MAC 2233 LECTURE OUTLINE and HOMEWORK
Lial/Greenwell/Ritchey: Calculus with Applications

Reading should be completed before you attend lecture. After each lecture, review your notes and make sure you understand the main ideas of the lecture **before** you work the exercises. If you have questions, you may ask your teaching assistant or lecturer during office hours. Tutoring is also available in the math lab.
You should complete each assignment before the next lecture class.

Review Assignment: Precalculus
Complete the Prerequisite Skills Diagnostic Test, p. xxii – xxiii
(answers in Appendix A)
As needed—
Reading: Algebra Reference, Sections R1 – R7
Exercises: Section R.1 (p. R2 – R5): 5, 15, 21, 24
Section R.2 (p. R5 – R8): 19, 24, 27, 29, 31
Section R.3 (p. R8 –R11): 23, 25, 35, 38
Section R. 4 (p. R11 – R16): 7, 13, 25, 31, 33, 37
Section R. 5 (p. R16 – R21): 5, 19, 23, 25, 33, 39, 43, 47, 49, 53
Section R.6 (p. R21 – R25): 5, 8, 19, 23, 25, 30, 33, 41, 45, 49, 53, 55
Section R. 7 (p. R25 – R29): 9, 17, 21, 23, 25, 29, 37, 39, 43

Lecture 1: Course Overview, Precalculus Review and the Cartesian Coordinate System
Reading: Algebra Reference (Sections R1 – R7)

Lecture 2: Linear Equations and Slope
Reading: Section 1.1
Exercises (p. 13 -- 16): 17, 18, 29, 33, 36, 41, 43, 51, 59, 61, 67, 69, 75**.**

Lecture 3: Linear Models
Reading: Sections 1.2, 1.3*
Exercises, Section 1.2 (p. 23 -- 25): 4, 5, 8, 9, 12, 13, 14, 24, 26, 27, 29, 33, 35, 37, 39, 43, 45, 47, 48.
Section 1.3* (p. 32 – 38): 1, 3, 5, 13, 15, 21.
*Calculator or computer program with regression needed

Lecture 4: Functions and Their Properties
Reading: Section 2.1
Exercises Section 2.1 (p. 53 – 57): 3 – 8, 18, 20, 21, 23, 26, 27, 28, 29, 32, 33, 35, 39, 40, 42, 43, 47, 51, 53, 54, 57 – 62, 63, 67, 68, 70, 71, 74a, b, d.

Lecture 5: Function Composition; Graphs and Translations
Reading: Section 4.3 (p. 218 -- 220) and Section 2.2 (p. 62 -- 64)
Exercises Section 4.3 (p. 225 – 226): 1, 3, 5, 6, 7, 10*, 11*, 13*, 17, 18, 19, 53, 59.

Section 2.2 (p. 64 – 67): 3 – 8, 25 – 30, 31 – 33, 35 – 37, 47, 48.

*Include the domain of each function you find in these problems.

Additional Exercises:

1) Sketch the graph of the function $f(x) = 2 - |x + 3|$

2) For each of the following functions, find $f(g(x))$ and $g(f(x))$ and their domains.

a) $f(x) = x^2 - 4$ and $g(x) = \sqrt{x+1}$

b) $f(x) = \frac{2}{x}$ and $g(x) = \frac{x}{x-1}$

Lecture 6: Polynomial Functions and Quadratic Models
Reading: Section 2.2 (p. 57 -- 62) and Section 2.3 (p. 67 – 70)
Exercises Section 2.2 (p. 64 – 67): 1, 2, 9, 13, 15, 17, 51, 55, 57, 58, 59, 60, 65, 69, 71.

Section 2.3 (p. 73 – 78): 1, 3, 5, 7, 13, 15, 21, 23, 48a, c, d.

Lecture 7: Rational and Exponential Functions
Reading: Section 2.3 (p. 71 -- 73) and Section 2.4
Exercises Section 2.3 (p. 75 -- 77): 29, 33, 35, 39, 40, 41, 51a, b, 59a, b. Challenge: try 58.

Section 2.4 (p. 86 – 89): 3 – 10, 15, 19, 21, 27, 30, 35, 39, 43, 45, 47, 49, 50a – c.

Lecture 8: Inverses and Logarithmic Functions
Reading: Section 2.5
Exercises Section 2.5 (p. 98 -- 99): 5, 6, 7, 9, 11, 15, 17, 19, 21, 23, 24, 25, 26, 31, 34, 35, 41, 45, 47, 48, 49, 51, 53, 56, 59, 61, 65, 69, 70, 72.

Lecture 8 Additional Exercises: 1) Let $f(x) = \sqrt[3]{3x-1}$ and let $g(x)$ be a one-to-one function with $g^{-1}(4) = 2$. If the graph of g contains the point $(-2,-1)$ find: a. $g(2)$ b. $f^{-1}(-1) + g(-2)$ c. $g(f(3))$
d. Find an expression for $f^{-1}(x)$. Find its range and domain.
2) For each one-to-one function listed, find a formula for the inverse function and its domain. Remember that the domain of the inverse function is the range of the original function.
a. $f(x) = \frac{x-1}{2+x}$ b. $g(x) = \sqrt{3-x}$ c. $h(x) = e^{2x+1}$
3) Sketch the graph of $f(x) = e^{x-1} + 4$ and $g(x) = \ln(x-4) + 1$ on the same set of axes. Show at least one point and any asymptotes on each graph. Then verify that f and g are inverse functions by showing that
$f(g(x)) = g(f(x)) = x$.

Lecture 9: Applications of Exponential and Logarithmic Functions
Reading: Section 2.5 and Section 2.6
Exercises Section 2.5 (p. 99 -- 101): 75a, d, 77, 79, 84 (take logarithm base b of equation $y = nx^m$, rewrite and substitute), 87, 89, 91 (use formula from problem 90).
Section 2.6 (p. 107 -- 110): 2 – 5, 11, 13, 19, 23, 29, 35, 37, 39.

Lecture 10: Introduction to Limits
Reading: Section 3.1 (p. 122 – 128)
Exercises Section 3.1 (p. 135 -- 139): 5 – 11, 13, 15, 17, 19, 55*, 56*, 57, 63(figures on pages 131 and 132), 64, 65, 67, 73a, 82, 83, 91(consider the graph of $f(x) = e^{-x}$). *graph the function to evaluate the limit

Lecture 11: Evaluating Limits Algebraically, Limits at Infinity
Reading: Section 3.1 (p. 128 – 135)
Exercises Section 3.1 (p. 135 -- 139): 1 – 3, 24, 25, 27, 28, 29, 33, 35, 37, 39, 41, 45, 47, 49, 51, 81, 85, 87, 89.

Lecture 12: One-Sided and Unbounded Functions, Continuity
Reading: Section 3.1 (p. 122 -- 127), Section 3.2
Exercises Section 3.1 (p. 135 -- 139): 4, 20, 55*, 56*, 61, 62
*find the limits algebraically; compare to their graphs from Lecture 10
Section 3.2 (p. 146 – 148): 1, 3, 5, 7, 9, 12, 19, 21, 23, 33 (be sure to find $\lim_{x\to 4^-} g(x)$; $\lim_{x\to 4^+} g(x)$; $\lim_{x\to 4} g(x)$; $\lim_{x\to 2^-} g(x)$; $\lim_{x\to 2^+} g(x)$; $\lim_{x\to 2} g(x)$), 34 (figure 8 is on page 128).

Lecture 13: Continuity and Applications
Reading: Section 3.2
Exercises Section 3.2 (p. 146 -- 148): 13, 17, 27, 28, 29, 35, 39.
Additional Exercises: 1) Find each point of discontinuity of $f(x) = \frac{x^2-2x}{x^3+x^2-6}$ and classify as removable or nonremovable. Can you define $f(x)$ to make it continuous at any of those points of discontinuity? If not, state why.
2) Find each point of discontinuity of $f(x) = \frac{x^2-2x}{|x-2|}$ and classify as removable or nonremovable. First rewrite $f(x)$ as a piecewise defined function without absolute value bars. What is $\lim_{x\to 2^-} f(x)$ and $\lim_{x\to 2^+} f(x)$? Sketch the graph of $f(x)$.
3) Let $f(x) = \begin{cases} x^2 - 1 & x < -1 \\ |x-1| & -1 < x < 2. \\ 3 - x & x > 2 \end{cases}$ Find and describe all discontinuities of $f(x)$. Define $f(-1)$ and $f(2)$ to make f continuous at $x = -1$ and $x = 2$ if possible. Sketch the graph of $f(x)$.
4) Let $f(x) = \begin{cases} \frac{\sqrt{x^2+3x}-2}{x-1}, & x \neq 1 \\ -3, & x = 1 \end{cases}$. Find each discontinuity of $f(x)$ and classify as removable or non-removable. Hint: find $\lim_{x\to 1} f(x)$.
5) Use the Intermediate Value Theorem to show that the function $f(x) = 1 - x - \sqrt{x}$ has at least one zero (a value *c* so that $f(c) = 0$) on the interval $(0, 1)$.

Lecture 14: Rates of Change
Reading: Section 3.3
Exercises Section 3.3 (p. 158 -- 161): 3, 5, 11, 17, 19, 23, 24, 25, 27, 29, 30a—d, 33, 35, 39, 42.

Lecture 15: Definition of the Derivative
Reading: Section 3.4 (p. 162 – 173)
Exercises Section 3.4 (p. 176 -- 179): 1, 3, 4, 7, 9, 10, 15, 17, 21, 24, 25, 39, 48a, b, 49, 51, 58, 61.

Lecture 16: Differentiability, Graphical Differentiation
Reading: Section 3.4 (p. 173 -- 175), Sec. 3.5
Exercises Section 3.4 (p. 176 -- 179): 2, 16, 35 – 38, 40.
Section 3.5 (p. 184 -- 186): 1, 7, 10, 11, 13, 17, 22, 23.

Lecture 17: Basic Rules of Differentiation
Reading: Section 4.1
Exercises Section 4.1 (p. 207 – 211): 3, 13, 15, 17, 20, 23, 24, 26, 33, 37, 43, 45, 46, 47, 53, 54, 56, 65a, b, 67, 71.

Lecture 18: Product and Quotient Rules
Reading: Section 4.2
Exercises Section 4.2 (p. 216 -- 218): 3, 7, 13, 21, 23, 29, 33, 35, 36, 41a, c, d, 43, 45, 49, 51.

Lecture 19: The Chain Rule
Reading: Section 4.3
Exercises Section 4.3 (p. 225 -- 227): 14, 20, 23, 27, 31, 33, 37, 41, 43, 45, 47, 49, 52, 54a, d, e, 55a, 59, 61, 65a, b.

Lecture 20: Implicit Differentiation
Reading: Section 6.4
Exercises Section 6.4 (p. 334 -- 336): 3, 7, 11, 19, 21, 27, 31, 33, 35, 37, 39, 42, 43, 49.

Lecture 21: Related Rates
Reading: Section 6.5
Exercises Section 6.5 (p. 341 -- 343): 3, 5, 9, 11, 13, 17, 21, 23, 24, 25, 28, 31, 32.

Lecture 22: Derivatives of Exponential Functions
Reading: Section 4.4
Exercises Section 4.4 (p. 232 -- 236): 11, 15, 17, 21, 23, 29, 31, 35, 39, 41a, b, e, f, g, 43a*, b, e, 56a, d, 59a, 61a, b. *$G(t) = \frac{250}{1+124e^{-0.45t}}$

Lecture 23: Derivatives of Logarithmic Functions
Reading: Section 4.5
Exercises Section 4.5 (p. 240 -- 243): 5, 7, 13, 15, 23, 25, 31, 37, 45, 46, 50, 54, 57, 59, 65.

Lecture 24: Increasing and Decreasing Functions
Reading: Section 5.1
Exercises Section 5.1 (p. 260 -- 262): 3, 7, 9, 11, 15, 19, 21, 25, 26, 29, 30, 31, 35, 37, 38, 41, 45, 46, 47, 55, 59, 62.

Lecture 25: Relative Extrema
Reading: Section 5.2
Exercises Section 5.2 (p. 271 -- 273): 3, 7, 9, 11, 15, 17, 23, 25, 27, 33, 36, 41, 43, 47, 49, 55, 57.

Lecture 26: Higher Derivatives and Concavity
Reading: Section 5.3 (p. 274 – 280)
Exercises Section 5.3 (p. 283 -- 286): 7, 9, 13, 16, 19, 23, 25, 31, 35, 39, 43, 45, 49, 73, 78, 79, 83, 90, 93, 94, 95, try 53

Lecture 27: Curve Sketching
Reading: Section 5.4
Exercises Section 5.4 (p. 294 -- 295): 1, 3, 9, 11, 17, 23, 25, 26, 29, 35, 39.
p. 298 43, 53, 57

Lecture 28: Second Derivative Test; Absolute Extrema
Reading: Section 5.3 (p. 280 – 282) and Sec. 6.1
Exercises Section 5.4 (p. 284, 286): 59, 61, 63, 90 (use the Second Derivative Test to verify).
Section 6.1 (p. 309 – 312): 1, 3, 7, 9, 10, 13, 15, 19, 23, 25, 27, 28, 32, 33, 37, 45, 55.

Additional Problem: For $f(x) = \frac{3x^2+3}{x}$, find

a) all relative extreme values. Use the First Derivative Test (number line), then check your answers with the Second Derivative Test. Hint: rewrite the function before differentiating.
b) all absolute extrema on $(0, 3]$. Consider your number line from (a).

Lecture 29: Applications of Extrema
Reading: Section 6.1 and 6.2
Exercises Section 6.1 (p. 310 – 312): 43, 51, 58.
Section 6.2 (p. 318 -- 322): 3, 5, 7, 11, 13, 15, 19, 21, 23, 24, 31, 33.
Additional Problem: A manufacturer produces a new product at a cost of $45 per unit. When the retail price of the product is $60, monthly sales average 4500 units. Each $2 price increase results in an average of 250 fewer sales per month. Assuming the demand function is linear,

1) Find the demand function $p(x)$.
2) Find the profit function $P(x)$.
3) How many units must be sold to maximize profit? What should the unit price be?

Lecture 30: Elasticity of Demand*; Differentials and Linear Approximation
Reading: Section 6.3 (p. 326 – 329)*; Section 6.6
Exercises Section 6.3 (p. 330): 19, 23, 25, 29, 31.*
Sections 6.6 (p. 348 – 349): 5, 7, 9, 15, 17, 21, 25, 33, 35, 37, 39.
***Optional Section, if time**

Lecture 31: Antiderivatives
Reading: Section 7.1
Exercises Section 7.1 (p. 366 – 368): 1, 2, 4, 11, 17, 21, 25, 27, 31, 33, 35, 39, 43, 45, 49, 51, 55, 57, 61, 63, 67, 69, 71.

Lecture 32: Method of Substitution
Reading: Section 7.2
Exercises Section 7.2 (p. 374 – 376): 1, 2b, c, d, 5, 7, 9, 11, 13, 15, 19, 21, 23, 25, 29, 31, 37, 41, 42, 44.

Lecture 33: Area and the Definite Integral
Reading: Section 7.3
Exercises Section 7.3 (p. 383 -- 388): 1, 3, 7, 9, 13, 14, 15, 17, 19, 23, 25, 27b, 35, 37.

Lecture 34: The Fundamental Theorem of Calculus
Reading: Section 7.4
Exercises Section 7.4 (p. 395 – 398): 5, 7, 9, 13, 19, 25, 27, 28, 29, 31, 33, 36, 37, 43, 45, 46, 47, 51, 53a, b, 55, 57, 61a, 69, 71a – c.

Lecture 35: Area Between Curves
Reading: Section 7.5
Exercises Section 7.5 (p. 405 -- 407): 3, 7, 9, 13, 17, 27, 31, 33, 35, 37, 39, 42.