks**	--
Programme	B.Sc. Mathematics (HONORS)		**External Marks**	--
Semester	V		**Practical Internal**	50
Category of Course	Minor Course-4 (Applied Mathematics-1)		**Practical External**	50
Course Credit	4		**Prac. External Exam Duration**	3 Hours
Teaching Hours	8 Hours/Batch/Week		**Total (SEE+CCE)**	100
Course Code			**Exam Duration**	3 Hours
Course Title	**Optimization (Practical based course)**			

Course Objectives:

- To learn how to formulate linear programming problems (LPP) based on real-world scenarios.
- To solve bounded and unbounded feasible region problems using graphical techniques.
- To apply simplex, two-phase and big-M methods to find optimal solutions.
- To understand and derive the dual of a given primal LPP, interpreting its significance.
- To compute initial solutions using methods like North West Corner, Least Cost and Vogel's Approximation.
- To apply the MODI method to balanced and unbalanced transportation problems and explore alternative solutions.
- To find the best assignment solutions for both balanced and unbalanced scenarios using optimization approaches.
- To apply algebraic, arithmetic and matrix methods to determine strategies for competitive games.
- To solve m × n games using LP techniques and graphical methods for special cases.
- To enhance analytical thinking by applying mathematical techniques to practical optimization problems.

Course Learning Outcomes: After successfully completing the course, a student will be able to….

- Structure mathematical models for optimization problems in real-world scenarios.
- Apply graphical, simplex, two-phase and big-M methods to find feasible and optimal solutions.
- Analyze the relationship between primal and dual problems in linear programming.
- Use methods like North West Corner, Least Cost and Vogel's Approximation to determine efficient transportation allocations.
- Refine solutions for both balanced and unbalanced transportation scenarios.
- Solve balanced and unbalanced assignment problems using optimization techniques.
- Apply algebraic, arithmetic, matrix, and graphical methods to analyze optimal strategies.

- Implement LP techniques for solving m × n games, improving decision-making efficiency.
- Assess and select the most suitable mathematical techniques for various optimization problems.
- Develop analytical reasoning to tackle complex mathematical challenges in business and engineering applications.

Course Content

Practical No.	Aim
1	Exercise on formulation of linear programing problems
2	Solve the given LPP using graphical method for bounded feasible region.
3	Solve the given LPP using graphical method for unbounded feasible region.
4	Solve the given LPP using simplex method.
5	Solve the given LPP using two phase method.
6	Solve the given LPP using big-M method.
7	Obtain Dual of the given Primal LPP.
8	Find the initial solution of a given transportation problem using North West Corner Method (NMCM).
9	Find the initial solution of a given transportation problem using Least Cost Method (LCM).
10	Find the initial solution of a given transportation problem using Vogel's Approximation Method (VAM).
11	Find the optimum solution of a given ***balanced*** transportation problem using the MODI method.
12	Find the optimum solution of a given ***unbalanced*** transportation problem using the MODI method.
13	Find the alternate optimum solutions of a given unbalanced transportation problem using the MODI method.
14	Find the optimum solution of a given balanced assignment problem.
15	Find the optimum solution of a given unbalanced assignment problem.
16	Find solution of m x n games by algebraic method.
17	Find solution of n x n games by using arithmetic method.
18	Find solution of n x n games by using matrix method.
19	Find solution of m x n games by linear programing method.
20	Find solution of m x 2 and 2 x n games by Graphical method.

Suggested References:

1. J. K. Sharma, Operations Research Theory and Applications, 6th edition, TrinityPress, 2017. (ISBN: 978-93-85935-14-5)
2. Operations Research An Introduction, 10th edition, Hamdy A. Taha, Pearson (ISBN 10: 1-292-16554-5, ISBN 13: 978-1-292-16554-7)
3. R. K. Gupta, Operations Research, Krishna Prakashan Media, 2014. (ISBN: 81-8283-087-7)
4. S. S. Rao, Engineering Optimization: Theory and Practice, Wiley, 2019. (ISBN 978-0-470-18352-6)
5. Operations Research by R.Panneerselvam,Third Edition, (ISBN: 9789354437892)
6. Operations Research by A. M. Natarajan, P. Balasubramani, A. Tamilarasi, fourth edition, 2009, Pearson education. (ISBN: 978-81-317-0000-6)

Suggested e-Learning Resources:

1. https://nptel.ac.in/courses/111107128
2. https://archive.nptel.ac.in/courses/111/104/111104027/
3. https://archive.nptel.ac.in/courses/112/106/112106134/
4. https://archive.nptel.ac.in/courses/111/102/111102012/

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Minor Course-5 for the students of who have opted Major Chemistry or Major Physics as per NEP-2020
Faculty of Science
Effective from June 2025
Subject: Mathematics
SEMESTER- V

Course Level	5.5		**Internal Marks**	50
Programme	B.Sc. (Hons.) Chemistry/Physics		**External Marks**	50
Semester	V		**Practical Internal**	-
Category of Course	Minor Course-5 for B.Sc. (Hons) with Chemistry/ Physics		**Practical External**	-
Course Credit	4		**Prac. External Exam Duration**	-
Teaching Hours	60		**Total (SEE+CCE)**	100
Course Code			**Exam Duration**	2 Hours
Course Title	**Fundamentals of Partial Differential Calculus**			

Course Objectives: By the end of this course, students will be able to:

- Understand the concepts of limit and continuity for functions of two variables.
- Develop proficiency in computing partial derivatives of various orders and types.
- Apply partial differentiation techniques to composite and homogeneous functions.
- Analyze and interpret important theorems such as Euler's, Young's, and Schwartz's.
- Use total differentials and the chain rule for multivariable function transformations.
- Utilize Jacobians and Taylor's theorem in solving approximation problems.
- Determine extrema of multivariable functions using various optimization techniques.
- Formulate partial differential equations (PDEs) through elimination methods.
- Solve first-order PDEs using techniques like Lagrange's and Charpit's methods.
- Classify and solve second-order linear PDEs using appropriate analytical methods.

Course Learning Outcome: After successfully completing this course, students will be able to:

- Evaluate limits and verify continuity of multivariable functions.
- Calculate partial derivatives, including higher-order and mixed derivatives.
- Apply Euler's theorem to homogeneous functions in both two and three variables.
- Transform variables and compute total differentials for multivariable functions.
- Derive and use Jacobians in coordinate transformations and error approximations.
- Utilize Taylor's theorem to approximate functions of two variables.
- Identify and analyze maxima, minima, and saddle points in multivariable systems.
- Construct partial differential equations from given functions and conditions.
- Solve linear first-order PDEs using both standard and special solution methods.
- Classify and resolve second-order PDEs using techniques like Monge's method.

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Minor Course-5 for the students of who have opted Major Chemistry or Major Physics as per NEP-2020
Faculty of Science
Effective from June 2025
Subject: Mathematics
SEMESTER- V

Unit No.	Title of the Unit and the Topics	Teaching Hours
1	Partial derivatives Partial derivatives of first and higher order, partial differentiation of composite functions, partial differentiation of homogeneous functions, Euler`s theorem on homogeneous functions of two and three variables, total differential and chain rule, change of variables, partial differentiation of implicit functions, Young`s and Schwartz`s theorem (without proof).	**14**
2	Applications of partial derivatives Errors and approximate values, Jacobians, Taylor`s theorem for functions of two variables, maxima, minima and saddle points of functions of several variables, Lagrange`s method of undetermined multipliers.	**10**
3	Formation of Partial differential equations by the elimination of arbitrary constants and arbitrary functions. Partial Differential Equations of the first order, the complete and particular integrals, Lagrange's solution of the linear equation. Some special types of equations which can be solved easily by the methods other than the general method, Charpit's method.	**18**
4	Partial differential equations of second and higher orders. Classification of linear partial differential equations of second order. Homogenous and non-homogenous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients. Monge's methods.	**18**

Reference Books:

1. Advanced Engineering Mathematics *by* ***Erwin Kreyszig, ISBN****: 9788126554232 (Indian edition)*
2. Higher Engineering Mathematics *by* ***B.S. Grewal, ISBN****: 9789352534028*
3. Partial Differential Equations for Scientists and Engineers *by* ***Stanley J. Farlow, ISBN****: 9780486676203*
4. Calculus, Volume II: Multivariable Calculus and Linear Algebra *by* ***Tom M. Apostol, ISBN****: 9788126518104*
5. Elementary Differential Equations and Boundary Value Problems *by* ***William E. Boyce & Richard C. DiPrima ISBN****: 9788126554560*

Course Level	5.5		**Internal Marks**	--
Programme	B.Sc. Mathematics (HONORS)		**External Marks**	--
Semester	V		**Practical Internal**	50
Category of Course	Minor Course-5 (Applied Mathematics-2)		**Practical External**	50
Course Credit	4		**Prac. External Exam Duration**	3 Hours
Teaching Hours	8 Hours/Batch/Week		**Total (SEE+CCE)**	100
Course Code			**Exam Duration**	3 Hours
Course Title	**Introduction to SAGE (FOSS) (Practical based course)**			

Course Objectives:

- **Develop a strong foundation in Sage:** Understand fundamental concepts, including variables, constants, data types, operators and built-in functions.
- **Solve mathematical expressions effectively:** Utilize Sage to solve equations, systems of equations, and approximate roots using commands like `solve()` and `find_root()`.
- **Master fundamental calculus operations:** Compute limits, derivatives, maxima/minima, partial derivatives and integral calculations using Sage.
- **Explore advanced calculus techniques:** Compute indefinite, definite, and numerical integrals, Taylor series expansions and power series.
- **Gain proficiency in differential equations:** Solve first-order and second-order ordinary differential equations using Sage tools.
- **Enhance mathematical visualization skills:** Create 2D and 3D graphical representations, including functions, polygons, conics and animations.
- **Apply matrix operations in linear algebra:** Understand determinants, transposes, adjoints, inverse matrices and classifications of matrices.
- **Perform advanced computations in linear algebra:** Compute rank, nullity, trace, echelon forms, eigenvalues and eigenvectors of matrices.
- **Explore essential number theory concepts:** Analyze prime numbers, modular arithmetic, prime ranges, divisors, continued fractions and transcendental numbers.
- **Apply group theory using Sage:** Work with permutation groups, symmetric groups, alternating groups, Abelian groups and matrix groups while verifying properties like cyclicity and commutativity.

Course Learning Outcomes:

After successfully completing this course, a student will be able to….

- **Understand and utilize Sage effectively** by working with variables, constants, data types and built-in functions for mathematical computations.
- **Apply equation-solving techniques** using Sage commands such as `solve()` and `find_root()` to determine solutions for algebraic and transcendental equations.

- **Demonstrate proficiency in calculus operations** by accurately computing limits, derivatives, integrals and extrema of functions using Sage.
- **Analyze advanced calculus concepts** such as Taylor series expansions, power series and numerical integration, enabling deeper understanding of function approximations.
- **Solve differential equations** efficiently, including first and second order ordinary differential equations, leveraging Sage's symbolic and numerical solvers.
- **Create mathematical visualizations** using 2D and 3D graphing tools in Sage to represent functions, geometric shapes and dynamic animations.
- **Perform essential matrix operations** by computing determinant, transpose, adjoint, inverse of a matrix and verifying matrix classification.
- **Execute advanced linear algebra computations** such as rank determination, eigenvalue, eigenvector computations& elementary row operations using Sage.
- **Apply number theory principles** using Sage to analyze prime numbers, modular arithmetic, divisors, continued fractions and transcendental numbers.
- **Demonstrate an understanding of group theory** by generating subgroups, verifying group properties and working with matrix groups and permutation groups using Sage.

Course Content

1	**Introduction to Sage:** i.e. Introduction to variables, constants, data types, some inbuilt (library) constants & functions, how to enter a matrix, how to enter a vector, operators, how to get help etc.
2	**Operations on expressions:** (a) Solve(f(x)==g(x),x) (b) Solve([f(x,y)==0,g(x,y)==0],x,y) (c) Find a root of f(x) in the given interval (a, b) such that f(x) ≈ 0 (approximate root) using find_root() command. (d) Finding sum and product of the given series from 1 to n terms. (using sum() and prod() functions)
3	**Calculus:** (a) Find limit of a given function. (b) Find left- and right-hand side limits of a given function. (c) Find derivative of a given function. (d) Finding maxima and minima of a given function f(x) in the given interval (a, b). (e) Find partial derivative of a given bivariate function.
4	**Calculus:** (a) Find indefinite integral of a given function. (b) Find definite integral of a given function. (c) Find numerical integral of a given function.
5	**Calculus:** (a) Find Taylor series expansion of a given function f(x) about x = a upto degree n. (b) Find power series expansions of functions.

6	**Calculus:** (a) Find general solution of ordinary differential equations of first order. (b) Find general solution of linear ordinary differential equations of second order.
7	**2D Graphics:** (a) Draw a line passing through the given points. (b) Draw a polygon having the given points as its vertices. (c) Draw a circle with the given point as centre and with the given radius. (d) Draw different conics using Cartesian as well as parametric equations. (e) Plotting the graph of a given continuous /discontinuous function.
8	**2D Graphics :** (a) Draw the graph of the given function in parametric form. (b) Draw different conics using Cartesian as well as parametric equations. (c) Drawing graph of the function in polar form.
9	**2D Graphics:** (a) Plotting the graph of a given continuous /discontinuous function. (b) Draw combined graphs. (c) Draw graphs with animation. (d) Explore different customization options in plotting of 2D graphs.
10	**3D Graphics:** (a) Drawing a line in three dimensions. (b) Draw a sphere with the given point as center and with the given radius. (c) Drawing Platonic solids. (tetrahedron, cube, octahedron, dodecahedron, icosahedron)
11	**3D Graphics:** (a) Draw the graph of given function f(x, y) in 3D. (b) Draw the graph of given function f(x, y) in 3D.(parametric form) (c) Explore different customization options in plotting of 3D graphs.
12	Simplification and expansion of given symbolic functions.
13	Finding partial fractions of given functions.
14	**Linear Algebra:** (a) Entering a rectangular matrix and finding its determinant. (b) Finding transpose, adjointand conjugate of a given matrix. (c) To determine whether the entered matrix is square, zero, identity, scalar, symmetric, invertible, nilpotent, idempotent or not. (d) Entering a square matrix and finding its inverse if exists.
15	**Linear Algebra:** (a) Finding rank, nullity no. of rows, no. of columns, trace of a matrix. (b) Finding Echelon form of the entered matrix. (c) Finding characteristic polynomial, eigen values and eigen vectors of the entered matrix.

	(d) Performing elementary row operations on the entered matrix.
16	**Number Theory:** (a) Determine the entered number is a prime or not. (b) Find the next prime, previous prime next probable prime to the entered number. (c) Finding primes p such that $m \leq p < n$. [using prime_range(m, n)] (d) Finding prime powers [using prime_powers(m, n)]
17	**Number Theory:** (a) Compute modular powers. (b) Decimal representation of an irrational number and a transcendental number up to certain decimal places.
18	**Number Theory:** (a) Finding continued fractions of a real number x. (b) Find divisors, number of divisors and the sum of the k^{th} powers of the divisors of an integer n.
19	**Group Theory:** (a) Permutation group, Symmetric group and Alternating group of n symbols. (b) Abelian group, Matrix groups (GL=General Linear group and SL=Special Linear group), normal subgroups.
20	**Group Theory:** (a) Generate subgroup of a permutation group. (b) Generate Cayley's Table for specific groups. (c) Verify group property like cyclicity, commutativity etc.

Suggested References:

1. Sage Beginner's Guide- Craig FinchISBN:9781849514477
2. An Introduction to SAGE Programming--Razvan A. Mezei · 2015 (With Applications to SAGE Interacts for Numerical Methods) ISBN:9781119122784
3. Sage for Undergraduates - Gregory V. Bard · 2015, ISBN:9781470411114
4. Visit https:\\www.sagemath.org for any query.

E-resource: https://onlinecourses.nptel.ac.in/

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Faculty of Science
Effective from June 2025
SEMESTER- V

INTERNAL EVALUATION SCHEME		
NO	**Particulars**	**Marks**
1	**Mid Semester Exam/ Practical Exam (Mandatory)**	**25**
2	Class Test	05
3	Open book exam/test	05
4	Open note exam/test	05
5	Self-test/ Online test	05
6	Essay/Article writing	05
7	Quizzes/Objective test	05
8	Class assignment	05
9	Home assignment	05
10	Reports Writing	05
11	Research/Dissertation	05
12	Case Studies	05
13	Viva/Oral exam	05
14	Group Discussion	05
15	Role Play	05
16	Paper presentation/Seminar	05
17	Language Lab work	05
18	Interview	05
19	Craft work	05
20	Co-curricular work	05
21	Field Assignment	05
22	Poster Presentation	05
23	Attendance	05
24	Project Work	05
	Total	**50**

Note: Sr.No.1 is mandatory. Select any five from Sr.No.2 to 24. Each contains five marks. Student should secure 18 Marks for passing in internal Exam.

Paper Style

Paper Style for SEE of Major Courses -11 & 12, Minor-04 (Physics/Chemistry) & 05 (Physics/Chemistry)

Que. No.	Particulars	From Which Unit	Marks
1	Answer any TWO out of THREE	1	**10**
2	Answer any TWO out of THREE	2	**10**
3	Answer any TWO out of THREE	3	**10**
4	Answer any TWO out of THREE	4	**10**
5	Answer any TWO out of THREE	From All Four Units	**10**
		Total Marks	**50**

Paper Style for SEE of Major Course – 13, Minor-04 (Applied Mathematics-1), Minor-05 (Applied Mathematics-2) (Practical Based Course of 4 Credits)

Que. No.	Particulars	Marks
1	Answer any Four out of Six (Each of 9 Marks)	**36**
2	Viva	**08**
3	Journal	**06**
	Total Marks	**50**