**Oral Qualifying Exam - Dynamics of Macromolecular Fluids**

**Topics Covered:** basic physical understanding of the fundamental dynamical behavior and properties, and relation to structure and interactions, of both colloidal suspensions and polymer liquids mainly in the linear response regime. The student is also responsible for the limit amount of relevant equilibrium knowledge required to describe and understand polymer and colloid dynamics.

**Non-exhaustive topical areas:**

* Elementary mechanics, solids vs liquids, elementary constitutive equation, measurement principle of viscosity and diffusion constant
* Brownian motion, time correlation functions, direct forces, fluctuating forces, Stokes-Einstein drag, colloidal dynamics in dilute suspensions
* Interparticle structure of colloidal fluids
* Single particle vs collective diffusion, viscosity, stress relaxation in time & frequency domains
* Slow dynamics in concentrated colloid suspensions, hard sphere colloids, the cage

effect, colloidal glass transition, role of attractive van der Waals and Coulomb forces

* Basic idea of origin of shear thinning, effective Peclet number
* Physical kinetic gelation of colloidal suspensions, elasticity, yielding
* Qualitative conformational structure of dense polymer melts, interchain interpenetration, packing length, chemical trends, impact on entanglement elastic modulus
* Dynamics of unentangled polymer melts, experimental behaviors, Rouse model, role of chain connectivity, segmental friction constant and temperature effects
* Dynamics of entangled linear chain polymer melts, experimental phenomena, reptation-tube model, predictions for anisotropic diffusion, relaxation and flow
* Role of polymer architecture on entangled dynamics (e.g., branching)

Suggested Texts:

There is no standard text on colloids and general part of the course. Two somewhat useful books are:

Russel, Saville and Schowalter, "Colloidal Dispersions"

Larson, "Structure and Rheology of Complex Fluids".

For the polymer part of the course, an excellent book is Rubinstein and Colby, “Polymer Physics”

**Related course:** MSE583: Dynamics of Complex Liquids