MATHEMATICAL MODELS OF MICROBIAL SPECIES
COMPETING FOR NUTRIENTS AND LIGHT

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Abstract. In the three lectures I shall present my works on the analysis of the mathematical models of the phytoplankton dynamics in a chemostat (a laboratory idealization of nature for population studies) and water column in ocean and lakes. Phytoplankton species consume 60% carbon dioxides on earth. Thus it is an important subject in the area of marine biology and aquatic ecology to study the ecological properties of various phytoplankton species. In the lectures I shall also propose some open problems.

Lecture I : Mathematical models of microbial species competing for nutrients and light in a chemostat.

(1) Simple chemostat equation for single limited nutrient with fixed yields. Holling-type functional response, general monotone and non-monotone functional response.

(2) Two species competing for two complementary (or two substitutable) nutrients in a simple chemostat

(3) Droop model: Variable yields model for single nutrient and multiple nutrients.

Lecture II: Mathematical models of microbial species competing for nutrients in an unstirred chemostat and their application to river ecology.

(1) PDE models of competition of two species for a single resource in an unstirred chemostat.

(2) Variable yields PDE models

(3) Application to PDE models of competition of two species for nutrients in river ecology.

Lecture III: Mathematical models of microbial species competing for nutrient and light in a water column.

(1) PDE models of the competition of species for nutrients in a water column

(2) Nonlocal PDE models of the competition of species for light in a water column

(3) Nonlocal PDE models of competition of species for nutrient and light in a water column

(4) Competition of two algal species in a water column with excessive dioxide in the atmosphere.