अनुशंसित सतत मूल्यांकन विधियाँ:

अधिकतम अंकः 100

सतत शैक्षिक मूल्यांकन (CCE): 30 अंक

विश्वविद्यालय परीक्षा (UE): 70 अंक

आंतरिक मूल्यांकन: सतत शैक्षिक मूल्यांकन (CCE):	क्लास टेस्ट असाइनमेंट / प्रस्तुतीकरण (प्रेजेंटेशन):	30 अंक
आकलनः विश्वविद्यालयीन परीक्षा समयः 03.00 घंटे	अनुभाग (अ): बहु विकल्पीय प्रश्न अनुभाग (ब): लघु उत्तरीय प्रश्न अनुभाग (स): दीर्घ उत्तरीय प्रश्न	70 अंक

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Department of Mathematics

B.Sc. II Semester, Core Course (Major – 3)

Part A : Introduction			
Program : Certificate Course	Class: B.Sc.	II Semester	Session: 2025-2026
Subject: Mathematics			
1	Course Code		
2	Course Title	**Differential Equations and Geometry**	
3	Course Type	**Core Course (Major – 3)**	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics in class 12th .	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Formulate the Differential equations for various Mathematical models. 2. Apply ordinary differential equations to model and solve practical problems in physics, biology, engineering, and economics. 3. Understand the Vedic geometry 4. Enhance the knowledge of three-dimensional geometrical figures (eg. cone and cylinder). 5. Recognize how differential equations arise in geometric contexts and how geometry influences the study of differential equations. 6. Formulate mathematical models of mechanical systems, biological systems, electrical circuits, and more using differential equations..	
6	Credit Value	Theory: 6	
7	Total Marks	Max. Marks: 30 + 70	Min. Passing Marks: 35

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 3 hours per week		
Total Lectures: 90 hours		
Module	Topics	No. of hours
I	**Indian Knowledge System:** 1.1 Historical Background of Differential Equations 1.2 Contribution of Indian Mathematicians in the field of Differential Equations: 1.2.1 Aryabhata 1.2.2 Bhaskracharya 1.2.3 Madhava 1.3 Ancient Geometry (Shulb Sutra) 1.4 Contribution of Indian Mathematicians in the field of geometry: 1.4.1 Baudhayana 1.4.2 Katyayana 1.4.3 NilkanthSomayaji 1.4.4 Parmeshwaran 1.4.5 Shankar Variyar 1.5 Vedic Geometry: 1.5.1 Introduction to triplets 1.5.2 Addition and subtraction of triplets 1.5.3 Triplet for double angles 1.5.4 Triplet for half angles	10
II	**Differential Equations-I:** 2.1 Linear differential equations	15

	2.1.1 Linear equation	
	2.1.2 Equations reducible to the linear form	
	2.1.3 Change of variables	
	2.2 Exact differential equations	
	2.3 First order and higher degree differential equations	
	2.3.1 Equations solvable for x, y and p	
	2.3.2 Equations homogenous in x and y	
	2.3.3 Clairaut's equation	
	2.3.4 Singular solutions	
	2.3.5 Geometrical meaning of differential equations	
	2.3.6 Orthogonal trajectories	
III	**Differential Equations-II:**	15
	3.1 Linear differential equation with constant coefficients	
	3.2 Homogeneous linear ordinary differential equations	
	3.3 Linear differential equations of second order	
IV	**Differential Equations-III:**	15
	4.1 Method of variation of parameters	
	4.2 Ordinary Simultaneous Differential Equation of First Order	
V	**Geometry - I:**	15
	5.1 General equation of second degree	
	5.2 Tracing of conics	
	5.3 System of conics	
	5.4 Polar equation of a conic	
VI	**Geometry - II:**	15
	6.1 Cone:	
	6.1.1 Equation of cone with given base	

	6.1.2 Generators of cone	
	6.1.3 Condition for three mutually perpendicular generators	
	6.1.4 Right circular cone	
	6.2 Cylinder:	
	6.2.1 Equation of cylinder and its properties	
	6.2.2 Right Circular Cylinder 6.2.3 Enveloping Cylinder	
Case Study	**Industrial Applications:** 1. Applications of Differential equations to solve the problems related to Industries, Business and Economics.. 2. Applications of Geometry to solve the problems related to Industries and real world.	05

Keywords/Tags:

Linear differential equations, Method of variation of parameters. Vedic geometry, General equation of second degree, Tracing of conics, System of conics, Equation of cone, Equation of cylinder..

Part C - Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. Gorakh Prasad: Integral Calculus, Pothishala Private Ltd., Allahabad, 2015.

2. M. D. Raisinghania: Ordinary and Partial Differential Equations, S Chand & Co Ltd. 2017.

3. S. L. Loney: The Elements of Coordinate Geometry Part-1, New Age International (P) Ltd., Publishers, New Delhi, 2016.

4. P. K. Jain and Khalil Ahmad: A text book of Analytical Geometry of Three Dimensions, Willey Eastern Ltd, 1999.

5. Gerard G. Emch, R. Sridharan and M. D. Srinivas: Contributions to the History of Indian Mathematics. Hindustan Book Agency, Vol. 3, 2005.

6. Bharati KrsnaTirthaji Maharaja, "Vedic Mathematics", Motilal Banarasidas Publisher, Delhi, 1994.

7. Udayan S. Patankar&sunil S. Patankar: Elements of Vedic Mathematics, TTU Press, 2018.

8. Enrique Fernández-Cara: Ordinary Differential Equations and Applications, World Scientific, 2024.

9. McGraw Hill: Geometry, Real World Application Transparencies and Masters, McGraw-Hill, 2003.

10. मध्य प्रदेश हिंदी ग्रंथ अकादमी की पुस्तकें।

Reference Books:

1. G. F. Simmons: Differential Equations, Tata McGraw Hill, 1972.
2. E. A. Codington: An Introduction to ordinary differential Equation, PrenticeHall of India, 1961.
3. D. A. Murray: Introductory Course in Differential Equations, Orient Longman (India) 1967.
4. H. T. H Piaggio: Elementary Treatise on Differential Equations and their Application, C. B.S. Publisher & Distributors, Delhi, 1985.
5. Gorakh Prasad and H. C. Gupta: Text Book on Coordinate Geometry, Pothishala Pvt. Ltd. Allahabad, 2000.
6. Bibhutibhusan Datta and Avadhesh Narayan Singh: History of Hindu Mathematics, Asia Publishing House, 1962.
7. Balachandra Rao: Differential Equations with Applications, Universities Press, 1996.
8. Georg Glaeser: Geometry and its Applications in Arts, Nature and Technology, Springer Nature Switzerland AG, 2020.

Suggested Digital Platforms Web links:

https://epgp.inflibnet.ac.in

https://freevideolectures.com/university/iit-roorkee

https://www.eshiksha.mp.gov.in/mpdhe

Suggested Equivalent online courses:

https://nptel.ac.in/courses/111106100/

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https://nptel.ac.in/courses/111104164

https://nptel.ac.in/courses/111/101/111101080/

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods:	
Maximum Marks:	100
Continuous Comprehensive Evaluation (CCE): 30 Marks	
University Exam (UE):	70 Marks
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 30**
External Assessment: University Exam Section Time: 03.00 Hours	Section (A) : Objective type Questions	**Total Marks: 70**
	Section (B) : Short Questions	
	Section (C) : Long Questions	

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बी.एससी. द्वितीय सेमेस्टर, माइनर-2

भाग अ - परिचय			
कार्यक्रम-प्रमाण पत्र	कक्षा -बी.एससी.	द्वितीय सेमेस्टर	सत्र: 2025-2026
विषय गणित			
1	पाठ्यक्रम का कोड		
2	पाठ्यक्रम का शीर्षक	साधारण अवकल समीकरण	
3	पाठ्यक्रम का प्रकार	माइनर-2	
4	पूर्वापेक्षा (Prerequisite):	इस कोर्स का अध्ययन करने के लिए, विद्यार्थी ने विषय गणित का अध्ययन कक्षा 12 वीं में किया हो।	
5	पाठ्यक्रम अध्ययन के परिणाम (कोर्स लर्निंग आउटकम - CLO):	पाठ्यक्रम छात्र/छात्राओं को सक्षम करेगा: 1. साधारण अवकल समीकरणों को पहचानें और उन्हें कोटि (प्रथम-कोटि, द्वितीय-कोटि, आदि) और प्रकार (रैखिक, अरैखिक) के आधार पर वर्गीकृत करने में। 2. विभिन्न गणितीय प्रतिरूपों के लिए अवकल समीकरण के सूत्रीकरण करने में। 3. भौतिकी, जीव विज्ञान, इंजीनियरिंग और अर्थशास्त्र में व्यावहारिक समस्याओं का प्रतिरूपीकरण करने और हल करने के लिए साधारण अवकल समीकरणों को लागू करने में। 4. अवकल समीकरणों का उपयोग करके यांत्रिक प्रणालियों, जैविक प्रणालियों, विद्युत परिपथ आदि के गणितीय प्रतिरूप को निर्मित करने में।	
6	क्रेडिट मान	सैद्धांतिक: 4	
7	कुल अंक	अधिकतम अंकः 30 + 70	न्यूनतम उत्तीर्णाकः 35

भाग ब - पाठ्यक्रम की विषयवस्तु		
व्याख्यान की कुल संख्या (प्रति सप्ताह घंटे में): प्रति सप्ताह 2 घंटे		
कुल व्याख्यान : 60 घंटे		
मॉड्यूल	विषय	घंटे की संख्या
I	भारतीय ज्ञान परंपराः 1.1 अवकल समीकरणों की ऐतिहासिक पृष्ठभूमि 1.2 अवकल समीकरण के क्षेत्र में भारतीय गणितज्ञों का योगदानः 1.2.1 आर्यभट्ट 1.2.2 भास्कराचार्य 1.2.3 माधव	05

II	अवकल समीकरण - I:
	2.1 रैखिक अवकल समीकरण
	2.1.1 रैखिक समीकरण
	2.1.2 रैखिक समीकरण में समानेय अवकल समीकरण
	2.1.3 चरों का परिवर्तन
	2.2 यथातथ अवकल समीकरण
	2.3 प्रथम कोटि एवं उच्च घातीय अवकल समीकरण
	    2.3.1 x.y और p में हल होने योग्य
	    2.3.2 x और y में ममघात समीकरण
	    2.3.3 क्लेरो का समीकरण
	    2.3.4 विचित्र हल
		20

III	अवकल समीकरण - II: 3.1 अचर गुणांकों वाले रैखिक अवकल समीकरण 3.2 साधारण रैखिक समघात अवकल समीकरण 3.3 द्वितीय कोटि के रैखिक अवकल समीकरण	20

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IV	अवकल समीकरण - III: 4.1 प्राचल विचरण विधि 4.2 प्रथम कोटि का साधारण युगपत अवकल समीकरण	10
वस्तु स्थिति अध्ययन / गतिविधि विधि	औद्योगिक अनुप्रयोग: उद्योग, व्यापार और अर्थशास्त्र से संबंधित समस्याओं को हल करने के लिए अवकल समीकरण के अनुप्रयोग।	05

सार बिंदु (कीवर्ड)/ टैग:

रैखिक अवकल समीकरण, यथातथ अवकल समीकरण, प्रथम कोटि एवं उच्च घातीय अवकल समीकरण, अचर गुणांको

वाले रैखिक अवकल समीकरण, प्राचल विचरण विधि।

भाग स - अनुशंसित अध्ययन संसाधन
पाठ्य पुस्तकें, संदर्भ पुस्तकें, अन्य संसाधन

अनुशंसित सहायक पुस्तकें / पाठ्यपुस्तकें / अन्य पाठ्य सामग्री:

पाठ्य पुस्तकें:

1. Gorakh Prasad: Integral Calculus, Pothishala Private Ltd., Allahabad, 2015.

2. M. D. Raisinghania: Ordinary and Partial Differential Equations, S Chand & Co Ltd, 20

3. Gerard G. Emch, R. Sridharan and M. D. Srinivas. Contributions to the History

   Mathematics. Hindustan Book Agency, Vol. 3, 2005.

4. Bharati Krana Tirthaji Maharaja, "Vedic Mathematics", Motilal Banarasidas Publisher, Delhi 1994.

5. Udayan S. Patankar & sunil S. Patankar: Elements of Vedic Mathematics, TTU Press, 2018.

6. Enrique Fernández-Cara: Ordinary Differential Equations and Applications, World Scientific, 2024.

7. मध्य प्रदेश हिंदी ग्रंथ अकादमी की पुस्तकें।

संदर्भ पुस्तकें:

1. G. F. Simmons: Differential Equations, Tata McGraw Hill, 1972.

2. E. A. Codington: An Introduction to ordinary differential Equation, Prentice Hall of India, 1961.

3. D. A. Murray: Introductory Course in Differential Equations, Orient Longman (India) 1967.

4. H. T. H Piaggio: Elementary Treatise on Differential Equations and their Application, C. B. S. Publisher & Distributors, Delhi. 1985.

5. Bibhutibhusan Datta and Avadhesh Narayan Singh: History of Hindu Mathematics, Asia Publishing House, 1962.

6. Balachandra Rao: Differential Equations with Applications, Universities Press, 1996.

7. B.R. Thakur, R.S. Chandel, R.S. Rathore: Ordinary Differential Equations, Ram Prasad and sons.

8. H.K. Pathak. Ordinary Differential Equation, Shiksha Sahitya Prakashan.

अनुशंसित डिजिटल प्लेटफॉर्म / वेब लिंक:

https://epgp.inflibnet.ac.in

https://freevideolectures.com/university/iit-roorkee

https://www.eshiksha.mp.gov.in/mpdhe

अनुशंसित समकक्ष ऑनलाइन पाठ्यक्रम:

https://nptel.ac.in/courses/111106100/

https://nptel.ac.in/courses/111/101/111101080/

भाग द - अनुशंसित मूल्यांकन विधियाँ		
अनुशंसित सतत मूल्यांकन विधियाँ: अधिकतम अंक: 100 सतत शैक्षिक मूल्यांकन (CCE): 30 अंक विश्वविद्यालय परीक्षा (UE): 70 अंक		
आंतरिक मूल्यांकन: सतत शैक्षिक मूल्यांकन (CCE):	क्लास टेस्ट असाइनमेंट / प्रस्तुतीकरण (प्रेजेंटेशन):	30 अंक
आकलन: विश्वविद्यालयीन परीक्षा समय: 03.00 घंटे	अनुभाग (अ): बहु विकल्पीय प्रश्न अनुभाग (ब): लघु उत्तरीय प्रश्न अनुभाग (स): दीर्घ उत्तरीय प्रश्न	70 अंक

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B.Sc. Second Semester Minor – 2

Part A : Introduction			
Program : Certificate Course	Class: B.Sc.	Second Semester	Session: 2025-2026
	Subject: Mathematics		
1	Course Code		
2	Course Title	Ordinary Differential Equations	
3	Course Type	Minor – 2	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics in class 12th.	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Recognize ordinary differential equations and classify them based on order (first-order, second-order, etc.) and type (linear, nonlinear). 2. Formulate the Differential equations for various Mathematical models. 3. Apply ordinary differential equations to model and solve practical problems in physics, biology, engineering, and economics. 4. Formulate mathematical models of mechanical systems, biological systems, electrical circuits, and more using differential equations.	
6	Credit Value	Theory: 4	
7	Total Marks	Max. Marks: 30 + 70	Min. Passing Marks: 35

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 2 hours per week		
Total Lectures:60 hours		
Module	Topics	No. of Hours
I	**Indian Knowledge System:** 1.1 Historical Background of Differential Equations 1.2 Contribution of Indian Mathematicians in Differential Equations: 1.2.1 Aryabhata 1.2.2 Bhaskracharya 1.2.3 Madhava	05

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II	**Differential Equations - I:** 2.1 Linear differential equations 2.1.1 Linear equation 2.1.2 Equations reducible to the linear form 2.1.3 Change of variables 2.2 Exact differential equations 2.3 First order and higher degree differential equations 2.3.1 Equations solvable for x, y and p 2.3.2 Equations homogenous in x and y 2.3.3 Clairaut's equation 2.3.4 Singular solutions	20
III	**Differential Equations - II:** 3.1 Linear differential equation with constant coefficients 3.2 Homogeneous linear ordinary differential equations Linear differential equations of second order	20
IV	**Differential Equations - III:** 4.1 Method of variation of parameters Ordinary Simultaneous Differential Equation of First Order	10
Case Study/ Activity	**Industrial Applications:** Applications of Differential equations to solve the problems related to Industries, Business and Economics.	05

Keywords/Tags:

Linear differential equations. Exact differential equations, First order and higher degree differential equations. Linear differential equation with constant coefficients ,Method of variation of parameters.
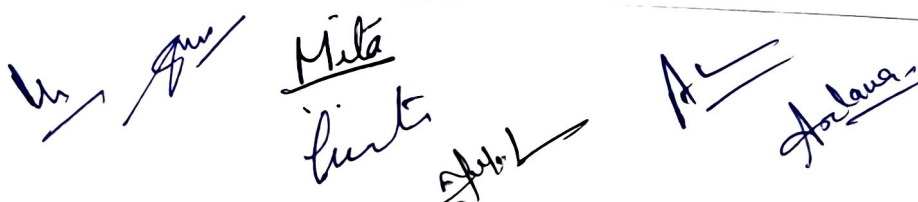

Part C - Learning Resources
Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. Gorakh Prasad: Integral Calculus, Pothishala Private Ltd., Allahabad, 2015.
2. M. D. Raisinghania: Ordinary and Partial Differential Equations, S Chand & Co Ltd, 2017.
3. Gerard G. Emch, R. Sridharan and M. D. Srinivas: Contributions to the History of Indian Mathematics. Hindustan Book Agency, Vol. 3, 2005.
4. Bharati KrsnaTirthaji Maharaja, "Vedic Mathematics", Motilal Banarasidas Publisher, Delhi, 1994.
5. Udayan S. Patankar&sunil S. Patankar: Elements of Vedic Mathematics, TTU Press, 2018.
6. Enrique Fernández-Cara: Ordinary Differential Equations and Applications, World Scientific, 2024.
7. मध्य प्रदेश हिंदी ग्रंथ अकादमी की पुस्तकें।

Reference Books:
1. 1. G. F. Simmons: Differential Equations, Tata McGraw Hill. 1972.
2. E. A. Codington: An Introduction to ordinary differential Equation, PrenticeHall of India. 1961.
3. D. A. Murray: Introductory Course in Differential Equations, Orient Longman (India) 1967.
4. H. T. H Piaggio: Elementary Treatise on Differential Equations and their Application.
   C. B.S. Publisher & Distributors, Delhi. 1985.
5. Bibhutibhusan Datta and Avadhesh Narayan Singh: History of Hindu Mathematics. Asia Publishing House, 1962.
6. Balachandra Rao: Differential Equations with Applications, Universities Press, 1996.
7. B.R. Thakur, R.S. Chandel, R.S. Rathore: Ordinary Differential Equations , Ram Prasad and sons
8. H.K. Pathak. Ordinary Differential Equations. Shiksha Sahitya Prakashan.

Suggested Digital Platforms Web links:
https://epgp.inflibnet.ac.in
https://freevideolectures.com/university/iit-roorkee
https://www.eshiksha.mp.gov.in/mpdhe
Suggested Equivalent online courses:
https://nptel.ac.in/courses/111106100/
https://nptel.ac.in/courses/111/101/111101080/

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	100	
Continuous Comprehensive Evaluation (CCE): 30 Marks		
University Exam (UE):	70 Marks	
Internal Assessment:		**Total Marks: 30**
Continuous Comprehensive Evaluation (CCE)		
External Assessment: University Exam Section Time: 03.00 Hours	Section (A) : Objective type Questions Section (B) : Short Questions Section (C) : Long Questions	**Total Marks: 70**

Faculty of Science

Bachelor of Science (B.Sc.)
SUBJECT: MATHEMATICS
B.Sc. III Semester
Paper- Elective
Abstract Algebra and Linear Algebra

Course Outcomes

CO.No.	Course Outcomes	Cognitive Level
CO1	Recognize the algebraic structures as a group, and classify them as abelian, cyclic and permutation groups, etc.	U
CO2	Link the fundamental concepts of groups and symmetrical figures.	Ap
CO3	Analyze the subgroups of cyclic groups.	U
CO4	Explain the significance of the notion of cosets, normal subgroups, and quotient groups.	E
CO5	The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphisms	U
CO6	Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.	U
CO7	Understand the linear transformations, rank and nullity, matrix of a linear transformation, algebra of transformations and change of basis.	U
CO8	Compute the characteristic polynomial, eigen values, eigen	Ap

vectors,and eigen spaces, as well as the geometric and the algebraic multiplicities of an eigen value and apply the basic diagonalization result.

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	4	40	60	100
Total	4	100		

Evaluation Scheme

	Marks	
	Internal	External
Theory	3 Internal Exams of 20 Marks (During the Semester) (Best 2 will be taken)	1 External Exams (At the End of Semester)

Content of the Course
Theory

No.of Lectures(in hours per week):4.5 Hrs.per week

Total No.of Lectures:60Hrs.   **Maximum Marks: 60**

Unit	Topics	No. of Lectures
	1.1 Historical background: 1.1.1. A brief historical background of the	

I		Algebrain the context of India and Indian heritage and culture 1.1.2. A brief biography of Brahmagupta 1.2 Groups, Subgroups and their basic properties 1.3 Cyclic groups 1.4 Coset decomposition 1.5 Lagrange's and Fermat's theorem 1.6 Normal subgroups 1.7 Quotient groups	20
II		2.1 Homomorphism and Isomorphism of groups 2.2 Fundamental theorem of homomorphism 2.3 Transformation and permutation groupSn(n<5) 2.4 Cayley's theorem 2.5 Group automorphism 2.6 Inner automorphism 2.7 Group of automorphisms	20
III		3.1 Definition and basic properties of rings 3.2 Ring homomorphism 3.3 Sub ring 3.4 Ideals 3.5 Quotient ring 3.6 Polynomial ring 3.7 Integral domain 3.8 Field	20
IV		4.1 Definition and examples of Vector space 4.2 Subspaces 4.3 Sumand direct sum of subspaces 4.4 Linear span, Linear dependence, linear independence and their basic	20

	properties	
	4.5 Basis	
	4.6 Finite dimensional vector space and dimension	
	4.6.1 Existence theorem	
	4.6.2 Extension theorem	
	4.6.3 Invariance of the number of elements	
	4.7 Dimension of sum of subspaces	
	4.8 Quotient space and its dimension	

References

Text Books:
1. I.N.Herstein:Topics in Algebra, Wiley Eastern Ltd. New Delhi.1977.
2. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi. 2000.
3. Gerard G. Emch, R. Sridharan and M.D. Srinivas: Contributions to the History of Indian Mathematics, Hindustan Book Agency, Vol.3,2005.
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1. Surjeet Singh and Qazi Zameeruddin: Modern Algebra,Vikas Publishing House Pvt Ltd; Eighth edition, 2006.
2. N. Jacobson: Basic Algebra. Vol. I and II,W. II Freeman,1980.
3. I.S. Luther and I.B.S. Passi: Algebra.Vol.I and II,Narosa Publishing House,1997.
4. Shanti Narayan: A text Book of Modern Abstract Algebra, S. Chand and Company. New Delhi, I967.
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Faculty of Science

Bachelor of Science (B.Sc.)
SUBJECT: MATHEMATICS
B.Sc. III Semester
Paper- Major/ Minor
Abstract Algebra and Linear Algebra

Course Outcomes

CO. No.	Course Outcomes	Cognitive Level
CO1	Recognize the algebraic structures as a group, and classify them as abelian, cyclic and permutation groups, etc.	U
CO2	Link the fundamental concepts of groups and symmetrical figures.	Ap
CO3	Analyze the subgroups of cyclic groups.	U
CO4	Explain the significance of the notion of cosets, normal subgroups, and quotient groups.	E
CO5	The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphisms	U
CO6	Analyze whether a finite set of vectors in a vector space is linearly independent. Explain the concepts of basis and dimension of a vector space.	U

CO7	Understand the linear transformations, rank and nullity, matrix of a linear transformation, algebra of transformations and change of basis.	U
CO8	Compute the characteristic polynomial, eigen values, eigen vectors and eigen spaces, as well as the geometric and the algebraic multiplicities of an eigen value and apply the basic diagonalization result.	Ap

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	6	40	60	100
Total	6	100		

Evaluation Scheme

	Marks	
	Internal	External
Theory	3 Internal Exams of 20 Marks (During the Semester) (Best 2 will be taken)	1 External Exams (At the End of Semester)

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Department of Mathematics

Content of the Course
Theory

No. of Lectures (in hours per week):6 Hrs. per week

Total No. of Lectures:90Hrs. **Maximum Marks: 60**

Unit	Topics	No. of Lectures
I	1.1 Historical background: 1.1.1 A brief historical back ground of the Algebra in the context of India and Indian heritage and culture 1.1.2 A brief biography of Brahmagupta 1.2 Groups, Subgroups and their basic properties 1.3 Cyclic groups 1.4 Coset decomposition 1.5 Lagrange's and Fermat's theorem 1.6 Normal subgroups 1.7 Quotient groups	24
II	2.1 Homomorphism and Isomorphism of groups 2.2 Fundamental theorem of homomorphism 2.3 Transformation and permutation group Sn (n<5) 2.4 Cayley's theorem 2.5 Group automorphism 2.6 Inner automorphism 2.7 Group of automorphisms	24
	3.1 Definition and basic properties of rings 3.2 Ring homomorphism	

III	3.3 Subring 3.4 Ideals 3.5 Quotient ring 3.6 Polynomial ring 3.7 Integral domain 3.8 Field	24

IV	4.1 Definition and examples of Vector space
	4.2 Subspaces
	4.3 Sum and direct sum of subspaces
	4.4 Linear span, Linear dependence, linear independence and their basic properties
	4.5 Basis
	4.6 Finite dimensional vector space and dimension
	    4.6.1 Existence theorem
	    4.6.2 Extension theorem
	    4.6.3 Invariance of the number of elements
	4.7 Dimension of sum of subspaces
	4.8 Quotient space and its dimension
		24

V	5.1 Linear transformation and its representation as a matrix 5.2 Algebra of linear transformation 5.3 Rank-Nullity theorem 5.4 Change of basis, dual space, bi-dual space and natural isomorphism 5.5 Adjoint of a linear transformation 5.6 Eigen values and Eigen vectors of a linear	24

	transformation Diagonalization	

References

Text Books:

1. I.N.Herstein:Topics in Algebra, Wiley Eastern Ltd. New Delhi.1977.
2. K. B. Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi. 2000.
3. Gerard G. Emch, R. Sridharan and M.D. Srinivas: Contributions to the History of Indian Mathematics, Hindustan Book Agency, Vol.3,2005.
4. मध्यप्रदेशहिंदीग्रंथअकादमीकीपुस्तके।

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3. I.S. Luther and I.B.S. Passi: Algebra.Vol.I and II,Narosa Publishing House,1997.
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6. K.Hoffiman and R. Kunze: Linear Algebra. 2nd Edition, Prentice Hall Engle wood Cliffs, New Jersey,1971.
7. A.R. Vasishtha and J.N. Sharma: Linear Algebra, Krishna Prakashan Media (P)Ltd., 2019.
8. Bibhutibhusan Datta and Avadhesh Narayan Singh: History of Hindu Mathematics, Asia Publishing House, 1962.

Faculty of Science

Bachelor of Science (B.Sc.)
SUBJECT: MATHEMATICS
B.Sc. IV Semester
Paper- Major/ Minor
Advanced Calculus and Partial Differential Equations

Course Outcomes

CO.No.	Course Outcomes	Cognitive Level
CO1	Understand many properties of the real line R and sequences.	U
CO2	Calculate the limit superior, the limit inferior, and the limit of a bounded sequence.	E
CO3	Apply the mean value theorems and Taylor's theorem.	Ap
CO4	Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers.	Ap
CO5	Formulate, classify and transform partial differential equations into canonical form.	E

Credit and Marking Scheme

	Credits	Marks		Total Marks
		Internal	External	
Theory	6	40	60	100
Total	6	100		

Evaluation Scheme

	Marks	
	Internal	External
Theory	3 Internal Exams of 20 Marks (During the Semester) (Best 2 will be taken)	1 External Exams (At the End of Semester)

Content of the Course
Theory

No. of Lectures (in hours per week):6 Hrs. per week

Total No. of Lectures:90 Hrs.

Maximum Marks: 60

Unit	Topics	No. of Lectures
I	1.1 Historical background: 1.1.1 A brief historical background of Calculus and partial differential equations in the context of India and Indian heritage and culture 1.1.2 A brief bibiography of Bodhayana 1.2 Field structure and ordered structure of R, intervals, bounded and unbounded sets, supremum and infimum, completeness in R, absolute value of a real number. 1.3 Sequence of real numbers 1.4 Limit of a sequence 1.5 Bounded and monotonic sequences 1.6 Cauchy's general principle of convergence 1.7 Algebra of sequence and some important theorems	24
II	2.1 Series of non-negative terms 2.2 Convergence of positive terms series 2.3 Alternating series and Leibnitz's test 2.4 Absolute and Conditional Convergence of Series of real terms 2.5 Uniform continuity	24
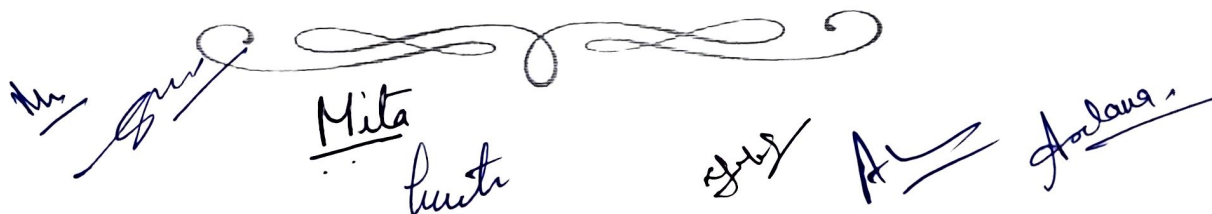
	2.6 Chain rule of differentiability	
	2.7 Mean value theorems and the irgeometrical interpretations	
III	3.1 Limit and continuity of functions of two variables	24
	3.2 Change of variables	
	3.3 Euler's theorem on homogeneous functions	
	3.4 Taylor's theorem for functions of two variables	
	3.5 Jacobians	
	3.6 Maxima and Minima of functions of two variables	
	3.7 Lagrange's multiplier method	
	3.8 Beta and Gamma Functions	
IV	4.1 Partial differential equations of the first order	
	4.2 Lagrange's solution	
	4.3 Some special types of equations which can be solved easily by methods other than the general method	24
	4.4 Charpit's general method	
	4.5 Partial differential equations of second and higher orders	
V	5.1 Classification of partial differential equations of second order	
	5.2 Homogeneous and non-homogeneous partial differential equations of constant coefficients	24
	5.3 Partial differential equations reducible to equations with constant Coefficients	

References

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1. Devi Prasad: Advanced Calculus, Prentice Hall India Learning Private Limited, 2009.
2. S.C. Malik and Savita Arora: Mathematical Analysis, New Age International Private Limited, 1st edition, 2017.
3. M.D. Raysinghania: Ordinary and Partial Differential Equations, S. Chand & Company, New Delhi, 2017.
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1. R.R. Goldbeg: Methods of Real Analysis, Oxford & I.B.H. Publishing co. New Delhi,2020.

2. T.M. Apostol: Mathematical Analysis, Narosa Publishing House. New Delhi.1985.

3. D. Soma Sundaram and B. Choudhary: A first Course in mathematical Analysis, Narosa Publishing, House, New Delhi, 1997.

4. Murray R. Spiegel: Theory and problems of advance Calculus, Schauma Publishing Co. New York, 1974.

5. Donald R. Sherbert, Robert G. Bartle: Introduction to Real Analysis, Wiley, 4th edition, 2011.

6. Shah Nita H.: Ordinary and Partial Differential Equation Theory and Applications, PHIL earning Private Limited, Second

edition,2015.

7. Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2015.

8. K. Sankara Rao: Introduction to Partial Differential Equations, PHI, 3rd edition,2010.

9. Bibhutibhusan Datta and Avadhesh Narayan Singh: History of Hindu Mathematics, Asia Publishing House, 1962.