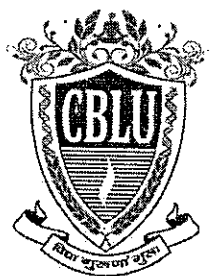
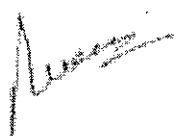


**CHAUDHARY BANSI LAL UNIVERSITY,  
PREM NAGAR, BHIWANI**

**SCHEME AND SYLLABI OF EXAMINATIONS  
FOR  
FIVE-YEAR INTEGRATED (B.SC-M.SC) IN  
MATHEMATICS  
WITH EFFECT FROM THE SESSION 2025-26  
(As per NEP)**



**DEPARTMENT OF MATHEMATICS  
Chaudhary Bansi Lal University,  
Prem Nagar-127031, Bhiwani  
HARYANA, INDIA**



Date of PGBOS&R: July 22, 2025

# CBLU-Syllabus: Five Year Integrated(B.Sc-M.Sc) Programme in Mathematics:2025-26

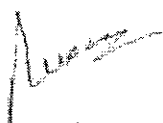
Credit Structure for Five Year Integrated (B.Sc-M.Sc) Mathematics Programs

| Structure of UG Program (First three years of Five Year Integrated (B.Sc-M.Sc) Mathematics Program)                                                                                     |                                  |                                           |                                 |                                   |                                                                             |                           |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------------------------|---------------------------------|-----------------------------------|-----------------------------------------------------------------------------|---------------------------|---------------|
| Semester                                                                                                                                                                                | Core Courses (CC)/ Major Courses | Minor(MIC)/ Minor Vocational (VOC)Courses | Multidisciplinary courses (MDC) | Ability Enhancement courses (AEC) | Skill Enhancement Courses (SEC)/ Internship /Dissertation/ Research Project | Value-Added Courses (VAC) | Total Credits |
| I                                                                                                                                                                                       | CC - U1 @ 4 credits              | CC-M1 @ 4 credits                         | MDC1 @ 3 credits                | AEC1 @ 2 credits                  | SEC1@ 3 credits                                                             | VAC1 @ 2 credits          | 22            |
|                                                                                                                                                                                         | CC - U2 @ 4 credits              |                                           |                                 |                                   |                                                                             |                           |               |
| II                                                                                                                                                                                      | CC - U3 @ 4 credits              | CC-M2 @ 4 credits                         | MDC2 @ 3 credits                | AEC2 @ 2 credits                  | SEC2@ 3 credits                                                             | VAC2 @ 2 credits          | 22            |
|                                                                                                                                                                                         | CC - U4 @ 4 credits              |                                           |                                 |                                   |                                                                             |                           |               |
| Students exiting the programme after second semester and securing 48 credits including 4 credits of summer internship will be awarded UG Certificate in the relevant Discipline/Subject |                                  |                                           |                                 |                                   |                                                                             |                           |               |
| III                                                                                                                                                                                     | CC - U5 @ 4 credits              | CC-M3 @ 4 credits                         | MDC3 @ 3 credits                | AEC3 @ 2 credits                  | SEC3@ 3 credits                                                             |                           | 24            |
|                                                                                                                                                                                         | CC - U6 @ 4 credits              |                                           |                                 |                                   |                                                                             |                           |               |
|                                                                                                                                                                                         | CC - U7 @ 4 credits              |                                           |                                 |                                   |                                                                             |                           |               |
| IV                                                                                                                                                                                      | CC - U8 @ 4 credits              | CC-M4(VOC)@ 4 credits                     | -----                           | AEC4 @ 2 credits                  | -----                                                                       | VAC4 @ 2 credits          | 24            |
|                                                                                                                                                                                         | CC - U9 @ 4 credits              |                                           |                                 |                                   |                                                                             |                           |               |
|                                                                                                                                                                                         | CC - U10 @ 4 credits             |                                           |                                 |                                   |                                                                             |                           |               |
|                                                                                                                                                                                         | CC - U11 @ 4 credits             |                                           |                                 |                                   |                                                                             |                           |               |
| Students exiting the programme after fourth semester and securing 96 credits including 4 credits of summer internship will be awarded UG Diploma in the relevant Discipline/Subject     |                                  |                                           |                                 |                                   |                                                                             |                           |               |
| V                                                                                                                                                                                       | CC - U12 @ 4 credits             | CC-M5(VOC)@ 4 credits                     | -----                           | -----                             | Internship1 @ 4 credits#                                                    | -----                     | 24            |

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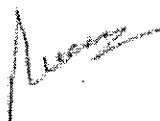
| Semester - I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                               |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------|
| Name of the Course: Algebra                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Course Code: 25IMSMA101       | Credit: 4 |
| Maximum Marks:<br>Theory: 20(Internal)+50(External)=70<br>Practical: 10(Internal)+20(External)=30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Time of Examinations: 3 Hours |           |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                                                                                                                                                                                                                                                                                                                                                     |                               |           |
| <b>Course Learning Outcomes (CLO):</b><br><b>CLO1</b> Determine the type of matrices and compute the elementary operations on the matrices. Compute the Eigen values, Eigen function, characteristic equation and minimal polynomial of a given matrix.<br><b>CLO2</b> Use the concept of rank of matrices to solve systems of linear equations.<br><b>CLO3</b> Familiar with transformation of equation which is very helpful to find the solution of the given problem.<br><b>CLO4</b> Use the Descartes's rule of sign to find the nature of roots.                                                                                                                                                                                                                                                                           |                               |           |
| <b>Section – I</b><br>Symmetric, Skew-symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices. Rank of a matrices. Inverse of a matrix. Linear dependence and independence of rows and columns of matrices. Row rank and column rank of a matrix. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix.                                                                                                                                                                                                                                                                                                                                                                     |                               |           |
| <b>Section-II</b><br>Applications of matrices to a system of linear (both homogeneous and non- homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |           |
| <b>Section-III</b><br>Relations between the roots and coefficients of general polynomial equation in one variable. Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |           |
| <b>Section-IV</b><br>Nature of the roots of an equation Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                               |           |
| <b>Practical/ Computational Work</b><br><b>(Based on course Algebra)</b><br><b>Practical: 10(Internal)+20(External)=30</b><br>There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.<br>Distribution of Marks will be as follows:<br>i) Written Practical/ Lab work : 10 Marks<br>ii) Viva-voce and practical record: 10 Marks                                                                                                                                                                                                                                                                                                                                                                          |                               |           |
| <b>List of Practicals</b><br>Following is the list of programmes to be performed in the Lab using PYTHON/ MATLAB: <ol style="list-style-type: none"> <li>1. Practical based on addition, multiplication of Matrices.</li> <li>2. Practical based on inverse, transpose.</li> <li>3. Practical based on determinant, rank.</li> <li>4. Practical based on eigenvectors, eigenvalues.</li> <li>5. Practical based on Characteristic equation and verification of Cayley Hamilton equation.</li> <li>6. Practical based on system of linear equations.</li> <li>7. Practical based on System of Homogenous Equation.</li> <li>8. Practical based on System of Non- Homogenous Equation.</li> <li>9. Practical based on Solutions of cubic equations.</li> <li>10. Practical based on Solutions of Biquadratic equations.</li> </ol> |                               |           |
| <b>References:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |           |

Date of PG BOS & R: July 22, 2025.



1. Dickson, Leonard Eugene (1922). First Course in The Theory of Equations. John Wiley & Sons, Inc. New York. The Project Gutenberg EBook.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill.
4. H.S. Hall and S.R. Knight : Higher Algebra, H.M. Publications 1994.
5. Shanti Narayan : A Text Books of Matrices.
6. Chandrika Prasad : Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.
7. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
8. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill.
9. B. Kolman, David R. Hill, Introductory Linear Algebra An Applied First Course, 8<sup>th</sup> Edition, Prentice Hall.
10. Jim DeFranza and Dan Gagliardi, Introduction to Linear Algebra with Applications, McGraw Hill Education (India) Pvt Ltd, New Delhi.

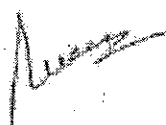
Date of PGBOS&R: July 22, 2025



Semester - I

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                     |                                      |                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------|
| <b>Name of the Course: Vector Calculus</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                     | <b>Course Code: 25IMSMA102</b>       | <b>Credit:4</b> |
| <b>Maximum Marks:</b><br><b>Theory: 30(Internal)+70(External)=100</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     | <b>Time of Examinations: 3 Hours</b> |                 |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                      |                                                                                                                     |                                      |                 |
| <b>Course Learning Outcomes (CLO):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                     |                                      |                 |
| <b>CLO1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Find the derivative along a curve and directional derivatives.                                                      |                                      |                 |
| <b>CLO2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Calculate and interpret gradient; divergence, curl and their related vector identities.                             |                                      |                 |
| <b>CLO3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Be familiar with gradient, divergence, curl and laplacian operators in terms of orthogonal curvilinear coordinates. |                                      |                 |
| <b>CLO4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Use theorems of Gauss, Green and Stokes to solve integrals.                                                         |                                      |                 |
| <b>Section – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                                      |                 |
| Scalar and vector product of three vectors, product of four vectors. Reciprocal vectors. Partial derivative, Vector differentiation. Scalar Valued point functions, Vector valued point functions, derivative along a curve, directional derivatives. Gradient of a scalar point function, geometrical interpretation of grad, gradient as a point function. Tangent planes and Normal lines.                                                                                                     |                                                                                                                     |                                      |                 |
| <b>Section – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                     |                                      |                 |
| Divergence and curl of vector point function, characters of $\text{Div} \vec{f}$ and $\text{curl} \vec{f}$ as point function, examples. Gradient, divergence and curl of sums and product and their related vector identities. Laplacian operator. Double integrals, double integrals in polar co-ordinates, change of order, change in variable, Triple integrals, Triple integrals in Cylindrical co-ordinates and Spherical co-ordinates, Change of order in triple integral, Volume integral. |                                                                                                                     |                                      |                 |
| <b>Section – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                     |                                      |                 |
| Line integrals, independent of the path, Green Theorem and problem based on Green Theorem.                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                     |                                      |                 |
| <b>Section – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                     |                                      |                 |
| Surface integral, Stokes' theorem and problem based on Stokes' theorem, Gauss theorem and problems based on Gauss theorem.                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                     |                                      |                 |
| <b>References:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                                      |                 |
| 1. Murrar R. Spiegel , Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                     |                                      |                 |
| 2. Murrar R. Spiegel , Vector Analysis, Schaum Publishing Company, New York.                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                     |                                      |                 |
| 3. N. Saran and S.N. Nigam, Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |                                      |                 |
| 4. Shanti Narayna , A Text Book of Vector Calculus. S. Chand & Co., New Delhi                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |                                      |                 |
| 5. Dennis G. Zill ,Advanced Engineering Mathematics, 6 <sup>th</sup> Edition, Jones & Bartlett learning                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                     |                                      |                 |

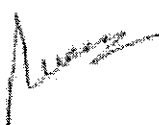
Date of PG BOS & R: July 22, 2025



Semester - I

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                                       |                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------|-----------------|
| <b>Name of the Course: Descriptive Statistics</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | <b>Course Code: 25IMSST101</b>        | <b>Credit:4</b> |
| <b>Maximum Marks:</b><br><b>Theory: 20(Internal)+50(External)=70</b><br><b>Practical: 10(Internal)+20(External)=30</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  | <b>Time of Examinations: 03 Hours</b> |                 |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                                                                                                                                                                                          |  |                                       |                 |
| <b>Course Learning Outcomes(CLO):</b><br>CLO 1: Explain the nature, scope, and importance of statistics, classify different types of data, and represent data effectively using tabular and graphical techniques.<br><br>CLO 2: Compute and interpret measures of central tendency, analyze their properties, and evaluate their suitability for different data sets.<br><br>CLO 3: Determine partition values and apply appropriate measures of dispersion to assess variability and consistency in statistical data.<br><br>CLO 4: Calculate moments and use measures of skewness and kurtosis to analyze the shape and characteristics of frequency distributions. |  |                                       |                 |
| <b>Section – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                       |                 |
| <b>Introduction of Statistics:</b> Nature, scope, and importance of statistics; Types of data; Classification and tabulation of data.<br><b>Graphical representation of data:</b> Bar Charts, Histograms, frequency polygon, frequency curve and ogives. Pie-Chart, Stem- and- Leaf and Box plots.                                                                                                                                                                                                                                                                                                                                                                    |  |                                       |                 |
| <b>Section – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                       |                 |
| <b>Measures of Central Tendency:</b> Introduction and significance; Mean, median, mode, geometric mean, harmonic mean; Properties and applications of central tendency; Merits and demerits of each measure; Relationship between mean, median, and mode.                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                       |                 |
| <b>Section – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                                       |                 |
| <b>Partition Values:</b> Quartiles, deciles and percentiles.<br><b>Measures of Dispersion:</b> Absolute and relative measures of range, quartile deviation, mean deviation, variance and standard deviation; coefficient of variation. Characteristics for an Ideal Measure of Dispersion.                                                                                                                                                                                                                                                                                                                                                                            |  |                                       |                 |
| <b>Section – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                       |                 |
| <b>Moments, Skewness and Kurtosis:</b> Raw and central Moments; derivation of their relationships, effect of change of origin and scale on moments, Sheppard's correction for moments (without derivation), Charlier's checks; Measures of Skewness and Kurtosis.                                                                                                                                                                                                                                                                                                                                                                                                     |  |                                       |                 |
| <b>Practical/ Computational Work</b><br><b>(Based on course Descriptive Statistics)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |                 |
| <b>Practical: 10(Internal)+20(External)=30</b><br>There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.<br>Distribution of Marks will be as follows:<br>i) <b>Written Practical/ Lab work :</b> 10 Marks<br>ii) <b>Viva-voce and practical record:</b> 10 Marks                                                                                                                                                                                                                                                                             |  |                                       |                 |

Date of PG BOS & R: July 22, 2025



**List of Practicals**

Following is the list of programmes to be performed in the Lab using MS-excel:

1. Diagrammatic Representation of Statistical Data Problems Based on Simple and Subdivided Bar Diagrams, Pie Diagram.
2. Graphical Representation of Statistical Data through Histogram, Frequency Polygon and Frequency Curve.
3. Representation of statistical data through Box plot.
4. Computation of Measures of Central Tendency mean, median and mode
5. Partition Values: Quartiles, deciles and percentiles
6. Various Measures of Dispersion. Use of an Appropriate Measure and Interpretation of Results.
7. Moments
8. Measures of Skewness
9. Measures of Kurtosis.

**References:**

1. Gupta, S.C. and Kapoor, V.K. (2020): Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Mukhopadhyay, P. (2020): Mathematical Statistics, Books and Allied Private Limited, Kolkata.
3. Kapoor, J.N. and Saxena, H.C. (2020): Mathematical Statistics, Sultan Chand & Sons, New Delhi.
4. Ross, S.M. (2017): Introductory Statistics, Academic Press, Elsevier.
5. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2016): Fundamentals of Statistics, Vol. I, The World Press Private Limited, Kolkata.
6. Gupta S. C. (2024): Fundamentals of Statistics, Himalaya Publishing House.
7. R. Vidya: Descriptive Statistics, NPTEL Swayam Portal  
(URL: [https://onlinecourses.swayam2.ac.in/cec21\\_ma01/preview](https://onlinecourses.swayam2.ac.in/cec21_ma01/preview))

Date of PG BOS & R: July 22, 2025



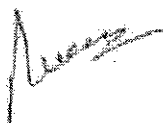
Semester - II  
Session: 2025-26

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------|------------|
| Name of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Calculus                                                                        | Course Code          | 25IMSMA201 |
| Maximum Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Theory: 20(Internal)+50(External)=70<br>Practical: 10(Internal)+20(External)=30 | Time of Examinations | 3 Hours    |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                                                                         |                                                                                 |                      |            |
| <b>Course Learning Outcomes (CLO):</b><br>CLO1 Understand the method of successive differentiation and Taylor series expansions.<br>CLO2 Be familiar with concepts of asymptotes, curvature and singular points.<br>CLO3 Apply the concepts of calculus for tracing and rectification of the curves in cartesian, parametric and polar coordinates.<br>CLO4 Understand the concepts of functions of several variables, their continuity and various properties.                                                                                      |                                                                                 |                      |            |
| <b>Section – I</b><br>Limit and Continuity ( $\epsilon - \delta$ definition), Discontinuity & its types, Differentiability of the functions, Successive differentiation, Leibnitz rule and its applications, L' Hospital's rule: Indeterminate forms. Taylor's theorem with Lagrange's and Cauchy's forms of remainders, Maclaurin's and Taylor's series expansions.                                                                                                                                                                                 |                                                                                 |                      |            |
| <b>Section – II</b><br>Tangent and Normal, Asymptotes of Curves in Cartesian and polar co-ordinates, Curvature, Radius of Curvature for Cartesian curves, parametric, polar and pedal form of curves, Circle of Curvature, Chord of Curvature. Concavity, Convexity and Inflection points.                                                                                                                                                                                                                                                           |                                                                                 |                      |            |
| <b>Section – III</b><br>Tracing of curves in Cartesian, parametric and polar co-ordinates of Standard curves (Cubic curves, Semicubical Parabola, Folium of Descartes, Cardioid, Lemniscate of Bernoulli, Astroid, Rose curve, Logarithmic Spiral, Epispiral, Cycloid, Catenary).                                                                                                                                                                                                                                                                    |                                                                                 |                      |            |
| <b>Section – IV</b><br>Functions of Several Variables, Limits and Continuity, Partial Differentiation and Euler's theorem on homogenous functions, Chain rule, Directional derivatives, Gradient vector and Tangent Plane.                                                                                                                                                                                                                                                                                                                           |                                                                                 |                      |            |
| <b>Practical/ Computational Work</b><br>(Based on course Calculus)<br><b>Practical: 10(Internal)+20(External)=30</b><br>There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.<br>Distribution of Marks will be as follows:<br>i) Written Practical/ Lab work : 10 Marks<br>ii) Viva-voce and practical record: 10 Marks.                                                                                                   |                                                                                 |                      |            |
| <b>List of Practicals</b><br>Following is the list of programmes to be performed in the Lab using PYTHON/ MATLAB Programming:                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                 |                      |            |
| 1. Study of Concavity, Convexity and point of inflexion using graph (i) $f(x) = (x-a)(x-b)$ (ii) $f(x) = (x-a)(x-b)(x-c)$ (iii) $f(x) =  x-a (x-b)$ (iv) $f(x) = \frac{x+1}{x^2+3}$ .<br>2. Plotting of graphs of the function $\sin(ax+b)$ , $\cos(ax+b)$ , $\sinh(ax+b)$ , $\cosh(ax+b)$ for various values of a and b.<br>3. Plotting of graphs of the function $e^{ax+b}$ , $\log(ax+b)$ , $\frac{c}{ax+b}$ , $c^{ax+b}$ for various values of a, b and c.<br>4. Sketching parametric curves (E.g. Trochoid, Cycloid, Epicycloids, Hypocycloid). |                                                                                 |                      |            |

Date of PGEOS&R: July 22, 2025

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| <p>5. Determine Asymptotes in Curve using graphs (i) <math>y = \frac{1}{x-3}</math> (ii) <math>y = \tan x</math> (iii) <math>y = e^{1/x}</math> (iv) <math>y = x + 1/x</math> (v) <math>y = \frac{x^2+2x-1}{x}</math>.</p> <p>6. Form the table for Sine function, Cosine function for <math>0^\circ, 1^\circ, 2^\circ, \dots, 90^\circ</math> using Maclaurin's series expansion.</p> <p>7. Plotting the graphs of polynomials of degree 2, 3, 4 and 5, the derivative graph, second derivative graph and comparing them.</p> <p>8. Trace the curves (i) <math>y^2(a^2 + x^2) = x^2(a^2 - x^2)</math> (ii) <math>a^2y^2 = a^2x^4 - x^6</math> (iii) <math>9ay^2 = (x - 2a)(x - 5a)^2</math> (iv) <math>x^2 = (y - 1)(y - 2)(y - 3)</math>.</p> <p>9. Trace the curves (i) <math>x^2y^2 = x^2 + 1</math> (ii) <math>y = \frac{x+1}{x^3}</math> (iii) <math>x^2y^2 = a^2(y^2 - x^2)</math>.</p> <p>10. Sketching parametric curves (E.g. Trochoid, Cycloid, Epicycloids, Hypocycloid, Catenary).</p> <p>11. Trace the curves (i) <math>y^2(a^2 + x^2) = x^2(a^2 - x^2)</math> (ii) <math>a^2y^2 = a^2x^4 - x^6</math> (iii) <math>9a^2 = (x - 2a)(x - 5a)^2</math> (iv) <math>x^2 = (y - 1)(y - 2)(y - 3)</math>.</p> <p>12. Trace the curves (i) <math>x^2y^2 = x^2 + 1</math> (ii) <math>y = \frac{x+1}{x^3}</math> (iii) <math>x^2y^2 = a^2(y^2 - x^2)</math>.</p> | <p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. G.B Thomas and R.L. Finney, Calculus, 9<sup>th</sup> edition, Pearson Education Delhi, 2005</li> <li>2. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002</li> <li>3. M.J Strauss, G.L. Bradley and K.J Smith, Calculus, 3<sup>rd</sup> edition, Dorling Kindersley (India) P Ltd (Pearson Education), Delhi, 2007</li> <li>4. R. Courant and F. John, Introduction to Calculus and Analysis, (Volume I &amp; II), Springer-Verlag, New York, Inc 1989</li> <li>5. Murray R. Spiegel, Theory and Problems of Advanced Calculus. Schaun's Outline series. Schaum Publishing Co., New York.</li> <li>6. N. Piskunov, Differential and integral Calculus. Peace Publishers, Moscow.</li> </ol> |
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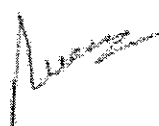
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Semester - II

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------|------------|
| Name of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Number Theory and Trigonometry        | Course Code          | 25IMSMA202 |
| Maximum Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Theory: 30(Internal)+70(External)=100 | Time of Examinations | 3 Hours    |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                                                                               |                                       |                      |            |
| <b>Course Learning Outcomes (CLO):</b><br>CLO1 Understand the concepts of congruences, residue classes and least residues.<br>CLO2 Learn the operations of addition, subtraction, multiplication and calculation of powers of integers with respect to modulo m.<br>CLO3 Determine multiplicative inverses with respect to modulo m and use these to solve linear congruences.<br>CLO4 Work with the trigonometric form of complex numbers including De-Moivre's formula.<br>CO5 Be familiar with the Euler form $r \cdot e^{i\theta}$ of complex numbers. |                                       |                      |            |
| <b>Section – I</b><br>Divisibility, G.C.D.(greatest common divisors), L.C.M.(least common multiple)<br>Primes, Fundamental Theorem of Arithemetic, Linear Congruences, Fermat's theorem. Wilson's theorem and its converse. Linear Diophantine equations in two variables.<br>Complete residue system and reduced residue system modulo m. Euler's $\phi$ function Euler's generalization of Fermat's theorem. Chinese Remainder Theorem.                                                                                                                  |                                       |                      |            |
| <b>Section – II</b><br>Quadratic residues. Legendre symbols. Lemma of Gauss; Gauss reciprocity law. Greatest integer function $[x]$ . The number of divisors and the sum of divisors of a natural number n (The functions $d(n)$ and $\sigma(n)$ ). Moebius function and Moebius inversion formula.                                                                                                                                                                                                                                                        |                                       |                      |            |
| <b>Section - III</b><br>De Moivre's Theorem and its Applications. Expansion of trigonometrical functions. Direct circular and hyperbolic functions and their properties.                                                                                                                                                                                                                                                                                                                                                                                   |                                       |                      |            |
| <b>Section – IV</b><br>Inverse circular and hyperbolic functions and their properties. Logarithm of a complex quantity. Gregory's series. Summation of Trigonometry series.                                                                                                                                                                                                                                                                                                                                                                                |                                       |                      |            |
| <b>References:</b><br>1. S.L. Loney, Plane Trigonometry Part – II, Macmillan and Company, London.<br>2. R.S. Verma and K.S. Sukla, Text Book on Trigonometry, Pothishala Pvt. Ltd. Allahabad.<br>3. Ivan Ninen and H.S. Zuckerman, An Introduction to the Theory of Numbers.                                                                                                                                                                                                                                                                               |                                       |                      |            |

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Semester - II

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| Name of the Course                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Statistical Methods                                                             | Course Code          | 25IMSST201 |
| Maximum Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Theory: 20(Internal)+50(External)=70<br>Practical: 10(Internal)+20(External)=30 | Time of Examinations | 03 Hours   |
| <b>Note:</b><br>Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions from all sections. Further, examiner will set two questions from each section and the candidates will be required to attempt one question from each Section. All questions will carry equal marks.                                                                                                                                                                       |                                                                                 |                      |            |
| <b>Course Learning Outcomes (CLO):</b><br><b>CLO 1:</b> Understand and Analyze the Association of Attributes.<br><b>CLO 2:</b> Measure and Interpret Correlation.<br><b>CLO 3:</b> Perform Regression Analysis.<br><b>CLO 4:</b> Apply the Method of Least Squares.<br><b>CLO 5:</b> Interpret and Apply Statistical Relationships in Practice.<br><b>CLO 6:</b> Apply Statistical Methods in Practical Contexts.                                                                                                                                                                  |                                                                                 |                      |            |
| <b>Section – I</b><br>Theory of Attributes: Notations and Terminology, Contingency Table, Class Frequencies, Ultimate Class Frequencies, Consistency; Association of Attributes, Independence, Methods of determining association: Frequency method, proportion method, Yule's coefficient of association, coefficient of colligation and coefficient of contingency.                                                                                                                                                                                                              |                                                                                 |                      |            |
| <b>Section – II</b><br>Correlation for Bivariate Data: Concept and types of correlation, Scatter diagram, Karl Pearson's Coefficient of correlation and Spearman's rank correlation coefficient. Difference between correlation and association                                                                                                                                                                                                                                                                                                                                    |                                                                                 |                      |            |
| <b>Section – III</b><br>Linear Regression: Concept of regression analysis, derivation of two lines of regression, properties of regression coefficients, standard error of estimate obtained from regression line, correlation coefficient between observed and estimated values. Angle between two lines of regression. Difference between correlation and regression.                                                                                                                                                                                                            |                                                                                 |                      |            |
| <b>Section – IV</b><br>Principle of Least Squares: Concept of error and residuals, Purpose of the least squares method, Fitting of straight line. Polynomials and Exponential Curves.<br>Partial and Multiple Correlation (Three Variables Only).                                                                                                                                                                                                                                                                                                                                  |                                                                                 |                      |            |
| <b>Practical/ Computational Work</b><br><b>(Based on course Statistical Methods)</b><br><b>Practical: 10(Internal)+20(External)=30</b><br>There will be five questions in all, and the students must attempt any three questions. The question paper will set on the spot jointly by the internal and external examiners.<br>Distribution of Marks will be as follows:<br>i) Written Practical/ Lab work : 10 Marks<br>ii) Viva-voce and practical record: 10 Marks<br><b>List of Practicals</b><br>Following is the list of programmes to be performed in the Lab using MS-excel: |                                                                                 |                      |            |

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1. Consistency of Data up to Two Attributes. Concepts of Independence and Association of Two Attributes.
2. Methods of determining association: Frequency method, proportion method, Yule's coefficient of association, coefficient of colligation and coefficient of contingency.
3. Bivariate Data: Scatter Diagram, Plotting and Interpretation.
4. Calculation of Product Moment Correlation Coefficient
5. Correlation Ratio, Rank Correlation.
6. Calculation of Regression Coefficients.
7. Fitting of Regression Lines by Least Squares.
8. Fitting of straight line, Polynomials and Exponential Curves by Least Squares.
9. Calculation of Partial and Multiple Correlation Coefficients for Three Variables.

**References:**

1. Montgomery, C.D. and Runger, C.G. (2021): Applied Statistics and Probability for Engineers, John Wiley & Sons, New Delhi
2. Gupta, S.C. and Kapoor, V. K. (2020): Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
3. Ross, S.M. (2017): Introductory Statistics, Academic Press, Elsevier.
4. Mukhopadhyay, P (2020): Applied Statistics, Books and Allied Private Limited, Kolkata.
5. Gupta, S.C. and Kapoor, V. K. (2020): Fundamentals of Applies Statistics, Sultan Chand & Sons, New Delhi.

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