**AUC Course Manual for Calculus**

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| Course Name | Calculus | |
| Course # | 900125ACCY | |
| Credits | 6 EC | |
| Timeslot | Groups 3, 5, 6: Tue 9:00–10:30 and Fri 13:45–15:15<br>Groups 1, 4: Tue 11:00–12:30 and Fri 16:00–17:30<br>Group 2: Tue 13:45–15:15 and Fri 9:00–10:30 | |
| Prerequisite(s) | Mathematics at exit level ‘Wiskunde B’ or comparable | |
| Related AUC Theme(s) | Energy, Climate and Sustainability; Life, Evolution, Universe; Health and Well-being; Information, Communication, Cognition | |
| Lecturers | Dr. Sonja Cox (Gr 1)<br>Dr. Leo Tzou (Gr 1)<br>Dr. Noah Olander (Gr 2)<br>Dr. Lorenzo Galeotti (Gr 3) | Dr. Fedde Benedictus (Gr 4)<br>Dr. Gabriele Benedetti (Gr 5)<br>Dr. Wouter Kager (Gr 6) |
| Coordinator | Dr. Yurii Khomskii | |

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| Course Content | This course deals with calculus of functions of one variable. In particular we cover:<br>• manipulating algebraically with exponential, logarithmic and (inverse) trigonometric functions<br>• determining limits of functions<br>• computing limits using l'Hôpital's rule<br>• calculating derivatives of any composition of elementary functions<br>• computing Taylor polynomials<br>• computing tangent lines to implicitly defined curves in the plane<br>• finding and classifying the (local) minima and maxima of functions<br>• graphing simple functions (e.g., rational functions, exponentials, logarithms, and compositions thereof)<br>• calculating areas under the graphs of elementary functions<br>• computing antiderivatives using integration by parts<br>• computing antiderivatives using an appropriately chosen substitution<br>• integrating simple rational functions (using "partial fractions")<br>• determining if an improper integral converges (and compute/estimate the area)<br>• solving first-order differential equations of separable type and of linear inhomogeneous type<br>• solving homogenous linear second-order differential equations with constant coefficients<br>• performing arithmetic with complex numbers<br>• determining if a series converges by comparing to a geometric series or p-series.<br>• determining if a series converges using an appropriately chosen convergence test<br>• determining the interval of convergence of a power series<br>• performing simple algebraic manipulations with power series<br>Students will also practice exercises in-class to improve their skills. |

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| Learning Outcomes | At the end of this course students will be able to:<br>1. calculate limits using appropriately chosen methods, such as l'Hôpital's rule or by identifying dominant terms.<br>2. compute derivatives, find local extreme values and use these to graph functions.<br>3. evaluate integrals using appropriately chosen methods, such as the substitution method, integration by parts or partial fraction expansion.<br>4. solve simple differential equations with or without initial data.<br>5. compute Taylor polynomials and manipulate Taylor series.<br>6. determine if an infinite series converges using an appropriately chosen test.<br>7. write down the arguments involved in solving a calculus problem in a logically correct manner. |
| Contribution to the general learning outcomes; select from Academic Standards and Procedures (OER), section 2.3. Indicate number. | 2.3.1a, 2.3.2a, 2.3.2b, 2.3.2d, 2.3.2h |
| Form(s) of Instruction | Lectures, including (interactive) work on exercises |
| Assessments | Week 6: Exam 1: 27% (LO 1,2,4,7)<br>Week 12: Exam 2: 27% (LO 1,2,3,4,7)<br>Week 16: Exam 3: 27% (LO 2,3,5,6,7)<br>MyMathLab assignments A1 – A12: 19% (LO 1-6) |
| Main Course Sources | *Calculus: A Complete Course* by R.A. Adams and C. Essex, 10th ed., Pearson, ISBN 9780135732588 |
| Visits and Excursions | None |
| Course Adjustments | We changed from 4 exams (unequally weighted) to 3 exams (equally weighted), and increased the number of MyMathLab assignments to 12. We cut out a couple of secondary topics so that there would be more time to focus on the most essential topics. |

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# Weekly Programme

| Week | Date | Subject | Reading pages | Practice Exercises | Assessment |
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| 1a | 6 Sep | Introduction | 1-23 | **§P.1:** 17, 19, 25, 31, 37, 41. | |
| 1b | 9 Sep | Functions, inequalities | 23-58 | **§P.4:** 12, 14, 15, 29, 33.<br>**§P.5:** 7, 27, 33. | |
| 2a | 13 Sep | Limits | 59-79 | **§1.2:** 9, 12, 14, 22, 28, 36, 39, 78.<br>**§1.3:** 3, 5, 7, 9, 11, 19, 28, 31. | MyMathLab A1 due |
| 2b | 16 Sep | Continuity and its consequences | 79-88 | **§1.4:** 1, 2, 13, 18, 29, 30, 32. | |
| 3a | 20 Sep | Differentiation | 95-127 | **§2.2:** 1, 2, 3, 4, 13a, 19a.<br>**§2.3:** 8, 11, 21, 41.<br>**§2.4:** 2, 6, 13, 30.<br>**§2.5:** 13, 30, 58. | MyMathLab A2 due |
| 3b | 23 Sep | More on differentiation | 127-150 | **§2.6:** 4, 28.<br>**§2.8:** 5, 6, 8, 16.<br>**§2.9:** 10, 15, 17. | |
| 4a | 27 Sep | Inverse function, exponential, logarithm, inverse trig | 166-184, 192-200 | **§3.1:** 3, 8, 29.<br>**§3.2:** 1, 4, 6, 11, 18, 30.<br>**§3.3:** 6, 14, 25, 26, 43, 70.<br>**§3.5:** 35, 42. | MyMathLab A3 due |
| 4b | 30 Sep | More limits, l'Hôpital's rule | 185-192, 230-235 | **§3.4:** 1, 3, 7, 9, 13.<br>**§4.3:** 2, 3, 6, 10, 14, 24, 28. | |
| 5a | 4 Oct | Extreme values | 236-247, | **§4.4:** 5, 20, 24, 35.<br>**§4.5:** 1, 11, 17, 24, 34. | MyMathLab A4 due |
| 5b | 7 Oct | Graph sketching | 247-255 | **§4.6:** 3, 7, 9, 18, 23, 26, 27, 31, 35. | |
| 6a | 11 Oct | Applications of optimization | 261-269 | **§4.8:** 7, 20, 21, 23, 40. | MyMathLab A5 due |
| 6b | 14 Oct | | | | **Exam 1** |
| Lecture-free week: 17 to 21 October | | | | | |

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| 8a | 25 Oct | Integration: definition and properties | 150-156, 291-307 | **§2.10:** 8, 11, 21, 24, 37, 42.<br>**§5.1:** 12, 19, 22, 33.<br>**§5.2:** 7, 14.<br>**§5.3:** 8, 10. | |
| 8b | 28 Oct | Fundamental theorem of calculus | 307-319 | **§5.4:** 9, 24, 30, 42.<br>**§5.5:** 4, 9, 23, 40, 42, 47. | |
| 9a | 1 Nov | Area of plane regions | 327-331 | **§5.7:** 4, 8, 14, 18. | MyMathLab A6 due |
| 9b | 4 Nov | Substitution rule, Integration by parts | 319-327, 334-340 | **§5.6:** 6, 7, 9, 11, 12, 17, 24, 43.<br>**§6.1:** 1, 3, 5, 7, 13, 31. | |
| 10a | 8 Nov | Partial fractions, Improper integrals | 340-348, 363-371 | **§6.2:** 6, 9, 11, 16.<br>**§6.5:** 4, 12, 33, 34, 36 | MyMathLab A7 due |
| 10b | 11 Nov | Solids of revolution, Mass, Center of mass | 393-402 413-420 | **§7.1:** 3, 17, 21, 22.<br>**§7.4:** 1, 3, 5. | |
| 11a | 15 Nov | 1st order ODEs | 185-192, 450-458 | **§3.4:** 24, 29.<br>**§7.9:** 2, 4, 6, 7, 11, 14, 18, 24, 28. | MyMathLab A8 due |
| 11b | 18 Nov | Complex numbers | A1-A10 | **§A1:** 1, 2, 3, 4, 5, 6, 7, 9, 13, 15, 23, 25, 34, 36, 37, 41, 42, 48, 49, 52, 54. | |
| 12a | 22 Nov | 2nd-order linear ODEs | 206-213 | **§3.7:** 1, 3, 5, 7, 9, 13, 15, 16, 28. | MyMathLab A9 due |
| 12b | **25 Nov** | | | | **Exam 2** |
| 13a | 29 Nov | Sequences, infinite series | 500-514 | **§9.1:** 1, 3, 4, 7, 9, 10, 12, 18, 19, 20, 21, 22, 23.<br>**§9.2:** 2, 3, 6, 12, 17, 18. | |
| 13b | 2 Dec | Convergence of series | 515-521 | **§9.3:** 4, 5, 6, 7, 10, 13, 25. | |
| 14a | 6 Dec | Ratio test, Root test | 521-525 (up to Thm 12) | **§9.3:** 18, 22, 41. | MyMathLab A10 due |
| 14b | 9 Dec | Absolute / conditional convergence | 525-531 | **§9.4:** 1, 4, 5, 6, 7, 8, 17, 21, 22, 28. | |
| 15a | 13 Dec | Power series | 531-542 | **§9.5:** 5, 8, 12, 13, 15, 17, 32. | MyMathLab A11 due |

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| 15b | 16 Dec | Taylor & Maclaurin series | 542-551 | **§9.6:** 3, 9, 10, 11, 23, 33, 40. | |
| 16a | 20 Dec | | | | **Exam 3** |