Nonintegrated, distributed heterogeneous databases arise for several reasons. First, many of these databases were created before the benefits of integrated databases were well understood. In those days, total integration was not a principal database design goal. Second, the lack of a central database administrator for some enterprises has made it difficult for independent organizations within an enterprise to produce an integrated database suitable for all of them. Third, the large size of many data processing applications has made distribution a necessity, simply to handle the volume of work. Since integrated distributed DBMSs had not been available, it had been necessary to implement applications on different machines. Since different applications often have different performance and functionality requirements, different DBMSs were often selected to run on these machines to meet the different requirements. Many organizations have experienced these problems and so there are many nonintegrated, distributed, heterogeneous databases in the world.

As the number of databases in a large organization grows, it is likely that the new classes of applications emerge which could benefit from the interaction with several databases. While these databases may meet the objectives for which each of them was designed and installed (as a
centralized database for a local application), the difficulty arises when the data at the multiple sites is to be shared by applications executing at different sites.

A principal problem in using databases of this type is that of uniform, integrated access. In such databases, each independent database has its own schema, expressed in its own data model, and can be manipulated only by its own data manipulation language. The fundamental need for uniform, integrated access to such databases arises because users cannot be expected to learn the use of many different DBMSs and the operational differences between them.

To meet this objective and to minimize the impact of existing heterogeneity, it is necessary to use a Distributed Heterogeneous Database Management System (DHDBMS). A DHDBMS is a software system that helps in integrating, nonintegrated, distributed, heterogeneous databases. The basic objective of a distributed heterogeneous database management approach is to present the illusion of an integrated database to users without requiring that the database be physically integrated. It supports database integration across organizational, application and geographical boundaries. A DHDBMS provides a uniform, integrated interface to access, to aggregate and to update information maintained in existing, distributed,
heterogeneous databases. It provides these facilities without changing existing database systems and without disturbing local operations.

Besides, allowing users, an uniform, integrated access to information, a DHDBMS must also be able to restrict access to the information stored in these databases. It is important to ensure that the information entrusted to these systems is protected. A number of cases of misuse involving access to databases keep coming in newspapers and periodicals. The integration of various databases leads to increased requirements for control over the access and manipulation of data because in a DHDBMS environment several databases may be involved.

In a database environment, a multiplicity of users with different security requirements, access a common pool of data of varying sensitivity. This increased level of sharing means that access to the data must be controlled in order to ensure security and privacy. It is therefore necessary that there should be a protection mechanism to restrict access to data to solely authorized users. The process of ensuring that information is accessed only in authorized ways is called access control. Therefore, an access control mechanism is needed in a DBMS so that data objects are accessed only by authorized users.
The advent of DHDBMS further increases the necessity for effective system level data access controls if these systems are to be entrusted with sensitive, proprietary, and operational data. One difference between centralized and distributed database management systems is that the processing sites storing and managing a distributed database may be controlled by different administrative authorities. Till these administrative authorities are fully satisfied about the security of their local databases, they may not agree for integrating their databases in a DHDBMS environment. They would also like to be ensured that there exists an access control mechanism for DHDBMS so that only the authorized users will have control over the access and manipulation of data.

The access control mechanism used for distributed homogeneous database management systems is not applicable in a DHDBMS because of the following two reasons:

1) The component DBMSs in a DHDBMS may have been built using different data models.

2) A DHDBMS uses Global Data Model concept for defining Global Conceptual Schema. This concept is not used in the distributed homogeneous database management systems presently available.
In this thesis, access control problems in a DHDBMS have been studied and an access control mechanism is proposed to solve these problems.

This thesis entitled "Access Control in Distributed Heterogeneous Database Management Systems" is divided into seven chapters. Chapter 1 is on introduction to the thesis. A generalized DHDBMS architecture is presented in chapter 2. Chapter 3 discusses the access control mechanisms for the existing centralized and distributed DBMSs. Chapter 4 describes the proposed access control mechanism for a DHDBMS. Chapter 5 describes implementation aspects of a DHDBMS. Chapter 6 deals with applicability and comparative assessment. Chapter 7 conclude the thesis and suggests future work in this area. A summary of each chapter is given below:

Chapter 1 - Introduction

In this chapter, a brief historical overview is given to present evolution of databases. The need of DHDBMSs is discussed in detail and it is explained that access control in a database is of vital importance. The problems related to access control in a DHDBMS are discussed.

Chapter 2 - DHDBMS Architecture

Chapter 2 deals with DHDBMS design objectives and
need for a DHDBMS architecture. It discusses some prominent semantic database models and the DHDBMS prototypes being developed based on these models. It presents a generalized DHDBMS architecture and describes query processing mechanism in a DHDBMS.

Chapter 3 - Database Security

This chapter briefly discusses different aspects of database security. It describes some important access control mechanisms used in existing centralized and distributed DBMSs. It also describes a content-dependent access control mechanism proposed by C.Y. Wang for a DHDBMS.

Chapter 4 - Access Control in a DHDBMS

In this chapter, an access control model for a DHDBMS is defined. Based on this access control model, an access control mechanism for a DHDBMS is proposed. The proposed access control mechanism supports content-dependent and functional access control policies.

Chapter 5 - Implementation Aspects

This chapter discusses implementation methodology. It also explains a procedure through an example to integrate the local Conceptual Schemas into a Global Conceptual Schema. It also deals with the features required in a Data Definition and Data manipulation language to implement a
DHDBMS.

Chapter 6 - Applicability and Comparative Assessment

This chapter discusses the applicability of the proposed access control mechanism to different DHDBMS prototypes. It is shown that the proposed mechanism is simple and can be implemented without any difficulty in various DHDBMS prototypes. It also compares the proposed access control mechanism with the mechanism proposed by C.Y. Wang. It is shown that the mechanism proposed in this thesis is simple, efficient and general.

Chapter 7 - Conclusion

This chapter summarizes main features of the work carried out in this thesis. It presents observations on the proposed access control mechanism for implementation and discusses its implementation strategy. It also gives directions for future work in the area of access control in a DHDBMS.