GUJARAT TECHNOLOGICAL UNIVERSITY

CALCULUS
SUBJECT CODE: 2110014
B.E. 1ST YEAR

Type of course: Engineering Mathematics

Prerequisite: Student should be able to graph elementary functions and solve both linear equations and inequalities. Students entering in Calculus should have a firm grasp of algebra and trigonometry, trigonometric functions, inverse trigonometric functions and their properties, exponential and logarithmic function. Continuity and Differentiability of functions, Derivatives of Functions in Parametric Forms, Mean Value Theorem, Rate of Change of Quantities, Increasing and Decreasing Functions, Tangent, Normal and Maxima and Minima of single variable function. Integrals, Integration as an Inverse Process of Differentiation, Integrals of some Particular Functions, Integration by Partial Fractions, Integration by Parts, Definite Integral, Fundamental Theorem of Calculus, Evaluation of Definite Integrals by Substitution, Properties of Definite Integrals, Area under Simple Curves and Area between Two Curves by integration.

Rationale: Mathematics is a language of Science and Engineering.

Teaching and Examination Scheme:

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

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Infinite Sequences and Series** • Introduction of Convergence, Divergence of Sequences and Infinite Series • The nth term test for Divergence, Integral Test • Comparison Test, Ratio Test, Root Test • Alternating Series, Absolute convergence, Conditional convergence • Power Series & Radius of convergence • Taylor's series • Maclaurin's series	7	20-22%
2	**Curve Sketching** • Concavity • Curve sketching • Polar co-ordinates, Relation between Polar and Cartesian	4	10-12%

	Co-ordinates • Graphs in Polar co-ordinates		
3	**Indeterminate Forms** • Indeterminate form $(0/0,\ \infty/\infty,\ \infty\cdot 0,\ \infty-\infty)$ • Indeterminate form $(0^0, \infty^0,\ 1^\infty)$ **Improper Integral** • Improper integrals of Type- I and Type - II • Convergence and divergence of improper integrals	4	10-12%
4	**Applications of Integration** • Volume by slicing • Volume of solids of revolution by disk method • Volume of solids of revolutions by washer method • Volume by cylindrical shell.	4	10-12%
5	**Partial Derivatives** • Function of 2-variables, graphs, level curves • Limit, continuity of function of several variables • Partial derivatives and Clairauts' theorem • Tangent plane, Normal line • Linear approximation, Total differential • Chain rule, implicit differentiation • Euler's theorem for homogeneous function • Maximum and minimum values by second derivative test • Lagrange multipliers • Taylor's formula for two variables	10	30-32%
6	**Multiple Integrals** • Double integrals over rectangles and Fubini's theorem, Properties of double integrals • Double integrals over general region • Double integrals in polar co-ordinates • Triple Integrals, Triple integrals in cylindrical co-ordinates • Triple integrals in spherical co-ordinates • Change of Order of Integration • Jacobian of several variables, Change of variable in multiple integrals	7	20-22%

Note: Teachers are advised to encourage students to perform the projects in group of 4 students for conceptual understanding by geometrically, numerically and algebraically.

Reference Books:

1. Calculus with Early Transcendental Functions, James Stewart, Cengage Learning
2. Thomas' Calculus, Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education
3. Calculus – Single and Multivariable, Hughes – Hallett et al., John-Wiley and Sons.
4. Calculus, Robert T. Smith & Ronald B. Minton, McGraw-Hill
5. Calculus, Volumes 1 and 2, T. M. Apostol, Wiley Eastern.

6. Engineering Mathematics, A Programmed Approach, C. W. Evans, Stanley ThornesPublishers Ltd.

Course Outcome:
1. Add together infinitely many numbers.
2. Represent a differentiable function f(x) as an infinite sum of powers of x.
3. Decide on convergence or divergence of a wide class of series.
4. See concavity of graph and find out points of inflection.
5. Observe behaviour of function f(x) as x goes to infinity/ negative infinity.
6. Able to evaluate indeterminate forms using L'Hospital's Rule.
7. To answer at least about the convergence or divergence of integral when integral is not easily evaluated using techniques known.
8. Able to evaluate the volume of solids such as pyramid, sphere, etc. by slicing method.
9. Generate the solid by rotating region about an axis in its plane and hence calculating the volume of solid, by disk method.
10. If the solid of revolution has a hole in it, then determine the volume by washer method.
11. Evaluate partial derivatives.
12. Apply the knowledge to solve some practical problems, such as constrained optimization problems and other problems involving Partial differentiation
13. Evaluate a double integral in polar coordinates.
14. Reverse the order of integration for a double integral.
15. Evaluate a triple integral to find volume in rectangular coordinates, cylindrical coordinates, and spherical coordinates.

List of Open Source Software/learning website:
The above mentioned contents can be referred through:
- NPTEL – Mathematics I: Calculus by Prof. Swagato K. Ray, Department of Mathematics, Indian Institute of Technology Kanpur.
  Link: http://utubersity.com/?page_id=735&tubepress_page=1

*PA (M): 10 marks for Active Learning Assignments, 20 marks for other methods of PA

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding the applications of Calculus to engineering applications – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Calculus is covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be sent to achievements@gtu.edu.in.