PREFACE

The work presented in this thesis has been carried out by the author as a part­time research scholar in the Department of Physics, Cochin University of Science and Technology during the period 1991-1998.

Ever since its discovery by Kammerling Onnes in 1911, the phenomena of superconductivity has proved to be of continuing interest both as a challenge to our scientific understanding and as a source of useful technology. More than a decade has elapsed since the discovery of high temperature superconductivity in layered cuprates and still there is no concensus on the microscopic mechanism responsible for high transition temperature in this class of materials. However, independent of the exact nature of the pairing mechanism within the layers, the inter layer coupling determines most of the superconducting properties of a real crystal. Hence there is a great need for a phenomenological model capable of describing the superconducting properties of these compounds.

The thesis deals with the study of superconducting properties of layered cuprates within the frame work of a modified Lawrence-Doniach (LD) model. The thesis is organized in seven chapters. Chapter I is a survey of the phenomena and theories of conventional superconductivity which can serve as a springboard for launching the study of the new class of oxide superconductors and it also includes a chronological description of the efforts made to overcome the temperature barrier. Chapter II deals with the structure and properties of the copper oxide superconductors and also the experimental constraints on the theories of high temperature superconductivity. A modified Lawrence-Doniach type of phenomenological model
which forms the basis of the present study is also discussed. In chapter III, the temperature dependence of the upper critical field both parallel and perpendicular to the layers is determined and the results are compared with d.c. magnetization measurements on different superconducting compounds. The temperature and angular dependence of the lower critical field both parallel and perpendicular to the layers is also discussed. Chapters IV, V and VI deal with thermal fluctuation effects on superconducting properties. Fluctuation specific heat is studied in chapter IV. Paraconductivity both parallel and perpendicular to the layers is discussed in chapter V. Fluctuation diamagnetism is dealt with in chapter VI. Dimensional cross over in the fluctuation regime of all these quantities is also discussed. Chapter VII gives a summary of the results and the conclusions arrived at.

A part of the present investigations has also appeared in the form of following publications


3. *Temperature Dependence of the Critical Fields \( H_{c2} \) and \( H_{c1} \) of Superconductors with Inequivalent Conducting Layers* (communicated to Physica Scripta).

and has also been presented in the following symposia/conferences

1. *Positive Curvature of the Upper Critical Field \( H_{c2} \) of Superconductors*
with Inequivalent Conducting Layers, Conference on Superconductivity, Dec.15-17,1997, University of Hyderabad.