MAT135H1F – REVIEW CHECKLIST

1. Limits

1.1. Basics.

(1) definition of limits at $a \in \mathbb{R}$, at $\pm\infty$,
(2) vertical and horizontal asymptotes (what are these and how do you find them),
(3) limit laws, substitution property, simple tricks to calculate limits,
(4) squeeze theorem (what is it and how do you apply it).

1.2. L'Hospital's rule.

(1) statement,
(2) types of indeterminate forms (quotients, differences, products and powers),
(3) how to deal with these indeterminate forms (i.e. transoforming powers to products by taking ln).

1.3. Important limits.

(1) rational functions, a^x when $a < 1$ or $a > 1$ and $x \to \pm\infty$,
(2) $\dfrac{e^x}{\text{polynomial}}$, $\dfrac{\ln(x)}{\text{polynomial}}$,
(3) $\dfrac{\sin(x)}{x}$ and $\dfrac{1-\cos(x)}{x}$.

1.4. Continuity.

(1) definition,
(2) types of discontinuities, examples and their graphs,
(3) sums, products and compositions of continuous functions are continuous,
(4) IVT and how to apply it to find roots of continuous functions.

2. Differentiation

2.1. Basics.

(1) definition of the derivative,
(2) meaning of the derivative as the slope of tangent, velocity, marginal cost and instantaneous rate of change,
(3) equation of tangent lines,
(4) differentiable implies continuous but not the other way. Example!

You have to know the derivatives of elementary functions and their inverses back and forth!

2.2. **Rules of differentiation.**

(1) product rule,
(2) quotient rule,
(3) chainrule (!).

2.3. **Implicit differentiation.**

(1) how to find tangent lines to curves given by implicit formulas,
(2) finding the derivative of inverses,
(3) differentiating complicated formula using logartihmic differentiation,
(4) derivatives of $f(x)^{g(x)}$ type functions (logarithmic differentiation).

2.4. **Rolle's theorem and MVT.**

(1) statement of Rolle's theorem and the MVT,
(2) consequences about functions with 0 derivative and functions with equal derivative,
(3) how do you apply Rolle's theorem to show that a function only has at most 1, 2, 3... roots?

3. Applications

3.1. **Finding local max and mins.**

(1) what are critical points,
(2) definition of local and global extreme values,
(3) definition of concave up and down, inflection points,
(4) EVT and Fermat's theorem,
(5) closed interval method,
(6) 1st derivative test for local max and min,
(7) 2nd derivative test for local max and min.

3.2. **Exponential growth and decay.**

(1) exponential growth model and the relative rate of growth,
(2) radioactive decay model and half-life,
(3) what is the number e?
(4) continuously compounded interest.

3.3. **Optimization.**

(1) how to find global maxima and minima?
(2) first derivative test for global max and mins,

3.4. **Related Rates.**

(1) How to connect the known and unknown quantities?
(2) Implicit differentiation for the rates of change.

3.5. **Sketching curves.**

(1) definition of increasing and decreasing,
(2) checklist for sketching curves (!),
(3) increasing, decreasing test (sign of the 1st derivative),
(4) testing concavity and finding inflection points (sign of 2nd derivative),
(5) how to find vertical, horizontal and slant asymptotes.

3.6. **Antiderivatives.**

(1) what is an antiderivative? (definition),
(2) antiderivatives of the simplest functions (see textbook).