Comprehensive Course Syllabus

BC Calculus 3

Course Description:
BC Calculus 3 is the third and final semester in the BC Calculus sequence. The semester begins with a study of improper integrals. This moves into a long study of infinite series and convergence, including Taylor series. Next comes a more detailed look at differential equations, including analytic solutions. Following these major topics are short studies of polar coordinates and vectors.

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Meeting Days, Time and Room(s)
Section 1 (Dover): 8 am, Room A151
Section 2 (Hasler): 9:00, Room A155
Section 3 (Hasler): 1:20, Room A155

Text(s) / Materials:
Calculus – Single Variable, Wiley, 5th edition, 2009, Hughes-Hallett, Gleason, et al.

Essential Content:
Improper integrals, sequences and series, Taylor series and error bounds.
Differential equations, including slope fields, separable differential equations, and basic modeling.
Polar graphs, including derivatives and tangent lines and area.
Vectors – basic arithmetic and calculus of 2D vectors.

Instructional Design and Approach:
Many topics are initially approached from an intuitive point of view. To do this, graphing calculators are used regularly. In addition, computer software such as *Mathematica*® and *Desmos* may be used. Class time is a combination of small and large group interactions as well as individual work. The textbook is one of several "Calculus Reform" projects which attempts to connect various approaches (graphical, analytic, numerical, and verbal: The Rule of Four) to many concepts and problems. Nevertheless, despite the importance of technology, mechanics remain crucial to a student's ability to understand calculus and to use it as a tool, and students will be given ample practice. The challenge is to find the most effective ways of balancing and combining the various approaches.

Student Expectations:
Students must approach the work seriously, which implies a willingness to do homework and classwork consistently. Each student needs to practice and work with new material regularly in order to understand, remember, and be able to use it. There is also an expectation that students will refine their mathematical communication skills, both oral and written. Completion of all assigned work accompanies the expectation of active involvement in class discussion and exploration. Much of the responsibility for asking questions to clarify what remains unclear, or checking answers in the solution manuals rests with the student.

Assessment Practices, Procedures, and Processes:
Various means of assessment include tests and quizzes, daily and extended homework assignments, possible projects and written assignments, many old AP free-response programs, and a semester exam. Individual tests and quizzes are 75% and other assignments or projects count 25% of the work during the semester. Together, these comprise 80% of the semester grade and the final exam is worth the remaining 20% of the semester grade.

Sequence of Topics and Activities

BC Calculus 3: Chapter 9 onward and parts of previous chapters

Days	Content
1 – 6	Sections 7.7 – 7.8: Improper integrals, convergence and divergence. Worksheets: Improper Integrals 1 and 2. The definition and the use of limits are emphasized. Integration, comparison tests, and encouraging intuition to start.
7 – 9	Section 9.1: Sequences. Lots of great problems! Technology is used extensively. Convergence and divergence.
10 – 18	Section 9.2 – 9.4: Infinite series and tests for convergence. Worksheet: Geometric series – development and review. Carefully develop the concepts of a sequence of partial sums and convergence of a series. Worksheet: Upper bounds. A proof that the harmonic series diverges. Comparison tests again and add ratio and integral tests. *P*-series. Alternating series with absolute and conditional convergence. Alternating series test for convergence and error bounds. Technology used extensively.
19 – 22	Section 9.5: Power series. General concept and ratio test to find interval of convergence.
21 – 35	Sections 10.1 – 10.4 Development of Taylor series, lots of worksheets! Development of Maclaurin and Taylor polynomials and infinite series, including more work on intervals of convergence and error analysis. Lagrange error bound. Manipulation of series, including substitution, differentiation, and integration. Technology and animations are used extensively.
36 – 39	Appendix D: Vectors. Review of pre-calc material and continue with text and worksheets. Magnitude and speed, derivatives, tangent and orthogonal vectors, modeling with trajectories.
40 – 46	Section 8.3: Polar graphs and calculus with polar functions. Worksheets: Polar 1, 2, and 3. Review of pre-calc material and continue with text and worksheets. Basic graphs, tangent lines and area.
47 – 52	Sections 11.1 – 11.3: Reminder of what DE's and IVP's are, what a solution is, intro to slope fields, and Euler's Method (review and expanded).

53 – 56	Sections 11.4 – 11.5: Separation of variables. Exponential growth and decay.
57 – 63	Sections 11.6 – 11.7: Tie the pieces together with models. Worksheets: Newton's Law of Cooling, logistic population growth, air drag. Worksheets take each model and look at slope fields, Euler, and analytic solutions together. Supplemented with old AP problems, text, and other books.
64 – 66	Semester Review