

Master Syllabus for MATH 2411 (Calculus II)
Fall 2010

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Preface

- This syllabus is aligned with *Calculus: Early Transcendentals*, 1e, Briggs & Cochran [Addison Wesley, 2010].

(#1) Velocity & Net Change

- (a) Position & velocity; Position from velocity.
- (b) Displacement vs. distance.
- (c) Future value of the position function.
- (d) Velocity from acceleration.
- (e) General future value problems.

(#2) Regions Between Curves

- (a) Area of a region between two curves.
- (b) Integrating with respect to either axis.
- (c) Geometric considerations; Solving for limits of integration.

(#3) Volume by Slicing

- (a) General slicing method.
- (b) Disk Method.
- (c) Washer Method.

(#4) Volume by Shells

- (a) Cylindrical shells.
- (b) Shell Method
- (c) How to choose the best method.

(#5) Length of Curves

- (a) Arc length; Arc length differential.
- (b) Families of curves with desirable arc length differentials.
- (c) Examples which require numerical approximations.

(#6) Physical Applications

- (a) Density and mass of a straight wire.
- (b) Work; Hooke's Law.
- (c) Lifting problems.
- (d) Force and pressure problems.

(#7) Logarithmic & Exponential Functions Revisited

- (a) Integral definition of $\ln(x)$.
- (b) Properties of $\ln(x)$.
- (c) Properties of e^x .
- (d) General logarithmic and exponential functions; General Power Rule.

(#8) Exponential Models

- (a) Exponential growth; Some insight for introducing (later):

$$\frac{dy}{dt} = ky$$

- (b) Rate constants & doubling time.
- (c) Financial models; Continuous compounding.
- (d) Exponential decay; Half-life.

(#9) Integration by Parts

- (a) Indefinite integrals.
- (b) Repeated use of IBP; Reduction formulas.
- (c) Cases where the original integral appears on both sides of the IBP equality.
- (d) Definite integrals.

(#10) Trigonometric Integrals

- (a) $\int \sin^m(x) \cos^n(x) dx$.
- (b) Reduction formulas for $\sin^n(x)$, $\cos^n(x)$, $\tan^n(x)$, and $\sec^n(x)$.
- (c) $\int \tan^m(x) \sec^{n(x)} dx$.

(#11) Trigonometric Substitution

- (a) Integrals involving $(a^2 - x^2)$.
- (b) Integrals involving $(a^2 + x^2)$.
- (c) Integrals involving $(x^2 - a^2)$. [optional]
- (d) Integrand which require completing the square.

(#12) Partial Fractions

- (a) Method of partial fractions.
- (b) Procedures (algebraically intense); Repeated linear factors.
- (c) Irreducible quadratic factors
- (d) Using technology.

(#13) Other Integration Strategies

- (a) Integral tables.
- (b) Using computer algebra systems.

(#14) Improper Integrals

- (a) Infinite intervals; Solids of integration.
- (b) Unbounded integrands; Integrals involving a vertical asymptote.
- (c) Applications.

(#15) Introduction to Differential Equations

- (a) Initial value problems.
- (b) First-order linear ODEs.
- (c) Separable first-order; Logistic population growth.
- (d) Direction fields.
- (e) Newton's Cooling [optional].

(#16) Overview of Sequences & Series

- (a) Notation.
- (b) Examples of sequences; Explicit formula definitions.
- (c) Recurrence relations.
- (d) Example of a limit of a sequence.
- (e) Infinite series; Sequence of partial sums.
- (f) Convergent sums; Example: Repeating decimals.

(#17) Sequences

- (a) Limits of sequences from limits of functions; Properties of limits of sequences.
- (b) Terminology.
- (c) Geometric sequences.
- (d) Squeeze Theorem revisited; Bounded Monotonic Sequence Theorem.
- (e) Growth rates of sequences.

(#18) Infinite Series

- (a) Geometric series.
- (b) Telescoping series.
- (c) All others are difficult to sum without Taylor series.

(#19) Divergence & Integral Tests

- (a) Harmonic series diverges.
- (b) Properties of convergent series.
- (c) Divergence Test
- (d) Integral Test.
- (e) p -Series Test.
- (f) Estimating the remainder of partial sum.

(#20) Ratio, Root, & Comparison Tests

- (a) Ratio Test
- (b) Root Test
- (c) Comparison Test
- (d) Limit Comparison Test
- (e) Review guidelines for the various tests.

(#21) Alternating Series

- (a) Alternating Series Test.
- (b) Alternating harmonic series.
- (c) Estimating the remainder of partial sum.
- (d) Absolute and conditional convergence.

(#22) Approximating Functions with Polynomials

- (a) Power series; Polynomial approximation.
- (b) Linear and quadratic approximation.
- (c) Taylor polynomials; More approximations.
- (d) Taylor's Theorem; Estimating the remainder.

(#23) Properties of Power Series

- (a) Interval of convergence; Radius of convergence.
- (b) Definition of convergence.
- (c) Combining power series.
- (d) Differentiating and integrating power series.

(#24) Taylor Series

- (a) Taylor/Maclaurin series for a function.
- (b) Binomial series.
- (c) Estimating remainder for some Maclaurin partial sums.
- (d) Manipulating common Maclaurin series.

(#25) Working with Taylor Series

- (a) Limits by Taylor series.
- (b) More differentiation and integration of power series.
- (c) Evaluating infinite series associated with Taylor series.

(#26) Parametric Equations

- (a) Parametric curves associated with single variable functions.
- (b) Circular paths and similar curves; Orientation.
- (c) Derivative for parametric curves.

(#27) Polar Coordinates

- (a) Converting between rectangular (Cartesian) and polar coordinates.
- (b) Basic curves in polar coordinates; Circles and lines;
- (c) Roses and cardioids.

(#28) Calculus in Polar Coordinates

- (a) Slopes of tangent lines.
- (b) Area of regions bounded by polar curves.