1 Introduction

AKA Soft Condensed Matter Physics (MC mai ghoom phir ke CMP pe aa gya). Course content

1. Intro to soft matter
2. Viscoelasticity
3. Colloids
4. Polymers
5. Surfactants
6. Liquid Crystals

Books

- Soft Matter Physics (Richard Jones)
- Soft Matter Physics (Masao Doi)
- Introduction to the Theory of Soft Matter (Jonathan Selinger) [liquid crystals]

So, there's three adjectives in front of the word 'Physics'.

1.1 Matter

Composed of atoms or molecules. Matter refers to collections of atoms and molecules. Don't go about referring to a single atom as 'matter'.

It is expected that when we say 'matter', we have a very large ($\approx N_A$) number of building components.

So, how does one go about dealing with such systems? Statistical physics. Your Hamiltonian formalism and Newton's equations will shit the bed.

Solid systems and gaseous systems are easy to deal with for Physicists, because some really neat approximations can be made. In liquids, however potential energy $\approx$ kinetic energy.

[Missed some part of the lecture]

An example of Helium's phase diagram was given. There is a critical pressure below which it cannot exist in the liquid state. Point was $P > 0$ for the existence of liquid, or something like that. You need pressure for the existence of liquids.

You see, the world is not just made up of solid, liquid and gas only. Like what the fuck even is the phase of toothpaste and shampoo??

- Solid
  - Translational order
  - translationally broken symmetry
  - broken rotational symmetry
- Fluid
  - Translationally disordered

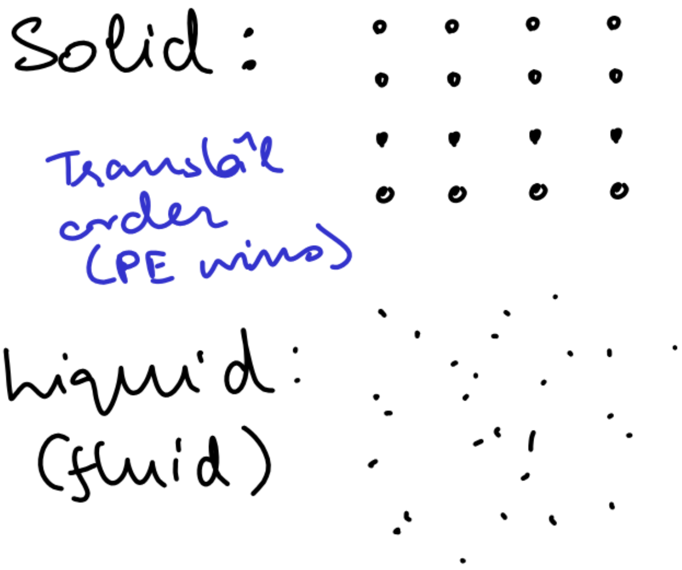

Figure 1: Fluids vs solids - order

  - translationally symmetric
  - rotational symmetries preserved

Deformations are not energetically favourable in solids and hence any attempts to move particles by shearing, compressing etc will result in strong restoring forces.

Fluids on the other hand have 0 elastic moduli

Then we have soft matter systems, where the elastic moduli are somewhere in between the above two cases.

Systems like liquid crystals are again quite unique because

- Rotational order
- No translational order

BTW time scales matter. Phase diagrams don't show time, only thermodynamic parameters. But, we generally think of different phases like solids, liquids etc in terms of their response funcions - their dynamics. If something is hard, it's solid. If something flows, it's liquid. Phase diagrams do not really capture the dynamics properly.

1.2 Grading

- Home assignments - 33%
- Midsem - 33%
- Endsem - 33%