Mathematics 5C

Course Description

Title: The Principles of Calculus III.

Short Title: POC III.

Credit Statement: 5 Units. Credit is awarded for only one of MATH005C or MATH007B or MATH009B or MATH009C or MATH009HB or MATH009HC.

Lecture: 3 hours per week, 2 meetings.

Discussion: 2 hours per week, 2 meetings.

Prerequisites: MATH005B with a grade of C- or better.

Catalog Description: Further topics on infinite series including test of convergence and Taylor's series. An introduction of integral calculus of one-variable with applications.

Further Description: The Principles of Calculus III uses the higher order approximations of functions as well as the principles of decomposition and integration to study global properties of functions from their local behavior. Topics include series and their convergence; Taylor's theorem and Taylor series; elementary geometry of particle motion in several spatial variables; the Fundamental Theorems of Calculus I and II and their consequences; area, volume, arc length, and surface area integrals in a single real variable; approximation of definite integrals; integration techniques; use of the Riemann integral in the construction of functions; simple differential equations; and work integrals in one independent variable and their application.

Primary Textbook: David Weisbart, Kinnari Atit, Bryan Carrillo, Dylan Noack, Cathy Lussier, and Yat Sun Poon; with the assistance of UCR XCITE. (In preparation). The Principles of Calculus. An e-Book commissioned by California Learning Lab (https://calearninglab.org) and obligated to be an Open Educational Resource.

Learning Outcomes. After successful completion of this course, students are expected to be able to perform the following:

VII.1. Recall the concept of power series and radius convergence. Utilize the M-test, comparison test, alternating series test, ratio test, root test, and limit comparison test for series of functions.

VII.2. Determine the radius of convergence of Taylor series for a function. Calculate the Taylor series for a function.

VII.3. Recall and identify sufficient conditions for term-by-term differentiation of a power series. Recognize the role of power series in solving differentiation equations.

VII.4. Describe a surface or revolution or a solid of revolution in coordinates. Determine paths of motion of particles restricted to planes given by graphs of functions. Determine paths of motion of particles restricted to surfaces given by graphs of functions and surfaces of revolution.

VIII.1. Remember and understand the Fundamental Theorems of Calculus I and II. Use Riemann sums to approximate the value of an integral. Calculate the area of a surface of revolution. Calculate the volume bounded by a surface of revolution. Calculate the arc length of a parameterized curve.

VIII.2. Approximate definite integrals. Evaluate improper integrals. Use the integral test for convergence of a series.

VIII.3. Calculate integrals using substitution. Calculate integrals using integration by parts.

VIII.4. Identify some special functions whose derivatives are elementary. Calculate integrals of trigonometric and hyperbolic functions. Apply trigonometric and hyperbolic substitution in the calculation of integrals.

VIII.5. Calculate integrals using partial fraction decomposition. Calculate integrals with rational functions with linear or quadratic terms in denominator. Use the Weierstrass substitution.

VIII.6. Understand equilibria solutions to differential equations. Use integrals to solve some more complicated differential equations. Calculate the work done by a force field in moving a particle. Compute areas bounded by simple, closed, parameterized curves.

Proposed Lecture Schedule:

Week	Sections	Topics
1	**VII.1**	Sequences and series of functions, power series and the radius of convergence.
2	**VII.2**	Taylor series, Taylor's Theorem.
3	**VII.3**	Differentiating series, applications of term-by-term differentiation, constant coefficient first and second order linear differential equations.
4	**VII.4**	Parameterization of curves and surfaces, constrained motion, normal forces.
5	**VIII.1**	The fundamental theorem of calculus I and II, the integral mean value theorem, area bounded by functions, volume of solid of revolution.
6	**VIII.1, VIII.2**	(Mid-term) VIII.1 Arc length, area of surface of revolution. VIII.2 Approximation methods for definite integrals, improper integration.
7	**VIII.3**	Integration by substitution, integration by parts.
8	**VIII.4**	Construction of functions by integration, integration with trigonometric and hyperbolic substitutions, applications of hyperbolic functions.
9	**VIII.5**	Integrals involving rational functions, partial fraction decomposition, a framework for trigonometric substitution: Weiestrass substitution.
10	**VIII.6**	Integrating differential equations, equilibria, work integrals and applications.

Additional References:

1. Richard Courant and Fritz John (1999). Introduction to Calculus and Analysis, Volume 1, Reprint of the 1989 Edition. Springer-Verlag. DOI 10.1007/978-3-642-58604-0.
2. Michael Spivak (2008). Calculus, 4th edition, Publish or Perish. ISBN 978-0-914098-91-1.
3. James Stewart (2008). Calculus, 6th edition, ISBN-13: 978-0495011606
4. Claudia Neuhauser and Marcus Roper (2018). Calculus for Biology and Medicine, 4th edition, Pearson. ISBN-13: 978-0134122601.

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