

**İSTANBUL TEKNİK ÜNİVERSİTESİ  
MATEMATİK BÖLÜMÜ**

**POSITIVE SOLUTIONS OF NONLINEAR OPERATOR  
EQUATIONS**

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**ABSTRACT**

In analyzing the real world phenomena, many mathematical models often give rise to boundary value problems for which only nonnegative solutions make sense. These problems involve nonsingular, or singular (with respect to independent as well as dependent variables), second or higher order partial, ordinary, impulsive, difference or functional differential equations together with some boundary conditions over bounded or unbounded domains. In fact, in the last twenty five years boundary value problems arising in diverse fields such as gas diffusion through porous media, thermal self-ignition of a chemically active mixture of gases in a vessel, catalytic theory, chemically reacting systems and adiabatic tubular reactors, diffusion of heat generated by positive temperature-dependent sources, fluid dynamics, electrical potential theory, combustion theory, steady-state of oxygen diffusion in a cell with Michaelis-Menten kinetics, cell membrane, heat conduction in the human brain, have been studied extensively and for these problems only positive solutions are of practical importance.

In these lectures we plan to provide easily verifiable sufficient conditions which guarantee the existence of positive solutions to several boundary value problems which find applications in (i) circular membrane theory, (ii) the study of plasma physics, (iii) determining the electrical potential in an isolated neutral atom, (iv) modeling phenomena which arises in the theory of shallow membrane caps, (v) the theory of colloids, (vi) The flow and heat transfer over a stretching sheet (vii) the unsteady flow of a gas through a semi-infinite porous medium, (viii) the theory of draining flows, (ix) percolation of water from a cylindrical reservoir into the surrounding soil, (x) slender dry patch in a liquid film draining under gravity down an inclined plane, etc. For each of these problems we shall also provide lower and upper solutions, which provide information on the exact but unknown solutions. The obtained lower and upper solutions have been used successfully to construct approximate solutions.