20A Syllabus - Calculus

Lecture Schedule based on Stewart's – *Calculus, Early Transcendentals* 5th Edition

Section	Lectures	Topic
1.1	1	Four ways to represent a function
1.2	1	Mathematical Models
1.3	1	New Functions from Old
1.5	1	Exponential Functions, the number *e*
1.6	1	Inverse Functions and Logarithms
2.1 & 2.2	1	Tangent and Velocity Problems; Limit of a Function
2.3, 2.5 & 2.6	2	Calculating limits using the limit laws; continuity; limits at infinity and horizontal asymptotes
2.7 & 2.8	1	Tangents, velocities, other rate of change; the derivative
2.9 & 3.1	1	Derivative as a function; Derivatives of polynomials and exponential functions
3.2 & 3.3	1	Product and Quotient Rules; Rates of change in the natural and social sciences
3.4	1	Derivatives of the trigonometric functions
3.5	1	The Chain Rule
3.6 & 3.7	1	Implicit Differentiation; Higher Derivatives
3.8 & 3.9	1	Derivatives of logarithmic functions; hyperbolic functions
3.10	1	Related Rates
3.11	1	Linear Approximations and differentials
4.1 & 4.2	1	Maximum and minimum values; Mean Value Theorem
4.3	1	How derivatives affect the shape of a graph
4.4	1	Indeterminate forms and L'Hospital's Rule
4.5 & 4.6	1	Summary of curve setching; graphing with calculus and calculators
4.7	1	Optimization problems
4.9	1	Newton's method
4.10	1	Antiderivatives
5.1	1	Areas and distances, Sigma notation introduced
5.2	1	The Definite Integral
5.3 & 5.4	1	The Fundamental Theorem of Calculus; Indefinite Integrals and the "total change theorem"

Recommended Calculator : TI-85 or TI-86. At the instructors discretion symbolic manipulation calculators such as TI-89 or TI-92 may be prohibited during exams. For some exams, calculators may not be permitted at all.

20B Syllabus - Calculus

Lecture Schedule based on Stewart's – *Calculus, Early Transcendentals,* 5th Edition

Section	Lectures	Topic
5.1, 5.2 & 5.3	1	Review of The Fundamental Theorem
5.4	1	Indefinite Integrals and "Total Change Theorem"
5.5	1	Substitution in Integrals
5.6	1	The Logarithm defined as an integral
6.1	1	Areas between curves
6.2	1	Volumes; solids of revolution
6.5	1	Average value of a function; Mean Value Theorem for Integrals
10.3 & 10.4	1	Polar Coordinates; integrals in polar coordinates
App G, Supp Nts	3	Complex Numbers; Complex Exponentials, derivation of trig identities
7.1	1	Integration by Parts
7.2	1	Trigonometric Integrals
7.3	1	Trigonometric substitution
Supp Nts & 7.4	2	Partial Fractions; Fundamental Theorem of Algebra
7.5 & 7.6	0.5	Strategy for Integration; integration using tables and computer algebra systems
7.7	1	Approximate integration; error bounds
7.8	1	Improper integrals; comparison test
8.1	1	Arc length
8.2	1	Area of a surface of revolution
8.3	1	Centroids and center of mass
9.1, 9.2 & 9.3	2	Modeling with Differential Equations; Direction Fields and Euler's Method; Separable Equations
10.5	1	Conic Sections

Fall Quarter – Possible Review Topics

Section	Lectures	Topic
3.11	1	Linear Approximations and Differentials
4.1 & 4.2	1	Antiderivatives; Mean Value Theorem
5.1 & 5.2	1	Areas and Distances; The Definite Integral
5.3 & 5.4	1	Indefinite Integrals and "Total Change Theorem"

Recommended Calculator : TI-85 or TI-86. At the instructors discretion symbolic manipulation calculators such as TI-89 or TI-92 may be prohibited during exams. For some exams, calculators may not be permitted at all.

20C Syllabus - Calculus

Lecture Schedule based on Stewart's – *Calculus, Early Transcendentals* 5th Edition

Note: The following syllabus takes 26 lectures versus 28 to 30 in a typical quarter. Some topics can be expanded or additional topics (eg Kepler's Laws) can be added if time permits.

Section	Lectures	Topic
12.1	1	Three-dimensional coordinate systems
12.2	1	Vectors
12.3	1	The Dot Product, projections and components
12.4	1	The Cross Product
12.5	1	Equations of lines and planes
13.1-13.4, 10.1, 10.2	4	Parametric equations in the plane; vector related functions in space; derivatives and integrals of vector functions; velocity, speed and acceleration
14.1	1	Functions of several variables
14.2	1	Limits and continuity
14.3	1	Partial Derivatives – omit Cobb-Douglas product function
14.4	1	Tangent planes and linear approximations
14.5	1	The Chain Rule, omit implicit differentiation
14.6	1	Directional derivatives and the gradient vector
14.7	1	Local maxima and minima
14.7	1	Absolute maxima and minima; extreme value theorem
14.8	1	Lagrange multipliers
15.1	1	Double integrals over rectangles
15.2	1	Iterated integrals
15.3	1	Double integrals over general regions
15.4	1	Double integrals in polar coordinates
15.5, 15.6	1	Selected applications of double integrals
15.7	1	Triple integrals
12.7	1	Cylindrical and spherical coordinates
15.8	1	Triple integrals in cylindrical and spherical coordinates

Recommended Calculator : TI-85 or TI-86. At the instructors discretion symbolic manipulation calculators such as TI-89 or TI-92 may be prohibited during exams. For some exams, calculators may not be permitted at all.

20D Syllabus – Intro Differential Equations, Fall 2004

Lecture Schedule based on Stewart's – *Calculus, Early Transcendentals* 5th Edition Chapter 11 & Conrad, *Differential Equations: A Systems Approach*, 1st Edition Chapters 1-7

Section	Lectures	Topic
11.1	1	Sequences; Concepts, Squeeze Thm, Monotonic Seq Thm
11.2-11.3	1	Geometric and Harmonic Series, Integral Test
11.4-11.5	1	Comparison and Alternating Series Tests
11.6	1	Absolute convergence, Ration and Root Tests
11.8-11.9	1	Power series, radius of convergence - examples
11.10	1	Taylor series and remainder estimate
11.2	2	Applications of Taylor series and remainder estimate
1.1-1.2	1	Introduction to ODE and linear growth/decay models
1.3 & Sum	1	Linear first-order ODE; SUMMARY of series material (Stewart 11.1 – 11.2)
2.1-2.2	1	Separable ODE, Exact form and integrating factors
2.3	1	Graphical analysis of ODE
2.4 & Rev	1	Initial Value Problems in ODE (IVP); Review for Midterm 1
2.5	1	Nonlinear growth models and asymptotic behavior
3.1-3.2	1	Systems of ODE and the phase plane
3.4-3.5	1	Autonomous systems; Interacting population models
4.1	1	IVP for linear systems of ODE
4.2	1	Systems with constant coefficients
4.4	1	General solution of a linear system
4.4	1	Complete example from 4.4, related examples from 4.1 & 4.2
4.3, 2.2	1	Complex numbers and eigenvalues, exact form and integrating factors (in detail)
5.1 & Sum	1	IVP for 2nd-order ODEs; SUMMARY of all ODE material so far (Conrad 1.1 – 4.4)
5.2-5.3	1	Homogeneous equations, the case of constant coefficients
5.5 & Rev	1	Inhomogeneous equations (method of undetermined coefs); Review for Midterm 2
5.8	1	Variation of constants/parameters
6.1, 6.3	1	Definition and properties of the Laplace transform
6.4	1	Inverse transforms of rational functions
7.1-7.2	1	Series solutions of ODE at a regular point

List of Topics for MATLAB laboratories:

1. Introduction to MATLAB using Sequences and Series
2. Taylor Series
3. Modeling with ODEs
4. Direction Fields with DFIELD
5. The Phase Plane and Solution Curves for Systems of ODEs
6. Solution of Linear Systems using Eigenvalues and Eigenvectors
7. Numerical Methods for ODEs and Systems of ODEs
8. The Laplace Transform

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20E Syllabus - Vector Calculus

Lecture Schedule based on Marsden and Tromba, *Vector Calculus*, Freeman 2004

Section	Lectures	Topic
1.1-1.2	1	Vectors, scalar product
1.3	0.5	Cross product, determinants
1.5	0.5	Matrix multiplication, linear maps
4.1, 2.1	1	Cylindrical, spherical coordinates, surfaces
2.2-2.3	1	Derivatives
2.4-2.5	1.5	Curves, the chain rule
2.6	0.5	Gradient
3.1-3.2	1	Taylors Theorem (3.5 – Implicit Function Theorem)
4.1-4.2	1	Parametrized curves and arclength
4.3	1.5	Vector fields and flow lines
4.4	0.5	Divergence and curl
5.1-5.4	1	Areas and double and iterated integrals
5.5	1	Triple integrals
6.1-6.2	2	Change of Variables
7.1-7.2	1.5	Path, line integrals
7.3	0.5	Parametrized surface
7.4	1	Area of surface
7.5-7.6	4	Integrals over surfaces
8.1	1	Green's Theorem
8.2	1	Stokes Theorem
8.3	1	Conservation Fields
8.4	1	Gauss's Theorem (8.5 – Maxwell's equations, Fluid mechanics and 8.6 – Differential forms

20F Syllabus – Linear Algebra, Fall 2004

Lecture Schedule based on Lay – *Linear Algebra and Its Applications* 3rd Edition

Section	Lectures	Topic
1.1	1	Systems of Linear Equations
1.2	1	Row Reduction and Echelon Forms
1.3	0.5	Vector Equations
1.4	1	The Matrix Equation $Ax = b$
1.5	1	Solution Sets of Linear Systems
1.6	0.5	Applications of Linear Systems
1.7	1	Linear Independence
1.8	0.5	Introduction to Linear Transformations
1.9	1	The Matrix of a Linear Transformation
2.1	1	Matrix Operations
2.2	1	The Inverse of a Matrix
2.3	0.5	Characterizations of Invertible Matrices
2.5	0.5	Matrix Factorizations
4.1	1	Vector Spaces and Subspaces
4.2	1	Null Spaces, Column Spaces and Linear Transformations
4.3	0.5	Linearly Independent Sets; Bases
4.5	0.5	The Dimension of a Vector Space
4.6	0.5	Rank
4.4	0.5	Coordinate Systems
4.7	1.5	Change of Basis
3.1	0.5	Introduction to Determinants
3.2	1	Properties of Determinants
3.3	0.5	Cramer's Rule; Volume and Linear Transformations
5.1	1	Eigenvectors and Eigenvalues
5.2	1	The Characteristic Equation
5.3	0.5	Diagonalization
6.1	1	Inner Product, Length and Orthogonality
6.2	0.5	Orthogonal Sets
6.3	1	Orthogonal Projections
6.4	0.5	The Gram-Schmidt Process
6.5	0.5	Least-Squares Problems
7.1	1	Diagonalization of Symmetric Matrices

List of Topics for MATLAB laboratories:

1. Introduction to MATLAB
2. Systems of Linear Equations and Floating-Point Errors
3. Matrix Algebra
4. Elementary Row Operations and LU-Factorization
5. Linear Dependence, Column Space, Null Space, and Bases
6. Change of Basis and Coordinate Transformations
7. Eigenvalues and Determinants
8. Orthogonality and Least Squares

http://www.math.ucsd.edu/~math20f/Spring/