OFFICIAL SYLLABUS

502- ADVANCED CALCULUS FOR ENGINEERS

ADOPTED – SPRING 2006 (Committee: Pelekanos (chair), Lu, Leem)

Catalog Description

Review of Vector calculus, Green's theorem, Gauss' theorem, and Stokes' theorem. Complex analysis up to contour integrals and residue theorem. Not for MATH majors. Prerequisite: MATH 250 or consent of instructor.

Textbook

Advanced Engineering Mathematics, 2nd Edition by Michael D. Greenberg

Course Outline and Topics

i) *Chapter 14: Vectors in 3-Space (Brief review)*

ii) *Chapter 15: Curves, Surfaces, and Volumes*

- 15.1 Introduction
- 15.2 Curves and Line Integrals
  - 15.2.1 Curves
  - 15.2.2 Arc length
  - 15.2.3 Line integrals
- 15.3 Double and Triple Integrals
  - 15.3.1. Double integrals *(briefly)*
  - 15.3.2 Triple integrals *(briefly)*
- 15.4 Surfaces
  - 15.4.1 Parametric representation of surfaces
  - 15.4.2 Tangent plane and normal
- 15.5 Surface Integrals
  - 15.5.1 Area element $d\,A$
  - 15.5.2 Surface integrals
- 15.6 Volumes and Volume Integrals
  - 15.6.1 Volume element $d\,V$
  - 15.6.2 Volume integrals

iii) *Chapter 16: Scalar and Vector Field Theory*

- 16.1 Introduction
- 16.3 Divergence
- 16.4 Gradient
- 16.5 Curl
- 16.8 Divergence Theorem
  - 16.8.1 Divergence Theorem
  - 16.8.2 Two-dimensional case
- 16.9 Stokes's Theorem
  - 16.9.1 Line integrals
  - 16.9.2 Stokes's theorem
  - 16.9.3 Green's theorem
- 16.10 Irrotational Fields
  - 16.10.1 Irrotational fields

iv) *Chapter 21: Functions of a Complex Variable*

- 21.1 Introduction
- 21.2 Complex Numbers and the Complex Plane
- 21.3 Elementary Functions
  - 21.3.1 Preliminary ideas
  - 21.3.2 Exponential function
  - 21.3.3 Trigonometric and hyperbolic functions

21.4 Polar Form, Additional Elementary Functions, and Multi-valuedness
- 21.4.1 Polar form
- 21.4.2 Integral powers of z and de Moivre's formula
- 21.4.3 Fractional powers
- 21.4.4 The logarithm of z
- 21.4.5 General powers of z
- 21.4.6 Obtaining single-valued functions by branch cuts
- 21.4.7 More about branch cuts

21.5 The Differential Calculus and Analyticity

v) *Chapter 22: Conformal Mapping*

22.1 Introduction
22.2 The Idea Behind Conformal Mapping
22.6 Applications to Fluid Mechanics *(optional)*

vi) *Chapter 23: The Complex Integral Calculus*

23.1 Introduction
23.2 Complex Integration
- 23.2.1 Definition and properties
- 23.2.2 Bounds

23.3 Cauchy's Theorem
23.4 Fundamental Theorem of the Complex Integral Calculus
23.5 Cauchy Integral Formula

vii) *Chapter 24: Taylor Series, Laurent Series, and the Residue Theorem*

24.1 Introduction
24.2 Complex Series and Taylor Series
- 24.2.1 Complex series
- 24.2.2 Taylor series

24.3 Laurent Series
24.4 Classification of Singularities
24.5 Residue Theorem
- 24.5.1 Residue theorem
- 24.5.2 Calculating residues
- 24.5.3 Applications of the residue theorem *(optional)*