



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Digital Helpline No.- 0261 2388888
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

પરીપત્ર

The University Grants Commission (Minimum Standards and Procedures for Award of Ph.D. Degree) Regulations, 2022 ની જોગવાઈઓને અનુરૂપ પીએચ.ડી. કોર્ષવર્કના અભ્યાસક્રમને અદ્યતન કરવા અંગે ગણિતશાસ્ત્ર વિષયની RESEARCH AND RECOGNITION COMMITTEE ની તા.૧૬/૦૧/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક (૩) થી તૈયાર કરેલ આ સાથે સામેલ અભ્યાસક્રમને એકેડેમિક કાઉન્સિલે તેની તા.૦૫/૦૨/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક (૪૨) થી નીચે મુજબ મંજૂર કરેલ છે. તદ્દનુસાર ઘટતી કાર્યવાહી કરવાની જાણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૫/૦૨/૨૦૨૬ ની સભાનો ઠરાવ ક્રમાંક : (૪૨)

:: આથી ઠરાવવામાં આવે છે કે, ગણિતશાસ્ત્ર વિષયની RRC ની તા.૧૬/૦૧/૨૦૨૬ ઠરાવ ક્રમાંક : ૩ થી કરેલ ભલામણ સ્વીકારી યુ.જી.સી. પીએચ.ડી. રેગ્યુલેશન ૨૦૨૨ ની જોગવાઈ મુજબ બનાવેલ ગણિતશાસ્ત્ર વિષયના પીએચ.ડી. કોર્ષવર્કના અભ્યાસક્રમ સુધારા સાથે મંજૂર કરવામાં આવે છે.


કુલ સચિવ વતી

ક્રમાંક : પીએચ.ડી./કોર્ષવર્ક/૩૩૩૭/૨૦૨૬
તા.૧૨/૦૨/૨૦૨૬

- પ્રતિ,
૧. તમામ કોલેજના આચાર્યશ્રીઓ, યુનિવર્સિટીના વિવિધ વિભાગોના વડાશ્રીઓ, યુનિવર્સિટી પરિસરના સ્વનિર્ભર અભ્યાસક્રમોના કો-ઓર્ડિનેટરશ્રીઓ, તમામ પીએચ.ડી.ના માર્ગદર્શક શિક્ષકશ્રીઓ તરફ જાણ તથા અમલ કરવા સારૂ...
 ૨. યુનિવર્સિટીના તમામ વહીવટી વિભાગોના વડાશ્રીઓ તરફ જાણ તથા જરૂરી કાર્યવાહી અંગે...

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Ph.D. Coursework in Mathematics

Effective from June 2025

Name of Program	Ph.D. Coursework (Mathematics)
Objective of Program	The main objective of this program is to prepare the research students and scholars to focus on developing advanced research skills, mastering complex mathematical theories, and contributing original knowledge to the field. This program will equip scholars with necessary theoretical backgrounds, methodological tools, and analytical skills required for advanced research.
Program Outcomes	<p>PO1: Basic Knowledge Enhancement The designed program enhances students/scholars with basic knowledge of the subject matter to demonstrate a deep understanding of fundamental mathematical theories.</p> <p>PO2: Advanced Knowledge Enhancement Demonstrate an in-depth understanding of core areas (such as Abstract algebra, Number theory, Differential Equations, Integral Transforms and Numerical Analysis) and specialized research fields, bridging the gap between basic theory and current scientific advancements.</p> <p>PO3: Research Methodology & Ethics Apply rigorous research methodologies to identify, formulate, and investigate complex mathematical problems while adhering to ethical standards in research and publication.</p> <p>PO4: Critical Thinking & Problem Solving Exhibit proficiency in analytical reasoning and critical thinking to analyze problems, formulate hypotheses, evaluate results, and draw logical conclusions.</p> <p>PO5: Scientific Communication Effectively communicate complex mathematical concepts, research findings, and theoretical arguments to both expert and non-expert audiences through seminars, conferences, and journal publications.</p> <p>PO6: Group discussion, presentation, and confidence Development The designed syllabi enable students/scholars to acquire proficiency in oral and written communication skills, group discussion, and sharing ideas. This also helps to enhance the confidence among the students/scholars.</p>

Dr. J. P.



Dr.

	<p>PO7: General Competence</p> <p>The designed syllabi will train researchers to conduct their research in accordance with recognized ethical standards for research.</p>
Program Specific Outcomes	<p>PSO1: Original Contribution</p> <p>Develop and strengthen the advanced knowledge and concepts that are required to manage the field of pure or applied mathematics.</p> <p>PSO2: Publication & Collaboration</p> <p>Communicate the high-quality research publications in reputed national and international mathematical journals and collaborate with the global research community.</p> <p>PSO3: Interdisciplinary Application</p> <p>Apply advanced mathematical techniques to solve real-world problems in interdisciplinary domains.</p> <p>PSO4: Pedagogical & Professional Skills</p> <p>Demonstrate the ability to teach mathematics effectively at the university level and pursue careers in academia, research institutions, or industry R&D sectors.</p>

Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4
	PO1	✓		✓	✓
	PO2	✓	✓	✓	✓
	PO3	✓	✓		
	PO4	✓	✓	✓	
	PO5		✓		✓
	PO6		✓	✓	✓
	PO7	✓	✓		✓

Theory Paper	Teaching Hrs.	Exam Schedule		Total Marks	Credits
		Internal Marks	External Marks		
MH 1001: Research Methodology in Mathematics and Publication Ethics	60	25+25 = 50*	50	100	4
MH 1002: Foundation of Mathematics	60	25+25 = 50*	50	100	4
Electives (Select any one Course)					
MH 10031: Mathematical Modelling	60	25+25 = 50*	50	100	4
MH 10032: Number Theory and Fibonacci Structures					
MH 10033: Numerical Solutions of Boundary Value Problems					
Total	180	150	150	300	12

* Continuous assessment will be done through tutorials, assignments and group discussions. Weightage will be given for active participation.

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Course Code	MH 1001																												
Course Title	Research Methodology in Mathematics and Publication Ethics																												
Credit	4 (Total 60 Hours)																												
Course Objective	To aware the research students/ scholars about research methods, design and formulation along with skill of scientific writing.																												
Course Outcome	<p>CO1: Discuss different methodologies and techniques used in research work.</p> <p>CO2: To make research students capable of writing scientific literatures.</p> <p>CO3: Integrate modern methods to develop research pipelines in respective disciplines.</p> <p>CO4: Organize and conduct research in an organized and ethical manner.</p>																												
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	PSO1	PSO2	PSO3	PSO4																									
CO1	✓		✓	✓																									
CO2		✓	✓	✓																									
CO3	✓	✓	✓	✓																									
CO4	✓			✓																									
Course Content	<p>Unit 1:An introduction to the Research Methodology: Meaning and objectives of research, Motivation in research, Types of research, Research methods vs Research methodology, Importance of Knowing How Research is Done, Criteria of good research, Defining a research problem, Selection of a research problem, Research design and its need.</p> <p>Unit 2:Writing a Research Report: Report writing,Significance of report writing, Steps in report writing, Layout of research reports, Types of Reports, Mechanics of Writing a Research Report, Precautions for writing Research Reports.</p> <p>Unit 3:Writing a Research Paper Review: To compose a summary (review) of research papers and academic articles that feature mathematical particulars of various research areas.</p> <p>Unit 4:Writing a Book Review: Writing a book review, To create a review of different books that include mathematical content and details.</p>																												
Reference Books	<ol style="list-style-type: none"> 1. C. R. Kothari: Research Methodology – Methods and Techniques, 2nd Edition,New Age International Publishers, New Delhi,2004. 2. Ranjit Kumar: Research methodology: A step-by-step guide for beginners, 3rd Edition, SAGE Publications, New Delhi, 2011. 3. Indian National Science Academy (INSA), Ethics inScience Education, Research and Governance (2019). (ISBN:978-81-939482-1-7) http://www.insaindia.res.in/pdf/Ethics_Book.pdf 4. R. P. Misra: Research Methodology - A Hand Book, Concept Publishing Company, New Delhi, 2002. 																												

Course Code	MH 1002																												
Course Title	Foundation of Mathematics																												
Credit	4 (Total 60 Hours)																												
Course Objective	Develop a unified foundation in abstract algebra and differential equations by mastering power-series and Laplace-transform solution techniques alongside practical numerical ODE solvers for single equations and systems.																												
Course Outcome	<p>CO1: Demonstrate an understanding of basic concepts related with the Ring and Field Theory, with particular emphasis on Polynomial rings, Extension fields and Construction with Straightedge and compass.</p> <p>CO2: Demonstrate a rigorous understanding of the theory of ordinary differential equations, with particular emphasis on solution techniques using power series methods.</p> <p>CO3: Demonstrate a thorough understanding of the definition, existence conditions, and fundamental properties of the Laplace transform, Laplace transforms of derivatives and integrals and inverse Laplace transforms.</p> <p>CO4: Apply and analyze numerical methods including Euler, Backward Euler, Mid-point, Taylor series, and Runge-Kutta techniques to approximate solutions of ordinary differential equations and systems of differential equations.</p>																												
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	PSO1	PSO2	PSO3	PSO4																									
CO1	✓	✓		✓																									
CO2		✓	✓	✓																									
CO3	✓	✓	✓																										
CO4		✓	✓	✓																									
Course Content	<p>Unit 1: Abstract Algebra (15 hrs)</p> <p>Ring Theory: Polynomial ring, Polynomials over the Rational Field. Field theory: Extension fields, Finite extension field, Algebraic extension, Algebraic number, Roots of polynomials, Construction with Straightedge and compass.</p> <p>References:</p> <ol style="list-style-type: none"> I. N. Herstein: <i>Topics in Algebra</i>. 4th Ed., John Wiley Sons. P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul: <i>Basic Abstract Algebra</i>, 2nd Ed., Cambridge University Press. <p>Unit 2: Ordinary Differential equations (15 hrs)</p> <p>Introduction of Power Series Methods, Solutions near an ordinary point, Solutions near a regular singular point: The method of Frobenius and the indicial equation, Legendre's equation, Bessel's equation, Theoretical justification for the power series method.</p> <p>References:</p> <ol style="list-style-type: none"> B. Rai, D.P. Choudhury, H.I. Freedman: <i>A Course in Ordinary Differential Equations</i>, Narosa Publishing House, 2002. 																												

2. S. G. Deo, V. Lakshmikantham, V. Raghvendra: Text Book of Ordinary Differential Equations (Second Edition), Tata McGraw Hill Pub. Co. Ltd, New Delhi, 1997.
3. Somasundaram D.: Ordinary Differential Equations, Narosa Publishing House, 2001.
4. King A. C., Otto R., Billingham J.: Differential Equations, Cambridge, 2005.

Unit 3: Integral Transforms (15 hrs)

Definitions and properties of the Laplace transforms, Transforms of derivatives and integrals, Derivatives and integrals of transforms, The inverse Laplace transforms, Exponential shifts, Convolutions, Applications to Initial value problems.

References:

1. B. Rai, D.P. Choudhury, H.I. Freedman: A Course in Ordinary Differential Equations, Narosa Publishing House, 2002.
2. Lokenath Debnath, Dambaru Bhatta: Integral Transforms and Their Applications, Taylor & Francis Group, 2007.
3. Ian Sneddon: The use of Integral Transform, TMIH, 1979.
4. Andrews, L. G. & Shivamoggi B. K.: Integral Transforms for Engineers, PHI, 2003.



Unit 4: Numerical Analysis (15 hrs)

Euler Method, Backward Euler Method, Mid-point Method, Taylor series Method, Runge-Kutta Methods, Runge-Kutta Method for system of equations.

References:

1. M. K. Jain, S. R. K. Iyenger, R. K. Jain: Numerical Methods for scientific and engineering computations, VI edition, New Age International Publishers
2. Philips and Taylor: Theory and Applications of Numerical Analysis Academic Press, 1996
3. Gourdin and Boumhart: Applied Numerical Analysis, P.H.I., 1996
4. A. S. Householder: Theory of Matrices in Numerical Analysis, Blarsedell - New York.

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Course Code	MH 10031																												
Course Title	Mathematical Modelling																												
Credit	4 (Total 60 Hours)																												
Course Objective	To equip students with the comprehensive skills to formulate, analyze, and critically evaluate ODE and PDE-based mathematical models for solving complex, real-world problems in research and interdisciplinary contexts.																												
Course Outcome	<p>CO1: Explain the fundamental need, scope, techniques, classifications, characteristics, and limitations of mathematical modelling in real-world and interdisciplinary contexts.</p> <p>CO2: Formulate mathematical models for simple real-life situations by identifying assumptions, variables, parameters, and governing relations.</p> <p>CO3: Critically evaluate the validity, applicability, and limitations of ODE- and PDE-based mathematical models with respect to physical assumptions, boundary and initial conditions, and real-world constraints.</p> <p>CO4: Integrate mathematical modelling techniques with analytical and qualitative methods to support advanced research and problem-solving in applied and interdisciplinary mathematical sciences.</p>																												
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CO1			✓																										
CO2	✓		✓																										
CO3	✓	✓																											
CO4	✓	✓	✓	✓																									
Course Content	<p>Unit 1: Mathematical Modelling: Need, Techniques and classifications, Simple Situations Requiring Mathematical Modelling, The Technique of Mathematical Modelling, Classification of Mathematical Models, Some Characteristics of Mathematical Models, Limitations of Mathematical Modelling.</p> <p>Unit 2: Mathematical modelling through ordinary differential equations of first order, Mathematical Modelling Through Differential Equations, Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models.</p> <p>Unit 3: Mathematical modelling through systems of ordinary differential equations of the first order, Mathematical Modelling in Population Dynamics, Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order, Compartment Models Through Systems of Ordinary Differential Equations.</p> <p>Unit 4: Mathematical modelling through partial differential equations: Equation of continuity in fluid dynamics, Equation of continuity for Heat flow, Equation of continuity for traffic flow on a high-way, Partial differential equation model for a vibrating string, Mathematical</p>																												

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modelling in terms of wave equation.

References:

1. J. N. Kapur: Mathematical Modelling, Wiley eastern Ltd., 1994.
2. J. N. Kapur: Mathematical models in Biology and Medicine, affiliated East west press, 1985.
3. Richard Haberman: Mathematical Models, Practice- Hall Inc., NJ, 1979.
4. P. E. Wellstead: Introduction to Physical System Modelling, Academic Press, 1979.

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Course Code	MH 10032																												
Course Title	Number Theory and Fibonacci Structures																												
Credit	4 (Total 60 Hours)																												
Course Objective	To provide a rigorous foundation in classical number theory and the analytical properties of mathematical sequences, enabling students to solve complex Diophantine equations and investigate generalized recursive structures for research and interdisciplinary applications.																												
Course Outcome	<p>CO1: Apply fundamental properties of divisibility, modular arithmetic, and congruences to solve complex number-theoretic problems and verify classical theorems like Fermat's and Euler's.</p> <p>CO2: Analyze and solve various forms of Diophantine equations, including Linear, Pythagorean, and Pell's equations, using systematic algorithmic approaches.</p> <p>CO3: Investigate the properties and identities of the Fibonacci sequence and the Golden Proportion, establishing connections between number theory and algebraic structures.</p> <p>CO4: Utilize the Binet formula and periodic properties to generalize sequences (Lucas, Pell, Jacobsthal) and demonstrate their relevance in advanced mathematical research and interdisciplinary applications.</p>																												
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CO1	✓		✓	✓																									
CO2	✓																												
CO3			✓	✓																									
CO4	✓	✓																											
Course Content	<p>Unit 1: Basic concepts of divisibility, Euclidean algorithm, Prime numbers, Modular Arithmetic, Congruences, Fermat's theorem and Euler's generalization, The greatest integer function.</p> <p>Unit 2: Diophantine equations: Solutions of Diophantine equation $ax + by = c$, Pythagorean equation $x^2 + y^2 = z^2$, Solution of Pell's equation $x^2 - dy^2 = 1$, Fundamental solution.</p> <p>Unit 3: Fibonacci sequence: Elementary properties of Fibonacci numbers, Number-theoretic properties of Fibonacci numbers, Certain identities involving Fibonacci numbers, Golden proportion.</p> <p>Unit 4: Fibonacci sequence: Binet formula, Certain identities using the Binet formula, Periodicity of Fibonacci sequence (mod m), Various generalizations (like Lucas sequence, Pell sequence, Jacobsthal sequence etc.).</p> <p>References:</p> <ol style="list-style-type: none"> David M. Burton: Elementary Number Theory, Tata McGraw-Hill Pub. Co. Ltd., N. Delhi, 2006. S. G. Telang: Number Theory, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1996. Koshy Thomas: Fibonacci and Lucas Numbers with applications, 																												

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	John Wiley and Sons, Inc., N. York, 2001.																									
Course Code	MH 10033																									
Course Title	Numerical Solutions of Boundary Value Problems																									
Credit	4 (Total 60 Hours)																									
Course Objective	To provide a comprehensive understanding of finite difference and variational methods for the numerical approximation and error analysis of linear and nonlinear boundary value problems in scientific and engineering research.																									
Course Outcome	<p>CO1: Apply finite difference schemes to approximate solutions of second-order and nonlinear boundary value problems while performing rigorous error analysis.</p> <p>CO2: Implement the Rayleigh-Ritz variational method by minimizing functionals and selecting appropriate trial functions to solve differential equations.</p> <p>CO3: Utilize the Collocation method to minimize residuals and derive approximate solutions for both linear and nonlinear boundary value problems.</p> <p>CO4: Formulate weighted residual solutions using the Galerkin method for higher-order and nonlinear systems to support advanced interdisciplinary research and R&D applications.</p>																									
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	PSO1	PSO2	PSO3	PSO4																						
CO1			✓	✓																						
CO2	✓		✓																							
CO3				✓																						
CO4	✓	✓	✓	✓																						
Course Content	<p>Unit 1: Solutions through a set of equations: Finite difference Method, Solutions of Second order Boundary value problems, Solutions of nonlinear boundary Value problems. Error Analysis.</p> <p>Unit 2: Rayleigh-Ritz Method: Functional, Minimization of functional, trial functions, approximation, solution of second order boundary value problems, Solutions of nonlinear boundary Value problems.</p> <p>Unit 3: Collocation Method: Residual, approximate solution, Solutions of linear Boundary value problems, Solutions of nonlinear Boundary value problems.</p> <p>Unit 4: Galerkin Method: Weight functions, Weighted residual, Choice of trail functions, Solutions of linear Second order Boundary value problems, Solutions of non-linear Second order Boundary value problems, Solutions of higher order boundary value problems.</p> <p>References:</p> <ol style="list-style-type: none"> 1. Gourdin and Boumhart: Applied Numerical Analysis, P.H.I., 1996 2. R. J. Leveque: Numerical methods for conservation Laws, Birkhauser Verlag, Basel, 1992 																									

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