

**ST. ALOYSIUS COLLEGE (AUTO), JABALPUR**  
**Reaccredited 'A+' by NAAC with CGPA (3.68/4.0)**  
**College with Potential for Excellence by UGC**  
**DST-FIST supported**

**BACHELOR IN SCIENCE (B.Sc.)**

Year 2022		Class: B.A./B.Sc. II Year	Session: 2022- 2023
<b>Subject: Mathematics</b>			
1	<b>Course Code</b>	S2-MATHIT	
2	<b>Course Title</b>	Abstract Algebra and Linear Algebra	
3	<b>Course Type</b>	Major – I	
4	<b>Pre- requisite (if any)</b>	To study this course, a student must have had the subject Mathematics in Certificate Course or equivalent.	
5	<b>Course Learning Outcomes</b>	<p>The course will enable the students to:</p> <ol style="list-style-type: none"> <li>1. Recognize the algebraic structures as a group, and classify them as abelian, cyclic and permutation groups, etc.</li> <li>2. Link the fundamental concepts of groups and symmetrical figures.</li> <li>3. Analyze the subgroups of cyclic groups.</li> <li>4. Explain the significance of the notion of cosets, normal subgroups, and quotient groups.</li> <li>5. The fundamental concept of rings, fields, subrings, integral domains and the corresponding morphisms.</li> <li>6. 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.</li> <li>7. Understand the linear transformations, rank and nullity, matrix of a linear transformation, algebra of transformations and change of basis.</li> <li>8. Compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result.</li> </ol>	
6	<b>Credit Value</b>	Theory : 6	

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7	Total Marks	Max. Marks 30+70

Unit	Topics	No. of Lectures
I	1.1 Historical background: 1.1.1 A brief historical background 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	18
II	2.1 Homomorphism and Isomorphism of groups 2.2 Fundamental theorem of homomorphism 2.3 Transformation and permutation group $S_n$ ( $n < 5$ ) 2.4 Cayley's theorem 2.5 Group automorphism 2.6 Inner automorphism 2.7 Group of automorphisms	18
III	3.1 Definition and basic properties of rings 3.2 Ring homomorphism 3.3 Subring 3.4 Ideals 3.5 Quotient ring 3.6 Polynomial ring 3.7 Integral domain 3.8 Field	18
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	18

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	4.8 Quotient space and its dimension	
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 Eigenvalues and Eigenvectors of a linear transformation Diagonalization	18
<b>Keywords / Tags:</b> Brahmagupta, Groups, Subgroups, Homomorphism and Isomorphism of groups, Ring, Ideals, Field, Vector space, Basis and dimension, Linear transformation, Diagonalization.		
<b>Text Books, Reference Books, Other Resources</b>		

**Suggested Readings:**

**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. मध्यप्रदेश हिंदी ग्रंथ अकादमी की पुस्तके ।

**Reference Books:**

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, 1967.
5. A. K. Vasishtha and A. R. Vasishtha: Modern Algebra, Krishna Publication; 68th edition, 2015.
6. K. Hoffman and R. Kunze: Linear Algebra. 2nd Edition, Prentice Hall Englewood 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.

**Suggested Digital Platforms Web links:**

<https://epgp.inflibnet.ac.in>

<https://www.highereducation.mp.gov.in/?page=xhzlQmpZwkylQo2b%2Fy5G7w%3D%3D>

<http://www.bhojvirtualuniversity.com>

**Suggested Equivalent online courses:**

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Kanday



<https://nptel.ac.in/courses/111/106/111106137/>  
<https://nptel.ac.in/courses/111/105/111105112/>  
<https://ugcmoocs.inflibnet.ac.in/index.oho/courses/viewug/32>

**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**

**Assessment and Evaluation**

**Suggested Continuous Evaluation Methods:**

Maximum Marks: **100**

Continuous Comprehensive Evaluation (CCE): **30 Marks**

External Exam : **70 Marks**

<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE)	1. Class Test	10
	2. Class Test	10
	3. Class Test	10
	4. Assignment/Presentation  (Best Three)	10
<b>Total Marks:</b>		<b>30</b> (Best Three)

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*Handwritten signature: Mandira*  
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**BACHELOR IN SCIENCE (B.Sc.)**

Year 2022		<b>Part A Introduction</b>	Session: 2022- 2023
		<b>Class: B.A./B.Sc. II Year</b>	
<b>Subject: Mathematics</b>			
1	Course Code	S2- MATH2T	
2	Course Title	Advanced Calculus and Partial Differential Equations	
3	Course Type	Major - 2/Minor/Elective	
4	Pre- requisite (if any)	To study this course, a student must have had the subject Mathematics in Certificate Course or equivalent.	
5	Course Learning Outcomes	The course will enable the students to: I. Understand many properties of the real line and sequences. II. Calculate the limit superior, the limit inferior, and the limit of a bounded sequence. III. Apply the mean value theorems and Taylor's theorem. IV. Apply the various tests to determine convergence and absolute convergence of an infinite series of real numbers. V. Formulate, classify and transform partial differential equations into canonical form.	
6	Credit Value	Theory : 6	
7	Total Marks	Max. Marks 30+70	

Unit	Topics	No. of Lectures
1	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 biography of Bodhayana	18

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	1.2 Field structure and ordered structure of $\mathbb{R}$ , intervals, bounded and unbounded sets, supremum and infimum, completeness in $\mathbb{R}$ , 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	
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 2.6 Chain rule of differentiability 2.7 Mean value theorems and their geometrical interpretations	18
III	3.1 Limit and continuity of functions of two variables 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	18
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 4.4 Charpit's general method 4.5 Partial differential equations of second and higher orders	18
V	5.1 Classification of partial differential equations of second order 5.2 Homogeneous and non-homogeneous partial differential equations of constant coefficients 5.3 Partial differential equations reducible to equations with constant Coefficients	18
<b>Keywords/Tags:</b> Bodhayana, Sequence, Series, Jacobians, Maxima and Minima, Beta and Gamma functions, Partial differential equations.		
<b>Text Books, Reference Books</b>		

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### Suggested Readings:

#### Text Books:

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.
4. Gerard G. Emch, R. Sridharan and M. D. Srinivas: Contributions to the History of Indian Mathematics. Hindustan Book Agency, Vol. 3, 2005.
5. मध्यप्रदेश हिंदी ग्रंथ अकादमी की पुस्तके ।

#### Reference Books:

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, PHI Learning 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,

#### Suggested equivalent online courses

#### Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.

2010.

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

#### Suggested Digital Platforms Web links:

<https://epgp.inflibnet.ac.in>

<https://www.highereducation.mp.gov.in/?page=xhzIQmpZwkylQo2b%2Fy5G7w%3D%3D>

<http://www.bhojvirtualuniversity.com>

#### Suggested Equivalent online courses:

<https://nptel.ac.in/courses/111/104/111104125/>

<https://nptel.ac.in/courses/111/101/111101153/>

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Assessment and Evaluation		
<b>Suggested Continuous Evaluation Methods:</b>		
Maximum Marks:	100	
Continuous Comprehensive Evaluation (CCE):	30 Marks	
External Exam :	70 Marks	
<b>Internal Assessment:</b> Continuous Comprehensive Evaluation (CCE)	1. Class Test	10
	2. Class Test	10
	3. Class Test	10
	4. Assignment/Presentation	10
	(Best Three)	<b>Total Marks: 30</b> (Best Three)

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