1056-11-936 **Sam Elder*** (`same@caltech.edu`), MSC 385, Pasadena, CA 91126. *Flat Cyclotomic Polynomials: A New Approach.*

The *height* of a polynomial is its greatest coefficient in absolute value. Polynomials of unit height are *flat*. The *cyclotomic polynomial* $\Phi_n(x)$ is the minimal polynomial of any primitive nth root of unity. The *order* of $\Phi_n(x)$ is the number of distinct odd primes dividing n. All cyclotomic polynomials of orders 0, 1 and 2 are flat, and some of orders 3 and 4 are flat as well.

In this paper, we build a new theory for analyzing the coefficients of $\Phi_n(x)$ by considering it as a gcd of simpler polynomials. We first obtain a generalization of a result known as periodicity: If n is a positive integer and s and t primes such that $n - \varphi(n) < s < t$ and $s \equiv \pm t \pmod{n}$, then $\Phi_{ns}(x)$ and $\Phi_{nt}(x)$ have the same height.

We also use this theory to provide two new families of flat cyclotomic polynomials. One, of order 3, was conjectured by Broadhurst: Let $p < q < r$ be primes and w a positive integer such that $r \equiv \pm w \pmod{pq}$, $p \equiv 1 \pmod{w}$ and $q \equiv 1 \pmod{wp}$. Then $\Phi_{pqr}(x)$ is flat. The other is the first general family of order 4. We prove that $\Phi_{pqrs}(x)$ is flat for primes p, q, r, s where $q \equiv -1 \pmod{p}$, $r \equiv \pm 1 \pmod{pq}$, and $s \equiv \pm 1 \pmod{pqr}$. (Received September 18, 2009)