V. P. & R. P. T. P. Science College (Autonomous), Vallabh Vidyanagar

DEPARTMENT OF MATHEMATICS & STATISTICS

(Bachelor of Science) (Undergraduate)

Semester-II

The following is the list of subject codes and subject names for courses offered by the Department of Mathematics & Statistics:

MATHEMATICS			
Sr. No	**Course**	**Subject Code**	**Subject Name**
1	Major Course-1	US02MAMTH01	Algebra
2	Major Course-2	US02MAMTH02	Problems & Exercises in Algebra & Laplace Transform
3	Minor Course-1	US02MIMTH01	Matrices & Complex Numbers
4	Minor Course-2	US02MIMTH02	Problems & Exercises in Matrices & Complex Numbers
5	Inter-disciplinary Course-1	US02IDMTH01	Basics of Matrices
6	Inter-disciplinary Course-2	US02IDMTH02	Problem & Exercises in Basics of Matrices & Calculus

STATISTICS			
Sr. No	**Course**	**Subject Code**	**Subject Name**
1.	Minor Course-1	US02MISTA01	Descriptive Statistics for Bivariate Data
2.	Minor Course-2	US02MISTA02	Statistics Practical-II

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Syllabus effective from the Academic Year 2024-2025

(Bachelor of Science) (Undergraduate)
B.Sc. (UG) Semester-II

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

Course Objectives:	• Explore and understand various aspects of complex numbers. • Apply various methods to determine the solution of the system and analyze feasibility of the solution.

Course Content		
Unit	Description	Weightage* (%)
1.	Complex Number, Properties of complex number, Polar form of complex number, De'Moivre's Theorem for rational indices and its applications, n^{th} root of a complex number, Statement of fundamental theorem of Algebra, Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $sin\theta$ and $cos\theta$ respectively. Expansion of $\sin^m \theta$, $\cos^n \theta$, $\sin^m \theta \cos^n \theta$ in a series of $sine$s or $cosine$s of multiples of θ.	25%
2.	Special type of a matrices: Symmetric, Skew symmetric, Hermitian, Skew-Hermitian Matrices, Idempotent, Involutory, Nilpotent, Orthogonal and Unitary Matrices, Algebra of matrices: Distributive law, Associative property, and Reversal law for the transpose and for the conjugate transpose of a product, Rank of a matrix, Elementary transformations and Elementary matrices, Invariance of a rank through elementary transformations, Row Echelon form, Reduced row echelon form.	25%
3	Inverse of a matrix through elementary transformation. System of linear equations and its solution: by Gauss Jordan method, Gauss Jordan elimination method and Cramer's rule. Matrices of Reflection and Rotation.	25%
4	Characteristic roots Characteristic vectors of a square matrix and some fundamental theorems, Algebraic and Geometric multiplicity, Cayley Hamilton theorem, Diagonalization of a symmetric matrix.	25%

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

Evaluation Pattern		
Details of the Evaluation		Weightage
CCE (Continuous and Comprehensive Evaluation)	○ Class test/Internal Written test (30%) ○ Quiz (30%) ○ Active learning (10%) ○ Home Assignments (10%) ○ Class Assignments (10%) ○ Attendance (10%)	50 %
SEE (Semester End Examination)	○ Written test 50 %	50 %

Course Outcomes:	
1.	Students will gain the basic knowledge of Complex numbers.
2.	Students will perform matrix computation in a comprehensive manner.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Brown J. W., & Churchill, R. V. Complex variables and applications, McGraw-Hill Book Company, (2009).
2.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
3.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.

On-line Resources: https://nptel.ac.in/courses

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B. Sc. (UG) Semester-II

Course Code	US02MAMTH02	Title of the Course	Problems And Exercises In Algebra & Laplace Transform (Practical)
Total Credits of the Course	04	Hours per Week	8 hours

Course Objectives:	1. Apply various methods to determine the solution of the system and analyse feasibility of the solution. 2. Understand how to convert complex functions into simpler forms for analysis and problem solving using Fourier series and Laplace transform.

Course Content		
Part	List of Practical	Weightage* (%)
Part-1	1. Rank of a matrix, Row echelon form, Reduced row echelon form. 2. Solution of a system of linear equations using Gauss-Jordan method, Gauss-Jordan elimination, and Cramer's Rule. 3. Transformation Matrices for Reflection and Rotation. 4. Characteristic roots and characteristic vectors of a square matrix along with studying algebraic and geometric multiplicities of characteristic roots. 5. Example based on Cayley-Hamilton theorem. 6. Diagonalization of a symmetric matrix. 7. Periodic function, Fourier series of a function with period $p = 2l$ 8. Fourier series of Even and odd functions.	50%
Part-2	1. Laplace Transformations and Inverse Laplace Transformations. 2. Properties of Laplace Transform: Laplace transforms of $e^{at}f(t), t^n f(t)$, $\frac{f(t)}{t}$. 3. Transform of Derivatives and Integrals. 4. Laplace Transformations of Unit step Function and Unit Impulse Function. 5. Dirac's delta function and Partial fraction. 6. Convolution Theorem.	50%

	7. Solution of Linear Differential Equations. 8. Application of Laplace Transformation.	

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

Evaluation Pattern			
Sr. No.	Details of the Evaluation		Weightage
1.	CCE (Continuous and Comprehensive Evaluation)	o Lab work Assessment (40%) o Viva Voce/Lab Quiz (40%) o Attendance (20%)	50 %
2.	SEE (Semester End Examination)	o Lab work Assessment (80%) o Viva Voce/Lab Quiz (20%)	50 %

Course Outcomes:	
1.	Students will perform matrix computation in a comprehensive manner.
2.	Students will be able to express function in terms of sine and cosine using Fourier series, and able to solve differential equation using Laplace transform.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
2.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.
3.	Erwin Kreyszing, Advanced Engineering Mathematics, 10^{th} edition, Authorized reprint by Wiley Dreamtech India.

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(Bachelor of Science) (Undergraduate)

B.Sc.(UG) 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. Apply various methods to determine the solution of the system and analyze feasibility of the solution. 2. Explore and understand various aspects of complex numbers.

Course Content		
Unit	Description	Weightage* (%)
1.	Rank of a matrix, Elementary transformations, Inverse of a matrix through elementary transformation. System of linear equations and its solution: by Gauss Jordan method, Gauss Jordan elimination method and Cramer's rule. Matrices of Reflection and Rotation, Characteristic roots and Characteristic vectors of a square matrix of order ≤ 3.	50%
2.	Complex Number, Properties of complex number, Polar form of complex number, De'Moivre's Theorem for rational indices and its applications, n^{th} root of a complex number, Statement of fundamental theorem of Algebra, Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $sin\theta$ and $cos\theta$ respectively. Expansion of $\sin^m\theta$, $\cos^n\theta$, $\sin^m\theta\cos^n\theta$ 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		
Details of the Evaluation		Weightage
CCE (Continuous and	○ Class test/Internal Written test (40%)	50 %

Comprehensive Evaluation)	○ Quiz (20%) ○ Home Assignments (20%) ○ Attendance (20%)	
SEE (Semester End Examination)	○ Written test (50 %)	50 %

Course Outcomes:	
1.	Students will perform matrix computation in a comprehensive manner.
2.	Students will gain the basic knowledge of Complex numbers.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.
2.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
3.	Brown J. W., & Churchill, R. V. Complex variables and applications, McGraw-Hill Book Company, (2009).

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(Bachelor of Science) (Undergraduate)

B.Sc.(UG) Semester-II

Course Code	US02MIMTH02	Title of the Course	Problems And Exercises In Matrices And Complex Numbers (Practical)
Total Credits of the Course	02	Hours per Week	4 hours

Course Objectives:	1. Apply various methods to determine the solution of the system and analyze feasibility of the solution. 2. Explore and understand various aspects of complex numbers.

Course Content		
Sr. No.	List of Practical	Weightage* (%)
1	Examples based on Idempotent, Involuntary, Nilpotent, Orthogonal, Unitary Matrices, construction of orthogonal and unitary matrices.	100%
2	Example based on Gauss elimination method.	
3	Example based on Gauss-Jordan elimination method.	
4	Example based on Cramer's Rule.	
5	Inverse of a matrix using elementary transformations	
6	Characteristic roots and characteristic vectors of a square matrix of order ≤ 3.	
7	Example based on Cayley-Hamilton theorem.	
8	Diagonalization of a symmetric matrix.	
9	n^{th} roots of a Complex number and its geometric representation.	
10	Complex Function: Exponential function, Hyperbolic functions, Inverse Hyperbolic functions, Real and Imaginary part of circular and Hyperbolic functions, Logarithmic functions.	

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

Evaluation Pattern		
Details of the Evaluation		Weightage
CCE (Continuous and Comprehensive Evaluation)	o Lab work Assessment (40%) o Viva Voce/Lab Quiz (40%) o Attendance (20%)	50 %
SEE (Semester End Examination)	o Lab work Assessment (80%) o Viva Voce/Lab Quiz (20%)	50 %

Course Outcomes:	
1.	Students will perform matrix computation in a comprehensive manner.
2.	Students will gain the basic knowledge of Complex numbers.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.
2.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
3.	Brown J. W., & Churchill, R. V. Complex variables and applications, McGraw-Hill Book Company, (2009).

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(Bachelor of Science) (Undergraduate)
B. Sc. (UG) Semester-II

Course Code	USO2IDMTH01	Title of the Course	Basics of Matrices
Total Credits Of the Course	2	Hours per Week	2 hours

Course Objectives:	1. Explore matrix operations. 2. Apply various methods to determine the solution of the system and analyze feasibility of the solution.

Course Content		
Unit	Description	Weightage* (%)
1.	Special type of a matrices: Symmetric, Skew symmetric, Hermitian, Skew-Hermitian Matrices, Idempotent, Involuntary, Nilpotent, Orthogonal and Unitary Matrices, Rank of a matrix, Elementary transformation, Row Echelon form, Reduced row echelon form, inverse of a matrix by elementary transformation.	50%
2.	System of linear equations and its solution: by Gauss Jordan method, Gauss Jordan elimination method, and Cramer's rule, Characteristic roots Characteristic vectors of a square matrix (of order ≤ 3), Cayley Hamilton theorem (Without proof).	50%

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

Evaluation Pattern		
Details of the Evaluation		Weightage
CCE (Continuous and Comprehensive Evaluation)	○ Class test/Internal Written test (40%) ○ Quiz (20%) ○ Home Assignments (20%)	50 %

	o Attendance (20%)	
SEE (Semester End Examination)	o Written test (50 %)	50 %

Course Outcomes:	
1.	Students will gain the basic knowledge of Matrices.
2.	Students will perform matrix computation in a comprehensive manner.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
2.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.

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B. Sc. (UG) Semester-II

Course Code	USO2IDMTH02	Title of the Course	Problem & Exercises in Basics of Matrices & Calculus (Practical)
Total Credits Of the Course	2	Hours per Week	4 hours

Course Objectives:	1. To determine the solution of the system and analyze feasibility of the solution. 2. Applying Mean Value Theorems for function analysis.

Course Content		
Sr. No.	List of Practical	Weightage* (%)
1.	Example based on Gauss-Jordan elimination and Gauss-Jordan method.	100%
2.	Example based on Cramer's rule.	
3.	Characteristic roots and Characteristic vectors of a square matrix of order ≤ 3.	
4.	Verification of Cayley Hamilton theorem.	
5.	Example based on Rolle's Mean Value Theorem	
6.	Example based on Lagrange's Mean Value Theorem.	
7.	Example based on Cauchy's Mean Value Theorem	
8.	Example based on Reduction formula- I	
9.	Example based on Reduction formula - II	
10	Example based on Reduction formula – III	

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

Evaluation Pattern		
Details of the Evaluation		Weightage
CCE (Continuous and Comprehensive Evaluation)	o Lab work Assessment (40%) o Viva Voce/Lab Quiz (40%) o Attendance (20%)	50 %
SEE (Semester End Examination)	o Lab work Assessment (80%) o Viva Voce/Lab Quiz (20%)	50 %

Course Outcomes:	
1.	Students will gain the basic knowledge of Matrices.
2.	Students will develop analytical skills in applying mean value theorems.

Suggested Reference Books:	
Sr. No.	Reference Books
1.	Narayan S., Mittal P. K., A textbook of Matrices, 11th revised edition, S. Chand and Co. Ltd., New Delhi, (2005).
2.	Krishnamurthy, V., Mainra, V. P. & Arora, J. L., An Introduction to linear Algebra, East West Press, 2001.
3.	Shanti Narayan, Differential Calculus, 14th Edition, S. Chand & Company Ltd., New Delhi, 2005.
4.	Shanti Narayan, Integral Calculus, 14th Edition, S. Chand & Company Ltd., New Delhi, 1996.

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DEPARTMENT OF MATHEMATICS AND STATISTICS

(Bachelor of Science) (Undergraduate)

B. Sc (UG) Semester- II

Minor Course – 1: Descriptive Statistics for Bivariate Data

Course Code	**US02MISTA01**	Title of the Course	**DESCRIPTIVE STATISTICS FOR BIVARIATE DATA**
Total Credits of the Course	02	Hours per Week	02 hours

Course Objectives:	1. To establish functional relationship between two variables. 2. To study causal relationship between two related variables and measure the strength of relationship between two variables. 3. Understand the line of best fit as a tool for summarizing a linear relationship and predicting for the future.

Course Content		
Unit	Description	Weightage* (%)
I	Curve fitting : Principle of least squares. Fitting of $(i)Y = a + bX$ $(ii)Y = a + bX + cX^2$ $(iii)Y = ab^X$ $(iv)\ Y = aX^b$ Correlation : Objectives, Definition, Methods of studying correlation (a) Scatter diagram method (b) Karl- Pearson's correlation coefficients and its properties (with proof) (c) Spearman's Rank Correlation coefficient and its properties (with proof) Examples	50%
II	Regression Analysis : Meaning and importance, Derivation of both the regression lines and properties of regression coefficients (with proof) and Examples	50%

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

Methodology	

Evaluation Pattern			
Sr. No.	Details of the Evaluation		Weightage
1.	CCE (Continuous and Comprehensive Evaluation)	○ Class test/Internal Written test (40%) ○ Quiz (20%) ○ Home Assignments (20%) ○ Attendance (20%)	50 %
2.	SEE (Semester End Examination)	○ Written test (50 %)	50 %

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand and interpret the correlation between two variables
2.	Learn how to apply linear regression models in practice
3.	

Suggested Text Books/ References:	
Sr. No.	Text Books
1.	B. L. Agarwal (2003). Programmed STATISTICS (Questions – Answers). New Age International Publishers. Chap. 13, 14, 16.
2.	D. Bhattacharya and S. Roychowdhury (2019 reprint).STATISTICS, Theory and Practice, 3rd Ed., U.N. Dhur & Sons Pvt. Ltd., Kolkata. Chap. 8-9.
3.	D. freedman, R. Pisani, R. Purves (2017 reprint). Statistics, 4th Ed., Viva Books, Kolkata. Chap. 8-12.
4.	Goon, A.M., Gupta, M. K. And Dasgupta, B. (2002). Fundamental of Statistics, Vol. I, 8th Ed., The World Press, Kolkata. Chap. 11-12, 14.
5.	B. L. Agarwal (2006). Basic Statistics, Revised 4th Ed., New Age International Publishers. Chap. 24.

	Reference Books
6.	Bilal, M. A. And Richard, H. M. (2015). Probability, Statistics, and reliability for Engineers and Scientists, 3rd Ed. Special Indian Ed., CRC Press. Chap. 12.
7.	J. McClave and T. Sincich (2018). Statistics, 13th Ed., Pearson, NY. Chap. 2, 11.
8.	A. Anderson and D. Semmerlroth (2015). Statistics for Big Data for Dummies: A Wiley Brand. John Wiley & Sons. Chap 15-16.

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DEPARTMENT OF MATHEMATICS AND STATISTICS

(Bachelor of Science) (Undergraduate)

B. Sc (UG) Semester-II

Minor Course – 2: Statistics Practical - II

Course Code	**US02MISTA02**	Title of the Course	**Statistics Practical - II**
Total Credits of the Course	02	Hours per Week	04 hours
Course Objectives:	1. To understand the two-dimensional data in scientific and other fields 2. To summarize and derive tangible information contained in the two-dimensional inter-related and time related scientific and other data		

List of Practicals

Sr. No.	**Task Using MS-EXCEL/Manual**
1	Tabulation of scientific data: Bivariate quantitative data (Bivariate frequency distribution)
2	Diagrammatical presentation of all bivariate scientific data: Scatter diagram, box-plots
3	Fitting of Straight line
4	Fitting of Second degree Parabola
5	Fitting of Exponential Curve
6	Fitting of Power curve
7	Computation of Karl Pearson correlation coefficient
8	Computation of Spearman's rank correlation coefficient
9	Fitting of regression lines
10	

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage

1.	CCE (Continuous and Comprehensive Evaluation)	○ Class test/Internal Written test (40%) ○ Quiz (20%) ○ Home Assignments (20%) ○ Attendance (20%)	50 %
2.	SEE (Semester End Examination)	○ Written test (50 %)	50 %

REFERENCE MATERIAL

1.	Fred, Pyrczak (2017). SUCCESS at STATISTICS, A worksheet with Humor, 6th Ed., Routledge, NY.
2.	K.V.S. Sarma: Statistics Made Simple (Do It Yourself on PC), 2nd Ed., PHI Learning
3.	Pal, N. And Sarkar, S. (2005). STATISTICS, Concepts and Applications, Prentice Hall of India, New Delhi.
4.	K.V.S. Sarma (2001). STATISTICS made Simple DO It Yourself on PC, Prentice Hall of India, New Delhi.
5.	B. L. Agarwal (2006). Basic Statistics, Revised 4th Ed., New Age International Publishers. Chap. 18.