Mathematics 1 – Term Syllabus

UPC - 2015

Based on *Calculus, Early Transcendentals*, Sullivan, Miranda, 2014; Freeman.

Lecture	**Sections**	**Topic**
Day 1		Functions: definition, domain, range. Definition of a sequence; examples. Operations on functions: sum, difference, product, quotient, composition.
Day 2		Identifying functions by a graph. Inferring properties of function from graph: domain, range, intercepts, increasing, decreasing. Even and odd functions. Sequences: increasing, decreasing, bounded.
Day 3		Average rate of change of a function: algebraic and geometric interpretations, applications. Library of functions: constant, linear, power, polynomial, rational function, algebraic functions, floor and ceiling functions.
Day 4		Constructing a function which describes a model; building a function from data. Lagrange interpolation; regression (just a hint or black box)
Day 5		Geometric interpretation of composite functions: Graphs of $y = f(ax + b) + c$ versus $y = f(x)$. Recognizing a function as a composite (will need for chain rule). What does the family of curves $y = x^a$ look like as a varies?
Day 6		Injective functions and inverses; graphing the inverse function. Exponential functions, a^x, and logarithmic functions, $\log_a x$. Solving equations with logarithms and exponentials.

Day 7		Trigonometric functions: Sine, cosine, tangent; amplitude, period, graphs; right triangles and unit circle definitions. Graphs of $y = a\sin(\omega x + t)$, etc.
Day 8		Inverse trigonometric functions; algebraic expressions for composites like $\sin(\tan^{-1} u)$. Solving trigonometric equations: e.g., $\tan\theta = 1$.
Day 9		For the brave: complex numbers, complex exponential, Euler's identity; Solving $z^n = \omega$ in $\mathbb{C}$.
Day 10		Revisit sequences. Monotone, bounded, limits and convergence (informal); can they infer that bounded, monotone sequences should converge? Other sequences: $\{\sin(n)\}$ or $\{\sin(n)/n\}$; squeeze theorem inferred. Comparison test inferred.
Day 11		What is a rigorous definition of a convergent sequence? Is a convergent sequence bounded? For what real values of r does $\{r^n\}$ converge?
Day 12		Limits of functions using numerical and graphical techniques. Limits at infinity; asymptotes.
Day 13		Limits of functions (definition) and properties.
Day 14		Continuity at a point; determining the domain on which a function is continuous.
Day 15		Limits and continuity of trigonometric, exponential, and logarithmic functions. Squeeze theorem.
Day 16		Rates of change and the derivative (at a point). The tangent line.
Day 17		The derivative as a function. Identify functions with no derivative at points of their domain.

Day 18		Basic rules for derivatives. The derivative of monomials, e^x, and polynomials.
Day 19		Product and Quotient Rules; higher order derivatives.
Day 20		Derivatives of trigonometric functions.
Day 21		Chain rule.
Day 22		Implicit differentiation. Derivatives of inverse trigonometric functions.
Day 23		Derivatives of logarithmic functions
Day 24		Application: Bachet duplication formula
Day 25		Application: Newton's Method
Day 26		Linear Approximation; application motion of a pendulum.
Day 27		Taylor Polynomials
Day 28		Approximation via Taylor polynomials. How does a calculator compute values of sine, cosine, e^x, etc?
Day 29		Wrap it up.