KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY

Faculty of Science

B. Sc. Semester V & VI

(Exit option)

MATHEMATICS

SYLLABUS

Curriculum as per UGC Guideline Framed according to National Education Policy (NEP) - 2020

With effect from June – 2025

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NATURE AND EXTENT OF BACHELOR'S DEGREE PROGRAMME IN MATHEMATICS (HONOURS)

A bachelor's degree in Mathematics with Research or without Research is a 4 year degree course which is divided into 8 semesters.

Sr. No.	Type of Award	Stage of Exit	Mandatory Credits to be secured for the Award
1	Certificate in the Discipline	After successful completion of 1st Year	Certificate With Exit 4 Credit course (44+4)
2	Diploma in the Discipline	After successful completion of 1st and 2nd Years	Diploma With Exit 4 Credit course (88+4)
3	B.Sc. in Mathematics	After successful completion of 1st, 2nd and 3rd Years	Bachelor degree (132)
4	B.Sc. (Honours with Research/without Research) in Mathematics	After successful completion of 1st, 2nd, 3rd and 4th Years	Bachelor + Honors degree (176) Bachelor + Research degree (176)

A student pursuing 4 years undergraduate programme with research in a specific discipline shall be awarded an appropriate Degree in that discipline on completion of 8th Semester if he/she secures required Credits. Similarly, for certificate, diploma and degree, a student needs to fulfil the associated credits. An illustration of credits requirements in relation to the type of award is illustrated as above.

Bachelor's Degree (Honours) is a well-recognized, structured, and specialized graduate level qualification in tertiary, collegiate education. The contents of this degree are determined in terms of knowledge, understanding, qualification, skills, and values that a student intends to acquire to look for professional avenues or move to higher education at the postgraduate level.

Bachelor's Degree (Honours) programmes attract entrants from the secondary level or equivalent, often with subject knowledge that may or may not be directly relevant to the field of study/profession. Thus, B.Sc. (Honours) Course in Mathematics aims to prepare students to qualify for joining a profession or to provide development opportunities in particular employment settings.

AIMS:

- To enable the students not only in learning of mathematical concepts but also in contemporary interdisciplinary ideas related to mathematics.
- Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.
- To shape students as a responsible and sensible citizen of India.

- To prepare students for national as well as international competitive examinations, especially UGC-CSIR NET/SET/JAM/GATE etc.

COURSE INTRODUCTION:

The newly designed curriculum of B.Sc. in Mathematics aims to achieve basic knowledge and computational skills to study mathematical science. Students would be exposed to different areas of mathematical science using a unique combination of theoretical and practical learning.

Students would be taught using modern methods and technologies to understand Theoretical mathematics, mathematical software like SCILAB, MATLAB etc. The programme also aims to equip students with computing techniques using Python and similar software.

The programme will also have study tours, students exchange programmes and various levels seminar, conference etc.

PROGRAMME OUTCOMES:

- Students will generate more interest in study of mathematics.
- Students will acquire basic Theoretical concepts and practical skills along with domain knowledge of different branches in mathematics.
- Students will become employable; they will be eligible for career opportunities in Industry, or will be able to opt for entrepreneurship.
- Students will possess basic subject knowledge required for higher studies and research as well as contemporary professional courses.
- Student will be equipped with mathematical modelling ability, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- Students will learn how to apply mathematical concepts to practical and real-life problems.

Year	Semester	Course Code	Paper Title	Credits	Marks		Total
					CA	UA	
Third Year	V	MAJ MAT-501 (Theory)	Group Theory	3	35	40	75
		MAJ MAT-502-P (Practical)	Group Theory - Practical	1	15	10	25
		MAJ MAT-503 (Theory)	Mathematical Analysis	3	35	40	75
		MAJ MAT-504-P (Practical)	Mathematical Analysis- - Practical	1	15	10	25
		MAJ MAT-505 (Theory)	Operations Research - I	3	35	40	75
		MAJ MAT-506-P (Practical)	Operations Research - I - Practical	1	15	10	25
			Total Credits	**12**	**Total Marks**		**300**
		MIN MAT-507 (Theory)	Ordinary & Partial Differential Equations	3	35	40	75
		MIN MAT-508-P (Practical)	Ordinary & Partial Differential Equations - Practical	1	15	10	25
		MIN MAT-509 (Theory)	Operations Research - II	3	35	40	75
		MIN MAT-510-P (Practical)	Operations Research - II - Practical	1	15	10	25
			Total Credits	**8**	**Total Marks**		**200**
Third Year	VI	MAJ MAT-601 (Theory)	Ring Theory	3	35	40	75
		MAJ MAT-602-P (Practical)	Ring Theory - Practical	1	15	10	25
		MAJ MAT-603 (Theory)	Graph Theory	3	35	40	75
		MAJ MAT-604-P (Practical)	Graph Theory - Practical	1	15	10	25
		MAJ MAT-605 (Theory)	Operations Research - III	3	35	40	75
		MAJ MAT-606-P (Practical)	Operations Research - III - Practical	1	15	10	25
			Total Credits	**12**	**Total Marks**		**300**
		MIN MAT-607 (Theory)	Complex Analysis	3	35	40	75
		MIN MAT-608-P (Practical)	Complex Analysis - Practical	1	15	10	25
		IN MAT – 609 (Internship)	Internship in Mathematics	4	40	60	100
			Total Credits	**8**	**Total Marks**		**200**

KSKV KACHCHH UNIVERSITY, BHUJ
B.Sc. : Semester V (FIVE) SUBJECT: MATHEMATICS
Paper: Group Theory
Paper Code: MAJ MAT – 501
(3 credits)

Unit 1

Groups, Examples of groups, Elementary properties of a Group, Order of a group, Residue Classes modulo m, Order of an element of a Group, Subgroups and Complexes, Necessary and sufficient conditions for a subgroup, Algebra of subgroups, Algebra of Complexes, Cosets, Coset Decomposition of a Group, Lagrange's theorem and applications (Euler's Theorem and Fermat's Theorem)

Unit 2

Permutations, Groups of Permutations, Cyclic permutation, Transpositions, expressing a permutation as a product of transpositions, Even and Odd permutations, Cyclic groups and their properties, Subgroups of a cyclic group, Group Homomorphisms, Properties of Homomorphism, Kernel of a homomorphism, Isomorphisms, Fundamental theorem of homomorphism, Group of Automorphisms of a Group, Inner Automorphism.

Unit 3

Normal subgroups, Conjugate Elements, Normalizer of an element of a Group, Class equation of a Group, Centre of a Group, Division Algorithm, Quotient groups, Group tables for quotient groups, First, second and third theorem of Group Isomorphism, Cayley's Theorem and examples.

Reference Books :

1. Dr. I. H. Sheth, "Abstract Algebra", Published by Prentice Hall of India
2. Bhattacharya P.B., Jain S.K. and Nagpal S.R., "Basic Abstract Algebra", Foundation books, New Delhi.
3. Fraleigh J. B., "A First Course in Abstract Algebra", Narosa Publishing, New Delhi
4. Gallian J.A., "Contemporary Abstract Algebra", Narosa Publishing House, New Delhi
5. Herstein I.N., "Topics in Algebra", Vikas Publishing, New Delhi

KSKV KACHCHH UNIVERSITY, BHUJ
B.Sc. : Semester V (FIVE) SUBJECT: MATHEMATICS
Paper: Group Theory Practical
Paper Code: MAJ MAT – 502-P
(1 credit)

Practical

Practical No.	Description
1	C++ Program for mathematical operations.
2	C++ Program to Check Whether Number is Even or Odd.
3	C++ Program to Find All Roots of a Quadratic Equation.
4	C++ Program to Find Factorial.
5	C++ Program to Display Fibonacci Series.
6	C++ Program to Subtract Complex Number Using Operator Overloading.
7	C++ Program to Check Whether a Number is Palindrome or Not.
8	C++ Program to Check Whether a Number is Palindrome or Not and Display Prime Numbers Between Two Intervals

❖ **Reference Books and websites:**

1. C++ Primer (5th Edition)" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo

Note: This list is demonstrative and institute can apply necessary changes in content and design of practical as per the availability of infrastructure and need of the students and requirement of skills in the region.

Preferable Infrastructure Requirement: A well-equipped computer lab with necessary software.

Human resource requirement: A lab in-charge with good computer knowledge preferably PGDCA, BCA required for computer lab.

KSKV KACHCHH UNIVERSITY, BHUJ
B.Sc. : Semester V (FIVE) SUBJECT: MATHEMATICS
Paper: Mathematical Analysis
Paper Code: MAJ MAT – 503
(3 credits)

Unit 1

Prerequisites: Sets & operations on sets, Functions & their properties.
Countable sets, Hilbert's paradox, Uncountable sets, Real valued Functions, Bounded subsets of R, Least Upper Bound and Greatest Lower Bound of set, Least Upper Bound Axioms, Archimedean Property, Rational Density Theorem.

Unit 2

Sequence of real numbers, Limit of sequence, Convergent and Divergent sequence, Bounded and Monotonic sequence, Nested interval property, Operation on convergent sequence, Subsequence, Cauchy sequence and Convergence criteria for sequence of real numbers, Bolzano-Weierstrass theorem, Cauchy condensation test for convergence of sequence.

Unit 3

Metric spaces- definition and examples, Limits of sequences in Metric space, Bounded sets in metric space, Limits of Functions in metric spaces (only definition), Isometry, Continuous functions on metric spaces, open sets in metric spaces, closed sets in metric spaces.

❖ **Reference Books:**

1. D. Somasundaram and B. Choudhary, "A First course in mathematical Analysis", Narosa Publishing House, 1996.

2. Walter Rudin, "Principles of Mathematical Analysis", Tata McGraw Hill Publishing, 1976,

3. S. C. Malik and Savita Arora, "Mathematical Analysis", New age International Publisher, 2017.

4. Kenneth A. Ross, "Elementary Analysis", Springer New York Heidelberg Dordrecht London, 2013.

5. Robert G. Bartle and Donald R. Sherbert, "Introduction to Real Analysis", John Wiley & Sons, 2011.

KSKV KACHCHH UNIVERSITY, BHUJ
B.Sc. : Semester V (FIVE) SUBJECT: MATHEMATICS
Paper: Mathematical Analysis - Practical
Paper Code: MAJ MAT – 504-P
(1 credit)

Practical

Practical No.	Description
1	Introduction and Installing Python, Jupyter Notebook and Print commands.
2	Mathematical operations and functions in Python.
3	Evaluate Fibonacci sequence and nth term of Fibonacci sequence in Python.
4	Evaluate first n prime and nth prime using Python.
5	Evaluate the sum of digits and sum of nth power of digits using Python.
6	Check the given number is Armstrong number or not and find all Armstrong numbers between limit using Python.
7	Draw 2D graph from given functions in Python.
8	Draw 3D graph from given functions in Python.

❖ **Reference Books and websites:**

1. Sam Morley, "Applying Math with Python", Packt Publishing Ltd., 2020.

2. Amit Saha, Doing Math with Python, No Starch Press, 2015.

3. https://www.w3schools.com

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Human resource requirement: A lab in-charge with good computer knowledge preferably PGDCA, BCA required for computer lab.

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Operations Research – I
PAPER Code: MAJ MAT-505
(3 Credits)

Unit 1

Theoretical Background: Introduction to Operations Research, Formulation of LPP: Examples on Production, Marketing, Finance, transportation.

Examples of Graphical Method to solve linear programming problems in two variables.

Unit 2

Introduction to slack variables, Examples of Simplex Method (≤ constraints) to find the solution of the linear programming problems for two or more variables.

Unit 3

Introduction of Surplus and artificial variables.

Examples of Big – M method to find the solution of the linear programming problems.

Examples of Two-phase method to find the solution of the linear programming problems.

❖ **Reference Books:**

1. Operations Research (Theory and Applications), J. K. Sharma, Third Edition, Published by MACMILLAN INDIA LTD.
2. Mathematical Models in Operation Research, J. K. Sharma-McGraw Hills
3. Linear Programming, G. Hadley- Narosa Publishing House.

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Operations Research – I - Practical
PAPER Code: MAJ MAT-506 - P
(1 Credit)

In this paper, every student will get an opportunity to develop his talent and skill in a little different aspect. It can be like; a student should review one book and prepare a detailed presentation on the book. Student will submit its synopses at least one week before the presentation. The book may not be strictly related to mathematics, but should be of a significance.

This book review presentation must contain all qualitative data regarding the book.

Note: This book review presentation is aimed to make students read some external literature for his all-round development. However, an institute can apply necessary changes in content and design of practical like preparing a small dissertation on a topic related to Operations Research or preparing them for group discussion on suitable topics etc., as per the need of the students and requirement of skills in the region.

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Ordinary and Partial Differential Equations
PAPER Code: MIN MAT-507
(3 Credits)

Unit 1

Ordinary Differential equations of first order but not of first degree, p, x or y, Clairaut's equation, singular equation, Envelop of a curve, Cauchy-Euler's equation, Method of Variation of parameter.

Unit 2

Formation of PDE, Geometric description of Linear partial differential equation, Pp + Qq=R and Lagrange's method, Nonlinear PDE of one order and higher degree, Charpit's method and standard forms.

Unit 3

Homogeneous linear partial differential with constant coefficient, Non-homogeneous linear partial differential with constant coefficient, Partial differential equation reducible to equation with constant coefficient, Solution under given geometrical conditions.

❖ Reference Books:

(1) G.F. Simmons: Differential equations with applications and Historical Notes second edition (Mc-Graw Hill).
(2)I. N. Snedden "Elements of Partial Differential Equations" (McGraw – Hill)

Reference Books:

(1) E. A. Coddington: Ordinary differential equations. Prentice Hall of India.
(2) M.D. Raisinghania: Ordinary and partial differential equations. (S.Chand)

(3) B. Rai and D. P. Choudhury: Ordinary Differential Equations: An Introduction

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Ordinary and Partial Differential Equations Practical
PAPER Code: MIN MAT-508-P
(1 Credit)

Practical

Practical No.	Description
1	C++ Program to Display Factors of a Number.
2	C++ Program to Check Armstrong Number and Display Armstrong Number Between Two Intervals
3	C++ Programs To Create Pyramid and Pattern.
4	C++ Program to Check Whether a Number can be Express as Sum of Two Prime Numbers.
5	C++ Program to Convert Octal Number to Decimal and vice-versa.
6	C++ Program to Add, Subtract and Multiply Two Matrix Using Multi-dimensional Arrays.
7	C++ Program to Find Transpose of a Matrix.
8	C++ Program to Swap Numbers in Cyclic Order Using Call by Reference.

❖ **Reference Books and websites:**

1. C++ Primer (5th Edition)" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo

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Human resource requirement: A lab in-charge with good computer knowledge preferably PGDCA, BCA required for computer lab.

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Operations Research – II
PAPER Code: MIN MAT-509
(3 Credits)

Unit 1

Introduction to Transportation problems and assignment problems, Initial feasible solution to Transportation Problems by North – West Corner Method, Lowest Cost Entry Method, VAM Method

Unit 2

Modi Method for the optimization of the initial feasible solution of the transportation problems for balanced and unbalanced transportation problems

Unit 3

Introduction to Tran-Shipment problems, Difference between Transportation problems and Tran-Shipment problems, Solution of Tran-Shipment problems

The course is mainly covered by :

Operations Research (Theory and Applications) ---- J. K. Sharma, Third Edition, Published by MACMILLAN INDIA LTD.

❖ **Reference Books :**

1. Mathematical Models in Operation Research by J. K. Sharma- McGraw Hills
2. Linear Programming By G. Hadley- Narosa Publishing House.

KSKV Kachchh University: BHUJ
B.Sc.: Semester: V (FIVE) SUBJECT: MATHEMATICS
PAPER: Operations Research – II - Practical
PAPER Code: MIN MAT-510 - P
(1 Credit)

In this paper, every student will get an opportunity to develop his talent and skill in a little different aspect. It can be like; a student should review one book and prepare a detailed presentation on the book. Student will submit its synopses at least one week before the presentation. The book may not be strictly related to mathematics, but should be of a significance.

This book review presentation must contain all qualitative data regarding the book.

Note: This book review presentation is aimed to make students read some external literature for his all-round development. However, an institute can apply necessary changes in content and design of practical like preparing a small dissertation on a topic related to Operations Research or preparing them for group discussion on suitable topics etc., as per the need of the students and requirement of skills in the region.

INTERNAL EVALUATION SCHEME :

❖ **Theory : 35 Marks**

1.	Internal Continuous and Comprehensive Evaluation (CCE) will be conducted by the department. The total internal theory marks will be 35 Marks.
2.	CCE Marking Scheme for Theory: For each paper, CCE may be further distributed as under. This list is not exhaustive and new parameters can be added : a) Unit Test / Internal Examination (MCQ or Descriptive) b) Seminar c) Assignments d) Attendance The Department Head will be final authority for finalizing the distribution of internal evaluation marks in every semester.

❖ **Practical : 15 Marks**

CCE Marking Scheme for Practical : Any one or more of the parameters from Lab Performance/ Lab attendance / Internal practical Test / Book Review synopsis / Journal / Viva or as per the requirement of the course can be used. The total internal practical marks will be 15 Marks.

➢ EXTERNAL (UNIVERSITY) EVALUATION SCHEME:

❖ Theory (MAJ MAT-501 / MAJ MAT-503 / MIN MAT-507) : 40 Marks

There will be a written test of total 40 marks, having total 4 questions.

The Demonstrative Structure of the External Examination Question Paper

Question No.	Question type	Marks
1 (Unit 1)	Descriptive Questions (2 out of 3)	10
2 (Unit 2)	Descriptive Questions (2 out of 3)	10
3 (Unit 3)	Descriptive Questions (2 out of 3)	10
4 (Unit 1,2,3)	Descriptive question / Short questions	10

❖ Theory (MAJ MAT-505 / MIN MAT-509) : 40 Marks

There will be 5 big questions, each of 10 marks, without any sub-questions. Student has to write any four out the five.

- The above paper scheme is demonstrative but not exhaustive. An examiner may apply necessary changes if felt necessary.
- Types of questions may be varied: like: one descriptive question/one-line answers / two-line answers / definitions / reasoning / derivations of equations / derivations of sums / drawing small figures etc.

❖ Practical : 10 Marks

There will be a practical test of total 10 marks, having total 4 exercises.

The Demonstrative Structure of the External Examination Practical Paper

Exercises No.	Exercises	Marks
1	Exercise 1 (Based on syllabus)	3
2	Exercise 2 (Based on syllabus)	3
3	Viva Voice/MCQ Exercise	2
4	Journal	2

The above practical paper scheme is demonstrative but not exhaustive. An examiner may apply necessary changes if felt necessary.