Syllabus for Math 253A – Accelerated Calculus III

Course Description: Vector calculus, maxima and minima in several variables, multiple integrals, line integrals and Green’s Theorem, surface integrals, Stokes’ Theorems.

Prerequisite: Math 252A, AP Calculus BC score of 4 or 5 and consent; or a grade of A in Math 242 and consent.


Format: This four credit class meets for 200 minutes of lecture per week.

Caution: The course covers a lot of material. Good planning is required so that there is enough time to cover all the material.

Final Exam: The final exam will cover all the topics listed below.

Course objectives: This is an honors course. A successful Math 253A student will have an in–depth, computational as well as conceptual, understanding of the topics listed above, be able to solve routine and challenging problems, and be able to apply the ideas creatively.

Program objectives: This is the third and final course of the honors calculus sequence for STEM (Science, Technology, Engineering, Mathematics) majors. As this is an honors course, the approach is not just computational, but there is also an emphasis on theory and proofs. Mathematics is the basic language for STEM fields. Understanding the language, the basic ideas and results, and the computational techniques of calculus is prerequisite to advanced learning in any STEM field.

Approximate Timeline:

Weeks 1–2: Vectors and the geometry of space.
   (1) Section 11.1: Three-dimensional coordinate systems.
   (2) Section 11.2: Vectors.
   (3) Section 11.3: The dot product.
   (4) Section 11.4: The cross product.
   (5) Section 11.5: Lines and planes in space.
   (6) Section 11.6: Cylinders and quadric surfaces.
Weeks 3 - 4: Vector–valued functions and motion in space.
(1) Section 12.1: Vector functions and their derivatives.
(2) Section 12.2: Integrals of vector functions.
(3) Section 12.3: Arc length in space.
(4) Section 12.4: Curvature of a curve.
(5) Section 12.5: Tangential and normal components of acceleration.
(6) Section 12.6: Velocity and acceleration in polar coordinates.

Weeks 5 - 7: Partial derivatives.
(1) Section 13.1: Functions of several variables.
(2) Section 13.2: Limits and continuity in higher dimensions.
(3) Section 13.3: Partial derivatives.
(4) Section 13.4: The chain rule.
(5) Section 13.5: Directional derivatives and gradient vectors.
(6) Section 13.6: Tangent planes and differentials.
(7) Section 13.7: Extreme values and saddle points.
(8) Section 13.8: Lagrange multipliers.
(9) Section 13.9: Taylor’s formula for two variables.

Weeks 8 - 10: Multiple Integrals.
(1) Review Section 11.5 and Section 11.6
(2) Section 14.1: Double and iterated integrals over rectangles.
(3) Section 14.2: Double integrals over general regions.
(4) Section 14.3: Area by double integration.
(5) Section 14.4: Double integrals in polar form.
(6) Section 14.5: Triple integrals in rectangular coordinates.
(7) Section 14.6: Moments and centers of mass.
(8) Section 14.7: Triple integrals in cylindrical and spherical coordinates.
(9) Section 14.8: Substitutions in multiple integrals.

Weeks 11 - 15: Integration in vector fields.
(1) Section 15.1: Line integrals.
(2) Section 15.2: Vector fields, work, circulation, and flux.
(3) Section 15.3: Path independence, potential functions, and conservative fields.
(4) Section 15.4: Green’s theorem in the plane.
(5) Section 15.5: Surfaces and area.
(6) Section 15.6: Surface integrals and flux.
(7) Section 15.7: Stokes’ theorem.
(8) Section 15.8: The divergence theorem and a unified theory.