The Cooper Union
Department of Mathematics

SYLLABUS

MA111 (4 cr.) **Calculus I**
Text: *Thomas' Calculus*,
Weir, Hass
Twelfth Edition,
Pearson / Addison-Wesley, 2010.

1. Real numbers and the real line (A.1, H.A.: 1–4, 6–8, 10–16, 18–22, 27). Functions and their graphs (1.1, H.A.: 1–12, 14, 15, 17, 20, 22, 25, 29, 35, 37–39, 47, 48, 50–55, 72). Combining functions; shifting and scaling graphs (1.2, H.A.: 1–5, 7, 9, 12, 17, 23, 25, 41, 51, 63, 67, 77, 85). Trigonometric functions (1.3, H.A.: 4, 8, 13, 14, 16, 18, 19, 21, 29, 30, 32, 39, 41, 54).

2. Rates of change and tangents to curves (2.1, H.A.: none). Limit of a function and limit laws (2.2, H.A.: 2, 11–13, 15–19, 21, 33–35, 37, 38, 40, 52, 60, 75). The precise definition of a limit (2.3, H.A.: 26, 36, 37, 39, 44, 49, 54, 56). One-sided limits (2.4, H.A.: 1, 5, 7, 11, 18–21, 25, 30, 31, 42, 46).

3. Continuity (2.5, H.A.: 1–9, 13, 16–21, 29, 37, 41, 52, 59, 62, 65). Limits involving infinity; asymptotes of graphs (2.6, H.A.: 1, 3–7, 9–11, 13–15, 18–21, 31, 35–39, 41–47, 55, 67, 72, 77, 81, 83, 92, 101). Oblique asymptotes (general case).

4. Tangents and the derivative at a point (3.1, H.A.: 7, 13, 21, 23, 27, 33, 34, 36). The derivative as a function (3.2, H.A.: 3, 9, 15, 21, 24, 25, 27–30, 32, 37, 41, 42, 44, 45, 47, 54, 58). Differentiation rules (3.3, H.A.: 1–3, 5, 8, 9, 11, 17–21, 23, 29, 33, 43, 47, 56, 65). The derivative as a rate of change (3.4, H.A.: 1, 3–7, 15, 22, 23).

5. Derivatives of trigonometric functions (3.5, H.A.: 1–5, 15, 19, 33, 35, 47, 49, 54, 59, 66). The chain rule (3.6, H.A.: 1, 3, 5–8, 10, 11, 13–23, 25–27, 29, 31–34, 36–39, 61, 66, 71, 83, 88, 89). Implicit differentiation (3.7, H.A.: 3, 7, 21, 23, 31, 35, 44, 47). Related rates (3.8, H.A.: 1, 7, 9, 11, 13, 21, 23, 32, 34, 42).

6. Linearization and differentials (3.9, H.A.: 3, 8, 17–21, 23, 25, 26, 28, 29, 31, 33, 35–37, 44, 48, 54ab). Extreme values of functions (4.1, H.A.: 1–14, 20, 23, 27, 29, 35, 45, 51, 61, 63, 70, 71, 75, 76). The mean value theorem (4.2, H.A.: 1, 5, 7, 9, 17, 26, 28, 47, 59, 64, 67). Monotonic functions and the first derivative test (4.3, H.A.: 1, 3, 5, 17, 23, 25–27, 29, 31, 33, 63, 69, 70).

7. Inverse functions and their derivatives (7.1, H.A.: 1, 3, 5, 11–15, 22, 27, 31, 38, 51, 53, 57, 58). Inverse trigonometric functions (7.6, H.A.: 1, 3, 11, 13, 15, 23, 41, 107, 116). L'Hôpital's rule I (basic indeterminate forms and the Cauchy mean value theorem) (7.5, H.A.: 4, 7–9, 11–17, 19, 23, 25, 35, 47, 68, 75). Concavity and curve sketching (4.4, H.A.: 1–8, 10, 11, 19, 23, 27, 54, 93, 94, 102, 112).

8. Applied optimization (4.5, H.A.: 1, 3, 7, 15, 22, 24, 25, 38, 61, 63). Newton's method (4.6, H.A.: 3, 5, 8, 21, 24). Antiderivatives (4.7, H.A.: 1, 5, 9, 15, 21, 31, 47, 57, 63, 67, 71, 83, 94). Area and estimating with finite sums (5.1, H.A.: 4, 17).

9. Sigma notation and limits of finite sums (5.2, H.A.: 1–19, 21–23, 25, 33, 39). The definite integral (5.3, H.A.: 5, 9, 15, 18, 19, 21–23, 26, 27, 41–45, 48, 49, 53, 59, 71, 73–75, 81, 88). The fundamental theorem of calculus (5.4, H.A.: 1–41, 47, 54, 55, 64, 65).

10. Indefinite integrals and the substitution method (5.5, H.A.: 1–4, 6–11, 13, 15–19, 21–27, 29–32, 34, 35, 37, 38, 40–47, 49, 51, 55, 62, 63). Substitution and area between curves (5.6, H.A.: 1–8, 10–13, 15, 17, 18, 20, 21, 24, 25, 29, 35, 43, 59, 63, 75, 79, 81–83, 86–88, 90a). Natural logarithms (7.2, H.A.: 1, 4–27, 36–39, 42–47, 49, 51–53, 65, 67, 70, 81, 84). Exponential functions (7.3, H.A.: 1, 5, 17, 23, 27–29, 32, 34, 35, 37, 39, 42–45, 47–51, 57, 71, 77, 87, 91, 105, 109, 115, 119, 121, 135a, 136; p.432, 123).

11. Exponential change and separable differential equations (7.4, H.A.: 1–7, 9–11, 28, 39, 44). L'Hôpital's rule II (exponential indeterminate forms) (7.5, H.A.: 51–57, 61, 71, 77, 80, 86, 88).

12. Hyperbolic functions (7.7, H.A.: 1, 5, 11–13, 15–17, 19, 21, 41, 44, 45, 77, 86). Relative rates of growth (7.8, H.A.: 2, 3, 6–9, 14, 18, 20, 22). Integration by parts (8.1, H.A.: 1, 3, 5, 6, 8–13, 15, 18, 19, 21, 24–37, 39–47, 49, 50, 51a, 61, 65, 66, 68). Trigonometric integrals (8.2, H.A.: 1–6, 8, 10, 12–15, 18–40, 42–49, 51, 62, 72).

13. Trigonometric substitutions (8.3, H.A.: 1–7, 9, 12–26, 28, 29, 31–49, 57, 58). Integration of rational functions by partial fractions (8.4, H.A.: 1–7, 11, 15, 17, 21, 29, 33, 41, 51). Integral tables and computer algebra systems (8.5, H.A.: 7, 28, 37, 44, 56).

14. The substitution $z = \tan(x/2)$ (p.494, H.A.: 41–47). Numerical integration (8.6, H.A.: 3, 9, 25, 28, 38). Improper integrals (8.7, H.A.: 1–5, 7–11, 13–19, 21–29, 32–63, 65, 66, 75b).

Grading Policy:

Assessment	**Course content (see schedule above)**	**Weight**
Exam 1	through sec. 2.6 & oblique asymptotes	13%
Exam 2	sec. 3.1 – 4.7, incl. curve sketching	22%
Exam 3	sec. 5.1 – 7.8	30%
Final Exam	ch. 8 AND cumulative	35%