

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: All Branches
SUBJECT NAME: Mathematics 01
SUBJECT CODE:
1st Year (Semester 1)

Type of course: Basic Science Course

Prerequisite: Algebra, Trigonometry, Geometry

Rationale: The study of rate of changes, understanding to compute area, volume and express the function in terms of series, to apply matrix algebra.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits C | Examination Marks | | | | Total Marks |
|-----------------|---|---|--------------|-------------------|--------|-----------------|--------|----------------|
| L | T | P | | Theory Marks | | Practical Marks | | |
| | | | | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 2 | 0 | 5 | 70 | 30 | 30 | 20 | 150 |

Content:

| Sr. No. | Content | Total Hrs | % Weightage |
|-----------|---|--------------|-------------|
| 01 | Indeterminate Forms and L'Hôpital's Rule. | 01 | 15 % |
| | Improper Integrals, Convergence and divergence of the integrals, Beta and Gamma functions and their properties. | 03 | |
| | Applications of definite integral, Volume using cross-sections, Length of plane curves, Areas of Surfaces of Revolution | 03 | |
| 02 | Convergence and divergence of sequences, The Sandwich Theorem for Sequences, The Continuous Function Theorem for Sequences, Bounded Monotonic Sequences, Convergence and divergence of an infinite series, geometric series, telescoping series, n^{th} term test for divergent series, Combining series, Harmonic Series, Integral test, The p - series, The Comparison test, The Limit Comparison test, Ratio test, Raabe's Test, Root test, Alternating series test, Absolute and Conditional convergence, Power series, Radius of convergence of a power series, Taylor and Maclaurin series. | 08 | 20 % |
| 03 | Fourier Series of 2π periodic functions, Dirichlet's conditions for representation by a Fourier series, Orthogonality of the trigonometric system, Fourier Series of a function of period $2L$, Fourier Series of even and odd functions, Half range expansions. | 04 | 10 % |
| 04 | Functions of several variables, Limits and continuity, Test for non existence of a limit, Partial differentiation, Mixed derivative theorem, differentiability, Chain rule, Implicit differentiation, Gradient, Directional derivative, tangent plane and normal line, total differentiation, Local extreme values, Method of Lagrange Multipliers. | 08 | 20 % |
| 05 | Multiple integral, Double integral over Rectangles and general regions, double integrals as volumes, Change of order of integration, double integration in polar coordinates, Area by double integration, Triple | 08 | 20 % |

| | | | |
|-----------|--|----|-----|
| | integrals in rectangular, cylindrical and spherical coordinates, Jacobian, multiple integral by substitution. | | |
| 06 | Elementary row operations in Matrix, Row echelon and Reduced row echelon forms, Rank by echelon forms, Inverse by Gauss-Jordan method, Solution of system of linear equations by Gauss elimination and Gauss-Jordan methods. Eigen values and eigen vectors, Cayley-Hamilton theorem, Diagonalization of a matrix. | 07 | 15% |

Suggested Specification table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|-------------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 7 | 14 | 14 | 14 | 14 | 7 |

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

- (1) Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.
- (2) Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.
- (3) James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
- (4) Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.
- (5) Calculus, Volumes 1 & 2, T. M. Apostol, Wiley Eastern.

Course Outcome:

After learning the course the students should be able to:

1. identify indeterminate forms and can evaluate
2. determine the convergence/divergence of improper integral
3. use beta and gamma functions
4. evaluate volume by cross section
5. compute length of curve
6. evaluate the area of surfaces of revolution
7. determine the convergence or divergence of sequences
8. use the sandwich theorem for sequences
9. evaluate the value of geometric series
10. determine the nature of telescoping series
11. use integral test
12. apply the p - series for comparison test or Limit comparison test,
13. apply various tests for convergence or divergence of an infinite series
14. find the radius of convergence of a power series
15. find the Taylor series, Maclaurin series.
16. express the function in fourier series who satisfied Dirichlet's conditions
17. express the function in half range expansion

18. evaluate the limits of functions of two variable
19. understand the continuity of functions of two variables
20. apply the test for non existence of limit
21. find partial derivative
22. use chain rule
23. determine gradients and directional derivative
24. implicit and total differentiation
25. find local extreme values
26. use Lagrange's multipliers method to find extreme values
27. evaluate double integrals as area as well as volume
28. apply change of order of integration to simplify integral
29. compute double integration in polar coordinates
30. compute triple integrals in rectangular, cylindrical and spherical Coordinates
31. determine the Jacobian for substitution in multiple integral
32. use elementary row operations to get Row echelon form
33. use elementary row operations to get Reduced row echelon forms
34. find rank by echelon forms
35. compute inverse by Gauss-Jordan method
36. solve the system of linear equations by Gauss elimination
37. solve the system of linear equations by Gauss-Jordan methods.
38. find eigen values of matrices
39. find eigen vectors of matrices
40. use Cayley-Hamilton theorem to find inverse of a matrix
41. use Cayley-Hamilton theorem to find higher powers of a matrix
42. understand the diagonalization of a matrix.

List of Open Source Software/learning website:

Scilab, MIT Opencourseware.