Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Non-equilibrium Thermodynamics: Residual Entropy, Internal Variables, Maxwell Relations, and the Prigogine-Defay Ratio PURU GUJRATI, The University of Akron — We extend a recently formulated [Phys. Rev. E 81, 051130 (2010)] non-equilibrium thermodynamic approach to an inhomogeneous system consisting of many smaller subsystems, each in internal equilibrium; their relative motions result in viscous effects. The correct Gibbs free energy of a subsystem contains the temperature and pressure of the medium, making our approach an extension of the classical non-equilibrium thermodynamics due to de Donder. The additivity of entropy requires quasi-independence of subsystems, so that the energy also becomes additive. We use Gibbs' entropy of the isolated system to derive the entropy for the system even when the latter is out of equilibrium. We use this entropy to discuss the residual entropy when the system is confined to one of the components in the phase space. The approach is extended to include internal variables that cannot be controlled by the observer during non-equilibrium evolution. We then identify the form of non-equilibrium Maxwell relations. We apply our formalism to evaluate the Prigogine-Defay ratio in glasses, which is found to be, in general, different from 1 at the apparent glass transition, as is normally seen in experiments.

Puru Gujrati
The University of Akron

Date submitted: 19 Nov 2010 Electronic form version 1.4