(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (II)

Course Code	US02MAMTH01	Title of the Course	Algebra
Total Credits of the Course	4	Hours per Week	4 hours

Course Objectives:	1. To provide the detailed knowledge of Matrix Algebra. 2. To introduce the concepts of Complex analysis.

Course Content		
Unit	Description	Weightage* (%)
1.	Matrix: Definition. Equal Matrices, Some special Types of Matrices; Square Matrix, Row Matrix, Column Matrix, Diagonal Matrix, Identity Matrix, Zero Matrix, Upper/Lower Triangular Matrix, Submatrix of Matrix, Determinant and Minor of a Matrix, Properties of Matrix Addition: Commutative Law, Identity, & Inverse Property, Associative Law, Scalar Multiplication of Matrix, Matrix Multiplication, Properties of Matrix Multiplication : Commutative Property, Identity Property & Inverse Property, Associative law, Distributive Law.	25%
2.	Transpose of a Matrix, Transpose of Addition of two Matrices, Reversal Law for transpose of a product of two Matrices, Conjugate of a Matrix, Conjugate of Addition and Multiplication of two Matrices, Conjugate Transpose of a Matrix, Conjugate Transpose of Addition and Multiplication of Matrices, Symmetric and Skew-symmetric Matrices, Hermitian and Skew-Hermitian Matrices, Expression of square matrix by symmetric and skew-symmetric matrices, Hermitian & skew-Hermitian Matrices. Orthogonal and Unity Matrices.	25%
3.	Elementary raw/column transformations on Matrix, Rank of matrix by elementary transformation, Reducing the matrix to Normal form, Elementary Matrices (Properties of Elementary Matrices). Singular and Non-singular matrix, Computing inverse of Non-singular matrix by elementary operation, Characteristic Matrix, Characteristic Equation of Matrix, Characteristic value and Characteristic vector of Matrix, Cayley-Hamilton Theorem.	25%
4.	Complex Number, Polar representation of complex number, De'Moivre's Theorem for rational indices and its applications, n^{th} root of a complex number. Expansion of $sinn\theta, cosn\theta, tann\theta$ in powers of $sinn\theta, cosn\theta, tann\theta$ respectively. Addition formulae for any number angles, Expansion of $sin^n\theta$, $cos^n\theta$, $sin^m\theta cos^n\theta$ in a series of $sine$s or $cosine$s of multiples of θ.	25%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Complex numbers in Complex Analysis in future.

Suggested References:	
Sr. No.	References
1.	Brown, J. W., & Churchill, R. V. (2009), Complex variables and applications, McGraw-Hill Book Company.
2.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.
3.	Andreescu T., Andrica D. (2006), Complex Numbers from A to Z, Birkhauser.

On-line resources to be used if available as reference material
On-line Resources

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (II)

Course Code	US02MAMTH02 (PART-1)	Title of the Course	PROBLEMS AND EXERCISES IN ALGEBRA (PART-1)
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To provide the detailed knowledge of Matrix Algebra

Course Content		
Unit	Description	Weightage* (%)
1.	Various illustrations of special types of matrices	12.50%
2.	Sub matrix, determinant of matrix , minor of matrix, adjoint of matrix, inverse of matrix by adjoint of matrix	12.50%
3.	Verification of properties of matrix addition	12.50%
4.	Verification of properties of matrix multiplication and distributive law	12.50%
5.	Verification of reversal law for transpose and conjugate transpose of product of two matrices	12.50%
6.	Verification of skew-symmetric, Hermitian and skew-Hermitian matrices for given square matrix	12.50%
7.	Construct symmetric and skew-symmetric, Hermitian and skew-Hermitian matrices for given square matrix	12.50%
8.	Construction of orthogonal and unitary matrices	12.50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Group discussion, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Matrices in their subject in future.

Suggested References:	
Sr. No.	References
1.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (II)

Course Code	US2MAMTH02 (PART-2)	Title of the Course	PROBLEMS AND EXERCISES IN ALGEBRA (PART-2)
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To provide the detailed knowledge of Matrix Algebra 2. To introduce the concepts of Complex analysis

Course Content		
Unit	Description	Weightage* (%)
1.	Rank of a matrix, Elementary transformation on a matrix, Invariance of rank under elementary transformation, Reduction to normal form, Elementary matrices.	12.50%
2.	Method for computing the inverse of a non-singular matrix by elementary operations, Equivalence matrices.	12.50%
3.	Solution of system of linear homogeneous algebraic equations, Solution of System of linear non-homogeneous algebraic equations.	12.50%
4.	Characteristic roots and characteristic vectors of a square matrix.	12.50%
5.	Complex numbers, Polar form of Complex number. De Moivre's theorem,	12.50%
6.	n^{th} roots of a Complex number and its geometric representation	12.50%
7.	Expansion of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ in powers of $\sin\theta$, $\cos\theta$, $\tan\theta$ respectively, Expansion of $\sin^m\theta$, $\cos^m\theta$, $\sin^m\theta\cos^n\theta$ in a series of sines or cosines of multiples of θ.	12.50%
8.	Complex Function: Exponential function, Hyperbolic functions, Inverse Hyperbolic functions, Real and Imaginary part of circular and Hyperbolic functions, Logarithmic functions.	12.50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Group discussion, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	University Examination	100%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Complex numbers in Complex Analysis in future.

Suggested References:	
Sr. No.	References
1.	Brown, J. W., & Churchill, R. V. (2009), Complex variables and applications, McGraw-Hill Book Company.
2.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.
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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (II)

Course Code	US02MIMTH01	Title of the Course	MATRICES AND COMPLEX NUMBERS
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To introduce the concepts of Complex analysis. 2. To provide the detailed knowledge of Matrix Algebra.

Course Content		
Unit	Description	Weightage* (%)
1.	Elementary raw/column transformations on Matrix, Rank of matrix by elementary transformation, Reducing the matrix to Normal form, Elementary Matrices (Properties of Elementary Matrices). Singular and Non-singular matrix, Computing inverse of Non-singular matrix by elementary operation, Characteristic Matrix, Characteristic Equation of Matrix, Characteristic value and Characteristic vector of Matrix, Cayley-Hamilton Theorem.	50%
2.	Complex Number, Polar representation of complex number, De'Moivre's Theorem for rational indices and its applications, n^{th} root of a complex number. Expansion of $sinn\theta, cosn\theta, tann\theta$ in powers of $sinn\theta, cosn\theta, tann\theta$ respectively. Addition formulae for any number angles, Expansion of $sin^n\theta$, $cos^n\theta$, $sin^m\theta cos^n\theta$ in a series of $sine$s or $cosine$s of multiples of θ.	50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Complex numbers in Complex Analysis in future.

Suggested References:	
Sr. No.	References
1.	Brown, J. W., & Churchill, R. V. (2009), Complex variables and applications, McGraw-Hill Book Company.
2.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.
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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (II)

Course Code	US02MIMTH02	Title of the Course	PROBLEMS AND EXERCISES IN MATRICES AND COMPLEX NUMBERS (Practical)
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To provide the detailed knowledge of Matrix Algebra 2. To introduce the concepts of Complex analysis

Course Content		
Unit	Description	Weightage (%)
1.	Rank of a matrix, Elementary transformation on a matrix, Invariance of rank under elementary transformation, Reduction to normal form, Elementary matrices.	12.50%
2.	Method for computing the inverse of a non-singular matrix by elementary operations, Equivalence matrices.	12.50%
3.	Solution of system of linear homogeneous algebraic equations, Solution of System of linear non-homogeneous algebraic equations.	12.50%
4.	Characteristic roots and characteristic vectors of a square matrix.	12.50%
5.	Complex numbers, Polar form of Complex number. De' Moivre's theorem,	12.50%
6.	n^{th} roots of a Complex number and its geometric representation	12.50%
7.	Expansion of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ in powers of $\sin\theta$, $\cos\theta$, $\tan\theta$ respectively, Expansion of $\sin^m\theta$, $\cos^m\theta$, $\sin^m\theta\cos^n\theta$ in a series of sines or cosines of multiples of θ.	12.50%
8.	Complex Function: Exponential function, Hyperbolic functions, Inverse Hyperbolic functions, Real and Imaginary part of circular and Hyperbolic functions, Logarithmic functions.	12.50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Group discussion, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Examination	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Complex numbers in Complex Analysis in future.

Suggested References:	
Sr. No.	References
1.	Brown, J. W., & Churchill, R. V. (2009), Complex variables and applications, McGraw-Hill Book Company.
2.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.
3.	Andreescu T., Andrica D. (2006), Complex Numbers from A to Z, Birkhauser.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics) Semester (II)

Course Code	US02IDMTH01	Title of the Course	BASICS OF MATRICES
Total Credits of the Course	2	Hours per Week	2 hours

Course Objectives:	1. To provide the basic knowledge of Matrix Algebra.

Course Content		
Unit	Description	Weightage* (%)
1.	Matrix: Definition. Equal Matrices, Some special Types of Matrices; Square Matrix, Row Matrix, Column Matrix, Diagonal Matrix, Identity Matrix, Zero Matrix, Upper/Lower Triangular Matrix, Submatrix of Matrix, Determinant and Minor of a Matrix, Properties of Matrix Addition: Commutative Law, Identity, & Inverse Property, Associative Law, Scalar Multiplication of Matrix, Matrix Multiplication, Properties of Matrix Multiplication : Commutative Property, Identity Property & Inverse Property, Associative law, Distributive Law.	50%
2.	Transpose of a Matrix, Transpose of Addition of two Matrices, Reversal Law for transpose of a product of two Matrices, Conjugate of a Matrix, Conjugate of Addition and Multiplication of two Matrices, Conjugate Transpose of a Matrix, Conjugate Transpose of Addition and Multiplication of Matrices, Symmetric and Skew-symmetric Matrices, Hermitian and Skew-Hermitian Matrices, Expression of square matrix by symmetric and skew-symmetric matrices, Hermitian & skew-Hermitian Matrices. Orthogonal and Unity Matrices.	50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Students can use the basic knowledge of Matrices in their subject in future.

Suggested References:	
Sr. No.	References
1.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi.

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(Bachelor of Science) (Mathematics)
(B.Sc.) (Mathematics)Semester (II)

Course Code	US02IDMTH02	Title of the Course	PROBLEMS AND EXERCISES IN BASICS OF MATRICES (Practical)
Total Credits of the Course	2	Hours per Week	4 hours

Course Objectives:	1.To provide the detailed knowledge of Matrix Algebra

Course Content		
Unit	Description	Weightage (%)
1.	Various illustrations of special types of matrices	12.50%
2.	Sub matrix, determinant of matrix , minor of matrix, adjoint of matrix, inverse of matrix by adjoint of matrix	12.50%
3.	Verification of properties of matrix addition	12.50%
4.	Verification of properties of matrix multiplication and distributive law	12.50%
5.	Verification of reversal law for transpose and conjugate transpose of product of two matrices	12.50%
6.	Verification of skew-symmetric, Hermitian and skew-Hermitian matrices for given square matrix	12.50%
7.	Construct symmetric and skew-symmetric, Hermitian and skew-Hermitian matrices for given square matrix	12.50%
8.	Construction of orthogonal and unitary matrices	12.50%

Teaching-Learning Methodology	Classroom teaching, Presentation by students, Group discussion, Use of ICT whenever required.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Examination	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Students will be able to use this knowledge of Matrices in initiating the study of Advanced linear algebra.
2.	Students can use the basic knowledge of Matrices in their subject in future.

Suggested References:	
Sr. No.	References
1.	Narayan S., Mittal P. K. (2005), A textbook of Matrices, 11^{th} revised edition, S. Chand and Co. Ltd., New Delhi.

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