Preface

On the basis of the field theoretical approach Abrikosov and Gor'kov (AG) showed that both nonmagnetic and magnetic impurities act as pair breaking centers which was supported by experiments in low-$T_c$ superconductors [A. A. Abrikosov and L. P. Gor'kov, Zh. Eksp. Teor. Fiz 39 (1960) 1781 (Sov. Phys. JETP 12 (1961) 1243)]. The suppression of the critical temperature is observed in cuprate high temperature superconductors (HTS) by the substitution for Cu and the rare earth sites. The cuprate superconductors like REBa$_2$Cu$_3$O$_{7-y}$ [RE = rare earth] (RE-123) have layered structures which consists of CuO$_2$ planes and charge reservoirs namely Cu-O-Cu chains. Substitution by the divalent transition metals for Cu offers a particularly attractive method of introducing structural disorders. The degradation of superconducting properties is an area of research of immense interest in low temperature physics.

An applied magnetic field also suppresses the critical temperature in cuprate superconductors. Depending upon the strength of the magnetic field the superconducting properties are affected. However, the correlation of several processes related to the degradation mechanisms require studying the experimental transport data of impurity substituted superconductors.
Our objective is to substitute both the magnetic and nonmagnetic impurities of different concentrations at Cu-site which affect the pairing mechanism and superconducting properties in NdBa$_2$Cu$_3$O$_{7-y}$ (NBCO). We investigated the degradation of the critical temperature and several other superconducting properties by using the transport data at several temperatures to explore the mechanism of the degradation as well as other impacts on the superconducting properties.

A huge number of reports on HTS is published so far. In the present thesis we have reviewed several related publications in the first chapter. An outline of the experimental techniques which have been used for this work is summarized in the second chapter. The metal to insulator transition and degradation of superconducting properties in Mn substituted NdBa$_2$Cu$_{3-x}$Mn$_x$O$_{7-y}$ (NBCMO) materials have been discussed in the third chapter. Resistivity, coefficient of magnetoresistance and upper critical field of NBCO and Mn substituted NBCO sample at several magnetic fields have been described in the fourth chapter. The Fifth chapter is related to the investigation of the transport properties of Zn substituted NdBa$_2$Cu$_{3-x}$Zn$_x$O$_{7-y}$ superconductors. In the sixth chapter a brief summary of all major results is presented to highlight the research activities carried out.