



Figure 2.9 Schema diagram for the university database.

2.5 Relational Query Languages

A **query language** is a language in which a user requests information from the database. These languages are usually on a level higher than that of a standard programming language. Query languages can be categorized as imperative, functional, or declarative. In an **imperative query language**, the user instructs the system to perform a specific sequence of operations on the database to compute the desired result; such languages usually have a notion of state variables, which are updated in the course of the computation.

In a **functional query language**, the computation is expressed as the evaluation of functions that may operate on data in the database or on the results of other functions; functions are side-effect free, and they do not update the program state.³ In a **declarative query language**, the user describes the desired information without giving a specific sequence of steps or function calls for obtaining that information; the desired information is typically described using some form of mathematical logic. It is the job of the database system to figure out how to obtain the desired information.

³The term *procedural language* has been used in earlier editions of the book to refer to languages based on procedure invocations, which include functional languages; however, the term is also widely used to refer to imperative languages. To avoid confusion we no longer use the term.