FOUR LECTURES ON THE DYNAMICAL THEORIES FOR LIQUID CRYSTALS

EPIFANIO G. VIRGA

1. Phenomenological Preliminaries

Liquid crystals are anisotropic fluids that exhibit a birefringence typical of uniaxial crystals. This lecture will present the optical properties of these most extraordinary fluids and show how those properties are related to the measures of the mesoscopic order that inhabits these fluids.

2. Dissipation Principle

Liquid crystals are *dissipative* complex fluids. This lecture will extend Rayleigh's classical principle from its original formulation in Lagrangian mechanics to the generalized continuum mechanics context envisaged here.

3. Director Theories

The Ericksen-Leslie theory is perhaps the most successful dynamical theory for liquid crystals. In this lecture, we shall derive it within the general theoretical framework outlined in Lecture 2 and discuss the balance laws for the dynamical actions exerted on the director $\boldsymbol{n}$, which is the mesoscopic descriptor of order employed in this theory.

4. Order Tensor Theories

A more detailed description of the mesoscopic order in liquid crystals is afforded by a symmetric, traceless tensor $\mathbf{Q}$ first introduced by de Gennes. A full dynamical theory can also be developed in this more general framework, where the balances of dynamical actions are trickier to interpret. This final lecture will attempt to navigate the student in this more slippery territory, with a possible excursion into biaxial nematic liquid crystals.

Bibliographical material. All four lectures are based on the book

A. M. Sonnet & E. G. Virga, *Dissipative Ordered Fluids: Theories for Liquid Crystals*, Springer, New York, USA, 2012.

Department of Mathematics, University of Pavia, Italy.
E-mail address: eg.virga@unipv.it

Date: April 16, 2018.