1125-35-107 **Wenqiang Feng*** (wfeng1@utk.edu), Department of Mathematics, The University of Tennessee, Knoxville, TN 37996, **Cheng Wang** (cwang1@umassd.edu), Department of Mathematics, The University of Massachusetts, North Dartmo, North Dartmouth, MA 02747, and **Steven Matthew Wise** (swise1@utk.edu), Department of Mathematics, The University of Tennessee, Knoxville, TN 37996. *An Energy Stable Finite-Difference Scheme for Functionalized Cahn-Hilliard Equation and its Convergence Analysis.* Preliminary report.

We present and analyze an unconditionally energy stable and convergent finite difference scheme for the Functionalized Cahn-Hilliard and the Cahn-Hilliard-Willmore equations. One key difficulty associated with the energy stability is based on the fact that, one nonlinear energy functional term in the expansion appears as non-convex, non-concave. To overcome this subtle difficulty, we add two auxiliary terms to make the combined term convex, which in turns yields a convex-concave decomposition of the physical energy. As a result, an application of the convex splitting methodology assures both the unique solvability and the unconditional energy stability of the proposed numerical scheme. To deal with a 4-Laplacian solver in an H^{-1} gradient flow at each time step, we apply an efficient preconditioned steepest descent algorithm to solve the corresponding nonlinear systems. In addition, a global in time H^2_{per} stability of the numerical scheme is established at a theoretical level, which in turn ensures the full order convergence analysis of the scheme. A few numerical results are presented, which confirm the stability and accuracy of the proposed numerical scheme. (Received July 29, 2016)