Introduction

Reaction-Diffusion equations and systems are widely used in many areas in physics and other fields. In particular, they arise ubiquitously in mathematical modeling in biology and ecology. These equations are particularly suited to describing propagation or invasion phenomena. The class of special solutions, called “Traveling waves” (TW), plays a major role in understanding the dynamical properties of these equations. In this series of lectures, I will present the fundamental results regarding existence and uniqueness of these solutions according to the type of equations. Determining the speeds of TWs is an essential question and I will show various formulae that characterize the minimal speed. I will also discuss systems and some related equations. The only prerequisite for this course is essentially basic knowledge of ordinary differential equations (ODEs).

Plan of the course

1. Reaction-diffusion equations and traveling waves
2. Construction of TW: the bounded interval approximation
3. Bistable and ignition equations

4. Positive and Fisher-KPP non-linearities
5. Uniqueness and comparison properties
6. Multi-stable equations
7. Formulas for the minimal speed
8. Traveling waves for systems of reaction-diffusion equations