

**Gujarat University**  
**Choice Based Credit System (CBCS)**  
**Syllabus for Semester I (Mathematics)**  
**MAT 101: Calculus and Matrix Algebra(Theory)**

Hours: 4 /week

Credits: 4

**Unit: I**

Successive Derivatives, standard results for  $n^{\text{th}}$  derivative, Leibniz's Theorem. Definition of limit of a sequence, Convergence and divergence of an infinite series, Alternating Series (Without proof). Comparison test, Ratio test and Root test.

**Unit: II**

Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems(MVT), Increasing and decreasing functions, Taylor's and Maclaurin's Theorems (both without proof). Using Taylor's and Maclaurin's Theorem find Maclaurin power series expansion of  $\sin x$ ,  $\cos x$ ,  $\log(1+x)$ ,  $e^x$ ,  $(1+x)^n$  under proper restrictions(if any). Indeterminate forms: all forms of L'Hôpital's Rules with proof and all forms.

**Unit: III**

Introduction to matrices, different types of matrices, operations on matrices, Theorems on matrices, Elementary operations on matrices and types of matrices, Symmetric and skew-symmetric matrices, Hermitian and skew-hermitian matrices. Linear dependence and independence of row and column matrices. Row rank, column rank and rank of a matrix. Row Reduced Echelon (RRE) form of a matrix and matrix inversion using it.

**Unit: IV**

Eigen values, Eigen vectors and the characteristic equation of a matrix. Cayley-Hamilton (CH) theorem and its use in finding inverse of a matrix. Application of matrices in solving a system of simultaneous linear equations. Cramer's rule. Theorems on consistency of a system of simultaneous linear equations.

**Reference Books:**

1. Calculus and Analytic Geometry – G. B. Thomas and R. L. Finney. Pearson Education. Indian Reprint.
2. Calculus – James Stewart, Sixth edition, (E-Book).
3. Calculus – T. M. Apostol. Volume I.
4. Differential Calculus – Shanti Narayan, P.K. Mittal, S. Chand and Co.
5. Differential Calculus – Harikishan, Atlantic Publishers.
6. Calculus – M. Spivak.
7. An Introduction to Linear Algebra – I. K. Rana, Ane Books Pvt. Ltd.
8. Linear Algebra Theory and Applications – Ward Cheney, David Kincaid. Jones and Bartlet India Pvt. Ltd.
9. Introduction to Linear Algebra – Serge Lang. Springer (India).
10. Matrix and Linear Algebra – K. B. Dutta, Prentice Hall.
11. A Textbook of Matrices – Shanti Narayan, P K Mittal, S. Chand Group.
12. Introduction to Linear Algebra – V. Krishnamurthy, Affiliated East-west Press Pvt Ltd.

**Gujarat University**  
**Choice Based Credit System (CBCS)**  
**Syllabus for Semester I (Mathematics)**  
**MAT 102: Calculus and Matrix Algebra (Practical)**

Hours: 4/week  
Duration: 2hrs/practical

Credits: 3  
Number of practicals: 20

**Unit I:**

Practicals based on Integral and successive differentiation. (Practical Number 1- 6).

**Unit II:**

Practicals based on convergence of infinite series, Mean value theorems, Expansions of functions, and L'Hôpital's Rule. (Practical Number 7 - 12).

**Unit III:**

Practicals based on Matrices and its applications. (Practical Number 13 - 17).

**Unit IV:**

Practicals based on tracing of curves. (Practical Number 18 - 20)

**List of Practical:**

1. Find the limit of sums using the definite integral(5+5=10 problems)
2. Find the definite integrals using substitution (5+5=10 problems)
3. Find the definite integrals using integration by parts(5+5=10 problems)
4. Find the integral by method of partial fractions(5+5=10 problems)
5. Find the nth derivative of the following functions at the given points.
6. Applications of Leibniz theorem
7. Discuss Convergence of the infinite series-I
8. Discuss Convergence of the infinite series-II
9. Geometrical Interpretation of MVT. and verification of MVT
10. Problems on MVT.
11. Expansions of functions in infinite power series using Taylor and Maclaurin formulae
12. Evaluate limit using L'Hôpital's rule.
13. Find RRE form and rank of a matrix
14. Find inverse using Gauss Jordan method( using row operations)
15. Verify the Cayley-Hamilton(CH) theorem – inverse of matrix using it- problems on CH theorem.
16. Find Eigen values and Eigen vectors
17. Solution of system of linear equations using row operations and Cramer's rule.
18. Asymptotes of curves
19. Concavity and point of inflexion of a curve in  $R^2$ .
20. Graphs of Cartesian equations of some standard functions.

**Gujarat University**  
**Choice Based Credit System (CBCS)**  
**Syllabus for Semester II (Mathematics)**  
**MAT 103: Differential Equations and Co-ordinate Geometry(Theory)**

Hours: 4 /week

Credits: 4

**Prerequisites (not to be asked but must be done):** Introduction of Differential equations, its order and degree. Family of curves leading to differential equation and its solution in family of curves. Different types of solutions (viz. General, Particular and Singular solutions). Constant of integration. Boundary/initial conditions. Differential equations of first order and first degree.

**Unit I: (a)** Methods of solving Differential Equations of first order and first degree: Variable separable, Homogeneous and non-homogeneous differential equations, Exact differential equations( without proof), Integrating factors, Linear differential equation of first order and first degree, Bernoulli's differential equation & Differential Equations reducible to them.

**(b)** Method of solving differential equations of first order and higher degree: solvable for  $y$ , solvable for  $x$ , solvable for  $p$  ( where  $p = \frac{dy}{dx}$  ), Clairaut's differential equation (both general and singular), Lagrange's differential equation.

**Unit II:** Linear differential equations of higher order and degree one: Differential operators ( $D$  and  $\theta$ ): Linear differential equations of higher order and degree one with constant coefficients. Complementary and Particular Integrals (Solutions). Inverse operator. Operational methods for its solutions. Euler form of homogeneous linear differential equations with variable coefficients.

**Unit III:** Sphere and Introduction to conicoid:

**(a)** Definition of a sphere in  $R^3$ , Cartesian equation of a sphere, General equation of a sphere, Equation of a sphere with diametrically opposite end points, Intersection of a sphere with Line/plane/sphere( No theory but only problems), Equation of a tangent plane to a sphere. The tangency of a plane and normality of a line to a sphere, Orthogonal spheres.

**(b)** Conicoids: Introduction to conicoid, types of central and non central conicoids in  $R^3$ , figures of conicoids.

**Unit IV:** Polar coordinate system and Cone and cylinder in  $R^3$ :

**(a)** Polar coordinates in  $R^2$  &  $R^3$  and its Relationships with Cartesian coordinates, polar equation of line-/circle /conic and properties of conics.

**(b)** Introduction to different types of cone and cylinder, Equations of enveloping cone/cylinder. Right circular cone/cylinder (without proof). Problems on cone and cylinder.

**Reference Books:**

1. Calculus - JAMES STEWART , THOMSON BROOKS/COLE
2. Calculus - T.M.Apostol
3. Calculus - Thomas and Finney , Pearson Education , Asian edition
4. Calculus - Dr. Elliot Mendel son, Mc GrawHill Book co.
5. A first course in calculus fifth edition By Serge Lang , Springer India
6. Ordinary and Partial Differential Equations Theory and Applications,By:Nita H. Shah, PHI
7. Introductory course in Differential equations-Murray
8. Differential equations and their applications, Prentice Hall of India- Zafar Ahsan (1999)
9. Elementary Differential equations –Kella
10. Co-ordinate Geometry By : R.J.T. Bell
11. Solid Geometry( three dimension) – H. K. Das ,S. C. Saxena and Raisinghania , S. Chand

**Gujarat University**  
**Choice Based Credit System (CBCS)**  
**Syllabus for Semester II (Mathematics)**

**MAT 104: Differential Equations and Co-ordinate Geometry(PRACTICALS)**

**Hours: 4 /week**

**Credits: 3**

**Number of Practicals: 20 (Each Practical is of 2-hours)**

**Special Instructions: Before starting each Practical necessary Introduction, Basic Definitions, Intuitive inspiring ideas and Prerequisites must be discussed.**

**Unit I:** Graphs of standard curves and graphical solution. Introduction to definite integral as a limit of sum, Method of integration by substitution/ partial fractions/ by parts, Reduction formulae ( $\sin^n x$ ,  $\cos^n x$  and  $\sin^m x \cos^n x$ ). Five practicals (Practical number 1 to 5)

**Unit II:** Application of reduction formulae. Application of integration (area, volume, length of arc and surface area formulae without proof). Five practicals (Practical number 6 to 10)

**Unit III:** Applications of Differential equations. Four practicals (Practical number 11 to 14)

**Unit IV:** Polar coordinates, spherical and cylindrical co-ordinates, sphere, cone, cylinder. Six Practicals (Practical number 15 to 20).

**List of Practicals:**

- (1) Graphical solution of Cartesian equations
- (2) Graphs of parametric equations of some standard curves.
- (3) Graphs of polar equations: cardioids, Limacön with a loop, Limacön with a dimple, spirals, rose curves
- (4) Problems on definite integral as a limit of sum, method of integration by substitution/by partial fractions/by parts( 10 problems)
- (5) Derivation of reduction formulae
- (6) Evaluate the following using reduction formulae only:  $\sin^n x$ ,  $\cos^n x$ ,  $\tan^n x$  for different odd/even  $n \in \mathbb{N}$  (10 problems)
- (7) Evaluate  $\sin^m x \cos^n x$  using reduction formulae only: for different odd/even  $m, n \in \mathbb{N}$  (10 problems)
- (8) Find the area of a bounded plane region between curves and the volume of a solid body on revolution of a bounded plane region about the co-ordinate axes using definite integral. (5+5=10 problems)
- (9) Find the length of arcs and curves in Cartesian & parametric forms using definite integral. (5+5=10 problems)
- (10) Find the area of a surface of revolution of a bounded curve about the co-ordinate axes using definite integral. (5+5=10 problems)
- (11) Solve the differential equations of order 1 and degree 1 & also higher degree.(10 problems)
- (12) Solve the differential equations of higher order and degree 1 with constant coefficients.(10 problems)
- (13) Solve the differential equations of higher order and degree 1 with variable coefficients. (8 problems)
- (14) Applications of differential equations and orthogonal trajectories
- (15) The mutual relation between polar and Cartesian co-ordinate systems in  $\mathbb{R}^2$  and  $\mathbb{R}^3$ . Transformation of equations from one system to another. (10 problems)
- (16) The mutual relations among Cartesian, cylindrical and spherical co-ordinate system in  $\mathbb{R}^3$  (10 problems)
- (17) The mutual relations among Cartesian, cylindrical and spherical co-ordinate system in  $\mathbb{R}^3$ . Transformation of equations from one system to another (8 problems)
- (18) Problems on sphere (8 problems)
- (19) Problems on cone(8 problems)
- (20) Problems on cylinder(8 problems).

**Gujarat University**  
**Choice Based Credit System (CBCS)**  
**Semester-I**  
**Syllabus**

**EC 101: Mathematical basics and Quantitative skills**

**Hours: 3/ week**

**Credit 2**

**Unit-1. Trigonometry:**

Unit circle, trigonometric functions, values of trigonometric function at distinct points, relation among trigonometric functions, trigonometric formulae,  $\sin(x \pm y)$ ,  $\cos(x \pm y)$ ,  $\tan(x \pm y)$ ,  $\operatorname{sinc} \pm \operatorname{sind}$ ,  $\operatorname{cosc} \pm \operatorname{cosd}$ ,  $2\sin x \cos y$  ( and others), inverse of trigonometric functions.

**Unit-2. Co-ordinate Geometry and Vectors:**

Distance Formula, Section Formula, Equation of a line and its slope, intersection of two lines, Equation of a circle and its tangent, elementary vector algebra.

**Unit-3. Limit and Differentiation:**

Right hand limit, Left hand limit and limit of a function.  $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$ ,  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ ,  $\lim_{h \rightarrow 0} \frac{a^h - 1}{h}$  and  $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$ , continuity, derivatives of  $x^n$ ,  $e^x$ ,  $\log x$ , trigonometric functions, inverse trigonometric functions, chain rule, geometric meaning of derivative.

**Unit-4. Integration:**

Integration of  $x^n$ ,  $e^x$ , trigonometric functions, well known functions like  $\frac{1}{x^2 \pm a^2}$ ,  $\frac{1}{\sqrt{x^2 \pm a^2}}$ ,  $\sqrt{x^2 \pm a^2}$ , Method of substitution, integration by parts, definite integral ( Up to Fundamental Theorem of Integral Calculus).

**N.B. All the results / formulae are without proof.**

**Books: (1)** Gujarat Rajya Pathya Pustak Mandal for std 11 and std 12.

**(2)** A Textbook for class XI & XII, National Council of Educational Research and Training.

**(3)** A Class Book of Mathematics for class XII by Chakrabarty S. K., Biswajit Bhagwati, S. Chand Publishers.

**(4)** Short Calculus by Serge Lang, Springer(India)