Conceptual Database Design

- Goal of conceptual database design is to create a high-level overview of the data requirements and how they relate to each other, without worrying about how the data will be implemented.
- **Entity-Relationship (ER) data model** is primarily used for **conceptual database design**. It helps in representing the high-level structure of a database by defining **entities, relationships, attributes, and constraints** without focusing on implementation details.
- It is mainly for **business users** and **stakeholders**, as it is intended to be understandable by people who may not have technical expertise.
- Independent of any specific database management system (DBMS).

Conceptual is an **adjective** that describes something at a **high level of abstraction**, focusing on **ideas rather than implementation**.

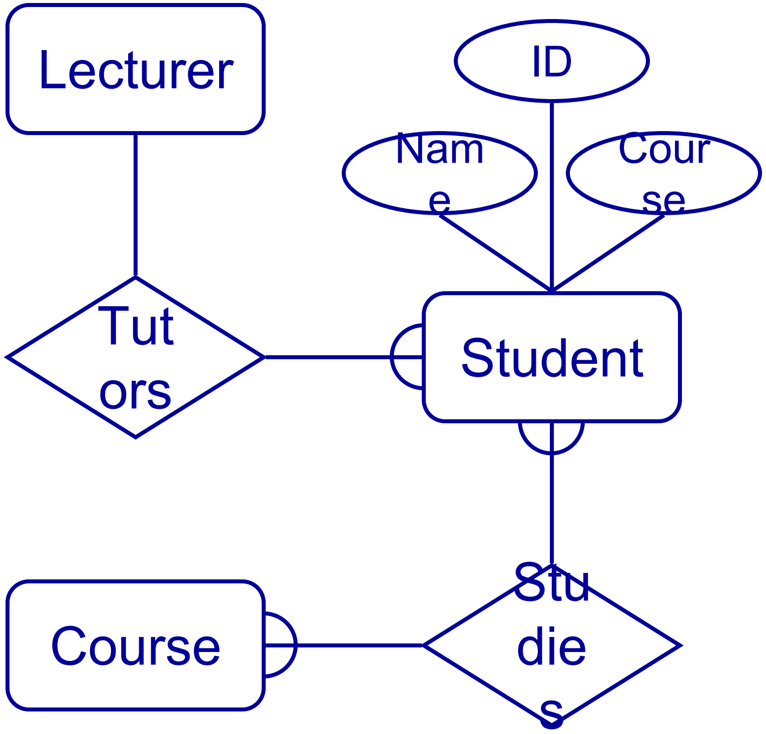
Entity/Relationship Modelling

- E/R Modelling key concepts includes:
  - Entities - objects or items of interest
  - Attributes - facts about, or properties of, an entity
  - Relationships - links between entities

- Example
  - In a University database we might have entities for Students, Courses and Lecturers. Students might have attributes such as their ID, Name, and Degree, and could have relationships with
  - Courses (enrolment)

Entity/Relationship Diagrams

- E/R Models are often represented as E/R diagrams



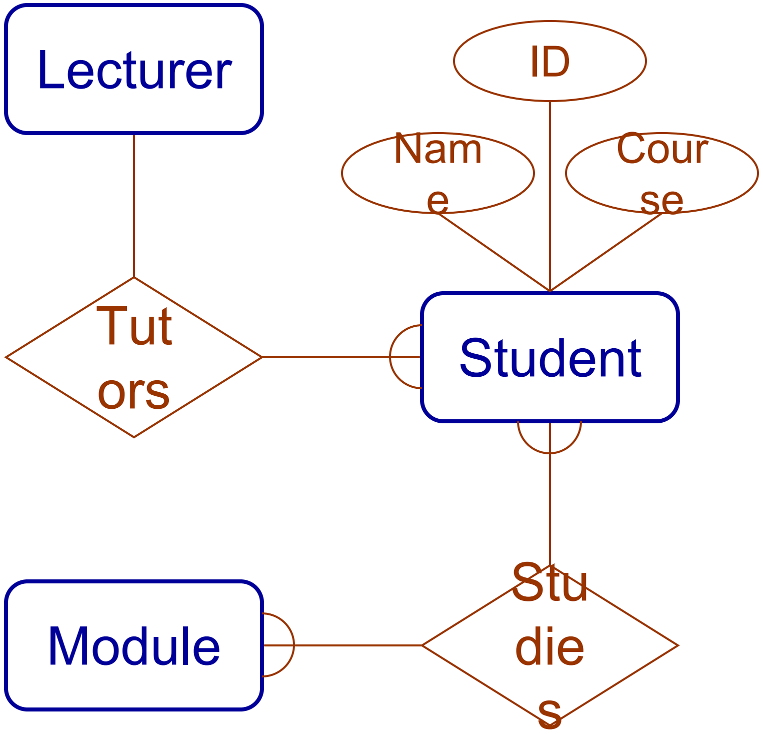
Entities

- Entities represent objects or things of interest
  - Physical (tangible) things like students, lecturers, employees, products
  - Nontangible things like courses, orders, degrees, registrations

- Entities have
  - A general type or class, such as Lecturer or Module
  - Instances of that particular type, such as Asad, Shoaib are instances of Lecturer
  - Attributes (such as name, email address)

Diagramming Entities

- In an E/R Diagram, an entity is usually drawn as a box with rounded corners
- The box is labelled with the name of the class of objects represented by that entity



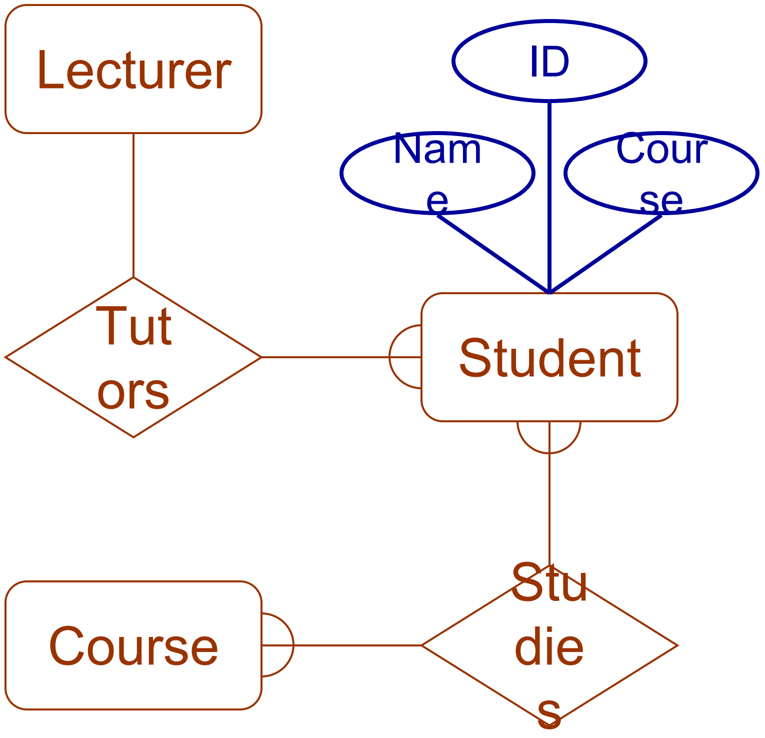
Attributes

- Attributes are facts, properties, or details about an entity
  - Students have IDs, names, degrees, addresses, …
  - Courses have codes, titles, credit weights, levels, …

- Attributes have
  - A name
  - An associated entity
  - Domains of possible values
  - Values from the domain for each instance of the entity they are belong to

Diagramming Attributes

- In an E/R Diagram attributes may be drawn as ovals
- Each attribute is linked to its entity by a line
- The name of the attribute is written in the oval



Relationships

- Relationships are an association between two or more entities
  - Each Student takes several Courses
  - Each Course is taught by a Lecturer
  - Each Employee works for a single Department

- Relationships have
  - A name
  - A set of entities that participate in them
  - A degree - the number of entities that participate (most have degree 2)
  - A cardinality ratio

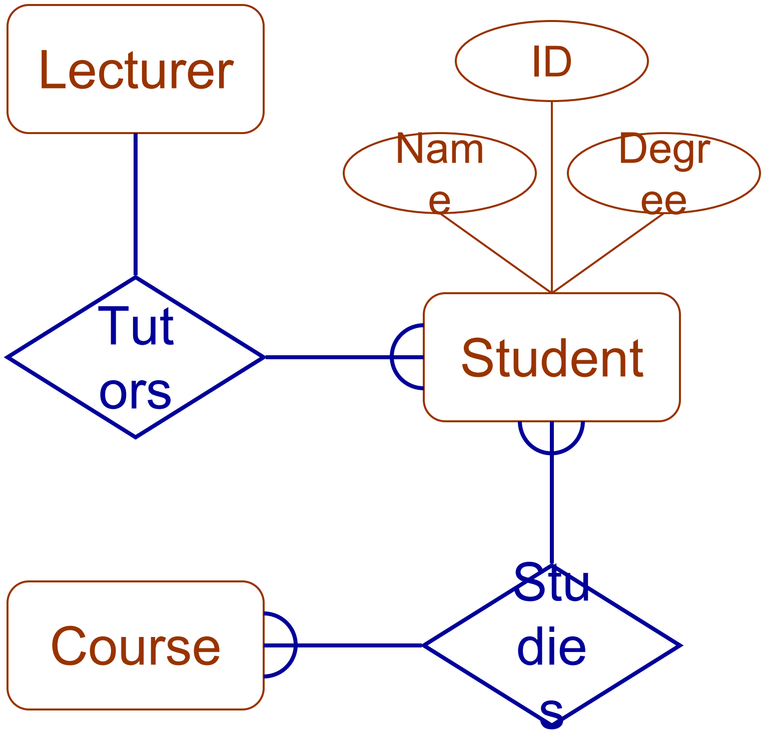
Cardinality Ratios

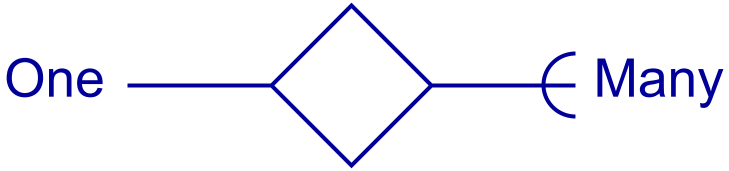
- **Cardinality ratios** define the number of instances of one entity that can be associated with instances of another entity in a relationship.
- This leads to 3 types of relationship…

- One to one (1:1)
  - Each lecturer has a unique office
- One to many (1:M)
  - A lecturer may tutor many students, but each student has just one tutor
- Many to many (M:M)
  - Each student takes several courses, and each course is taken by several students

Diagramming Relationships

- Relationships are links between two entities
- The name is given in a diamond box
- The ends of the link show cardinality





Making E/R Models

- To make an E/R model you need to identify
  - Enitities
  - Attributes
  - Relationships
  - Cardinality ratios
- from a description

- General guidelines
  - Since entities are things or objects they are often nouns in the description
  - Attributes are facts or properties, and so are often nouns also
  - Verbs often describe relationships between entities

Example

A university consists of a number of departments. Each department offers several degrees. A number of courses make up each degree. Students enrol in a particular degree and take courses towards the completion of that degree. Each course is taught by a lecturer from the appropriate department, and each lecturer tutors a group of students

Example - Entities

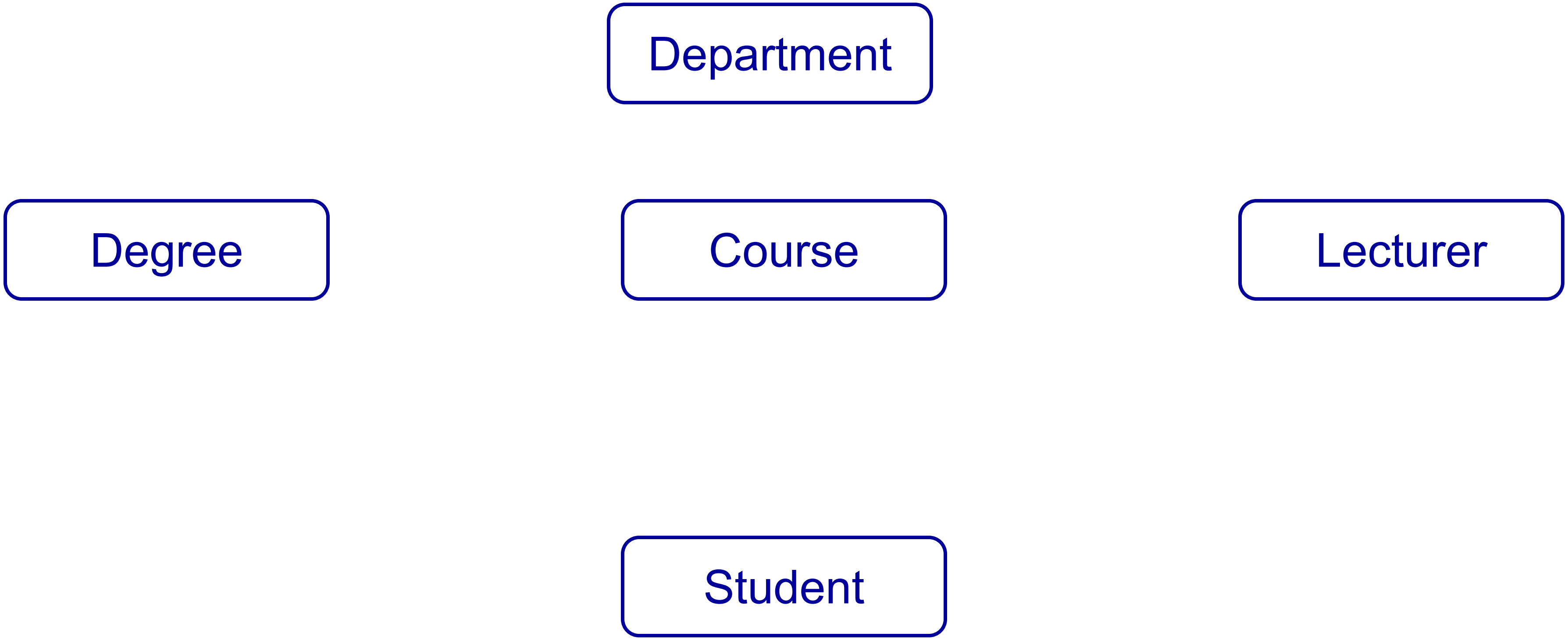
A university consists of a number of **departments**. Each department offers several **degrees**. A number of **courses** make up each degree. **Students** enrol in a particular degree and take courses towards the completion of that degree. Each course is taught by a **lecturer** from the appropriate department, and each lecturer tutors a group of students

Example - Relationships

- A university consists of a number of departments. Each department **offers** several degrees. A number of courses **make up** each degree. Students **enrol in** a particular degree and **take** courses towards the completion of that degree. Each course is **taught by** a lecturer **from the** appropriate department, and each lecturer **tutors** a group of students

Example - E/R Diagram

Entities: Department, Degree, Course, Lecturer, Student



Department

Degree

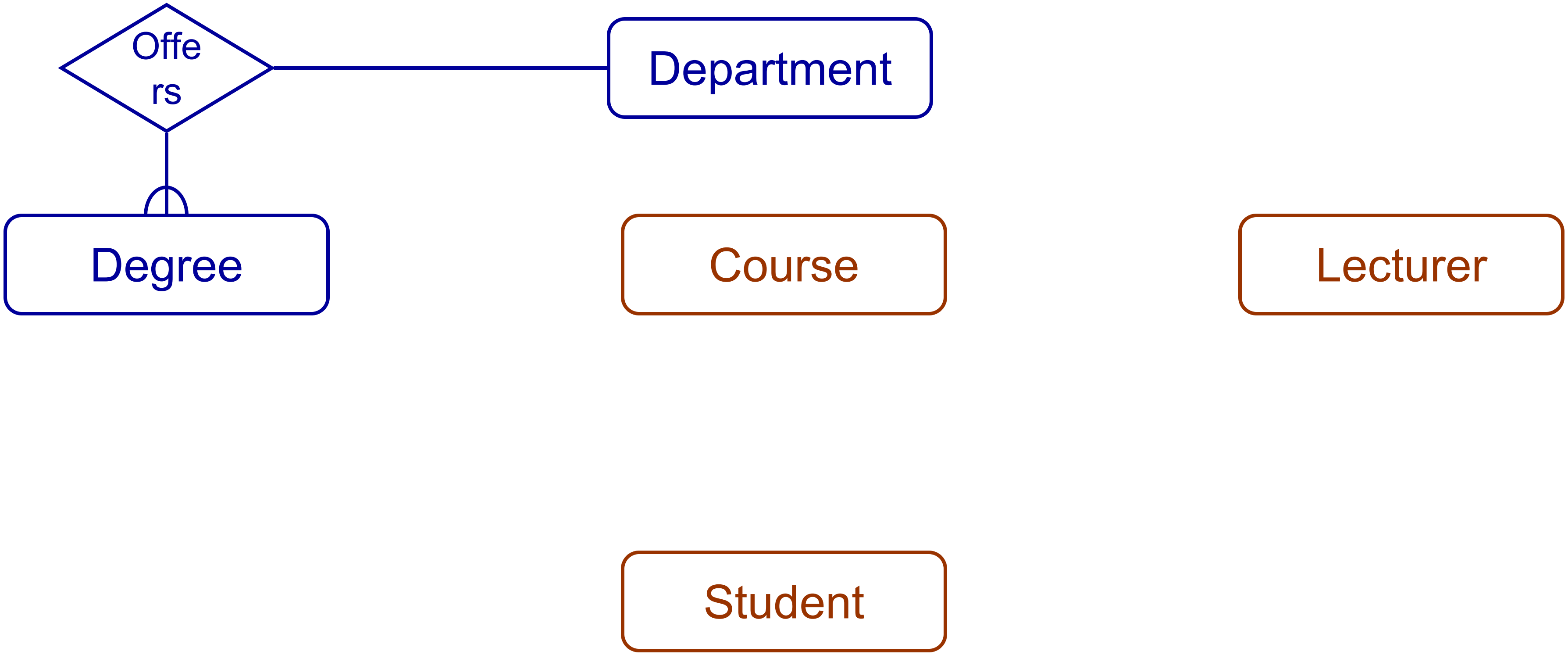
Course

Lecturer

Student

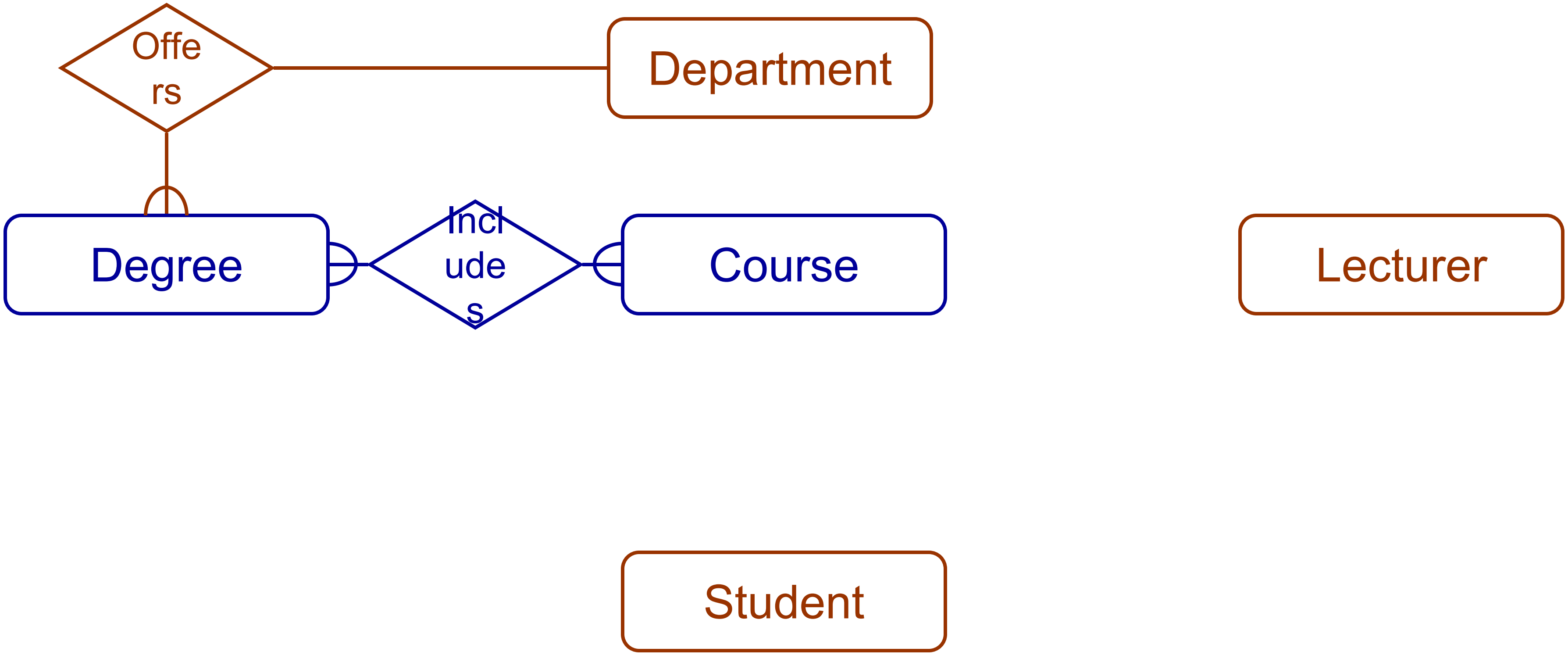
Example - E/R Diagram

Each department offers several courses



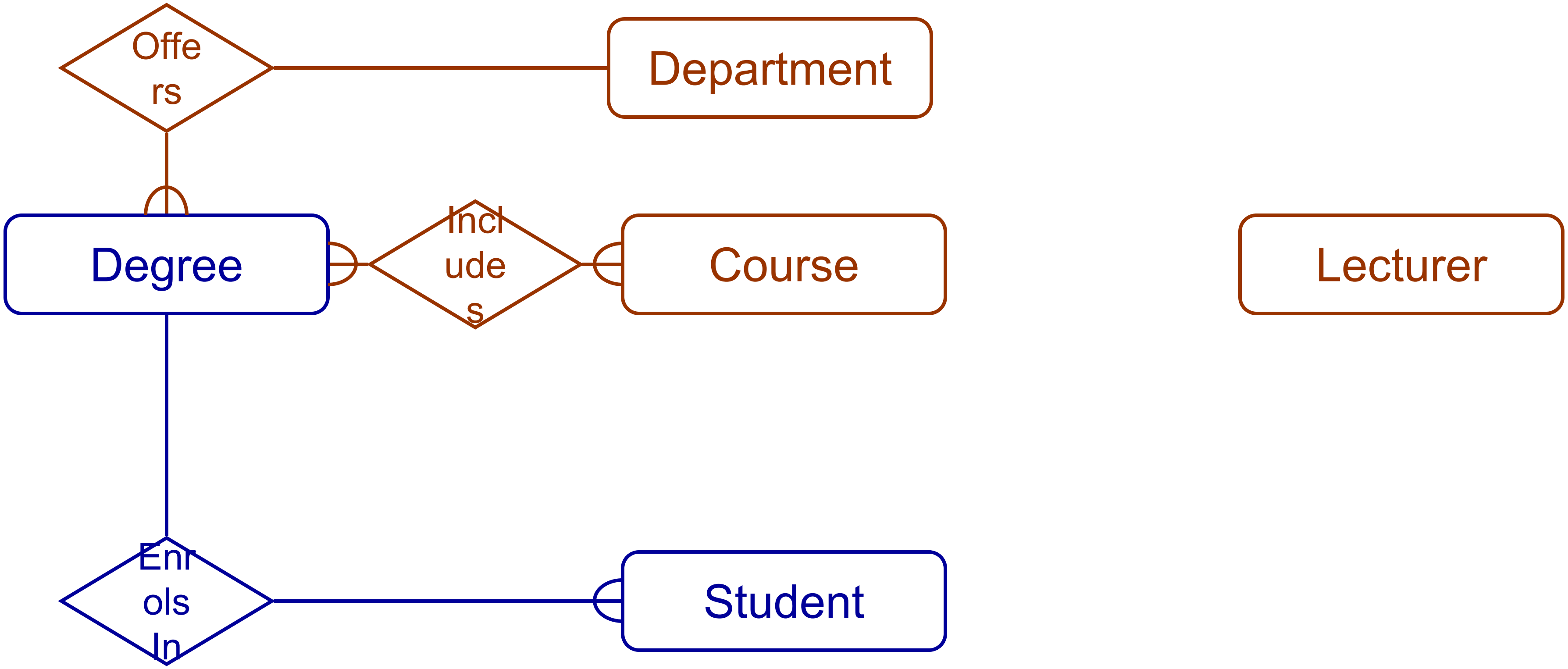
Example - E/R Diagram

A number of modules make up each courses



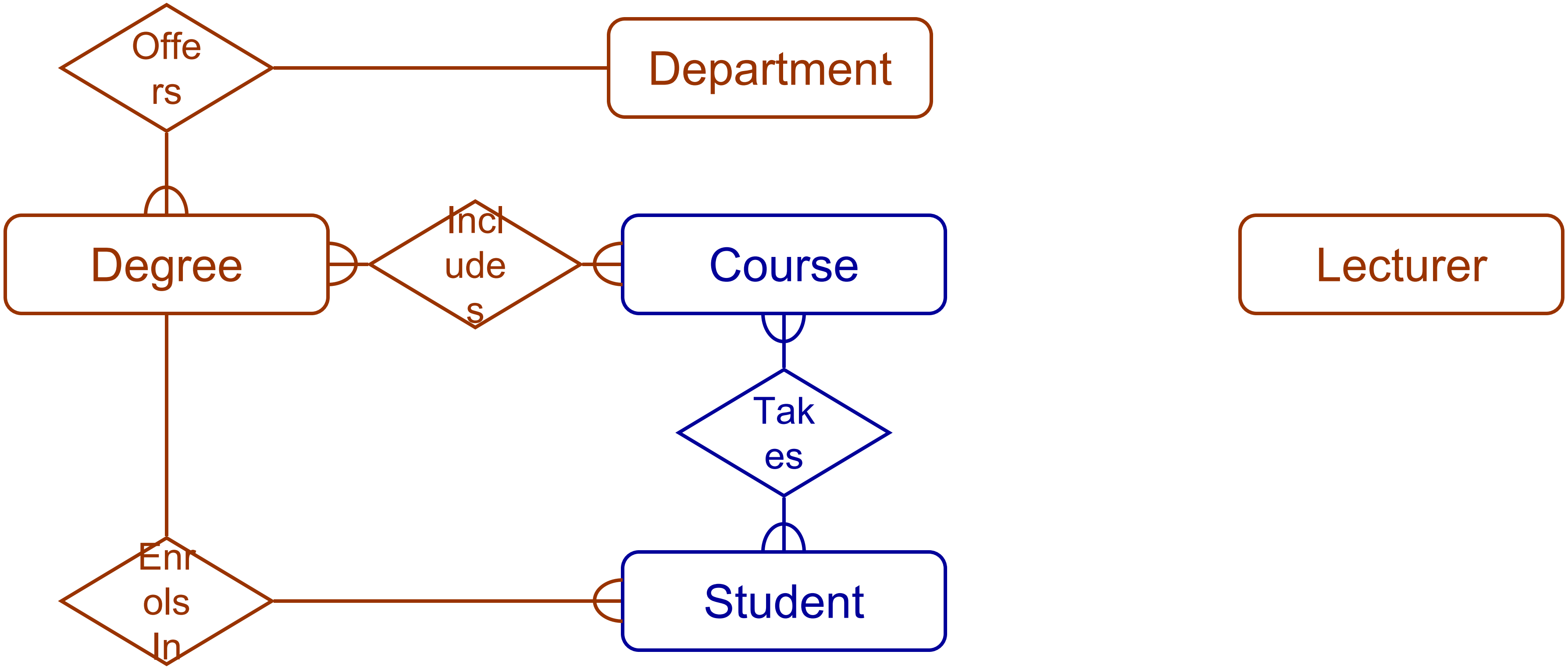
Example - E/R Diagram

Students enrol in a particular course



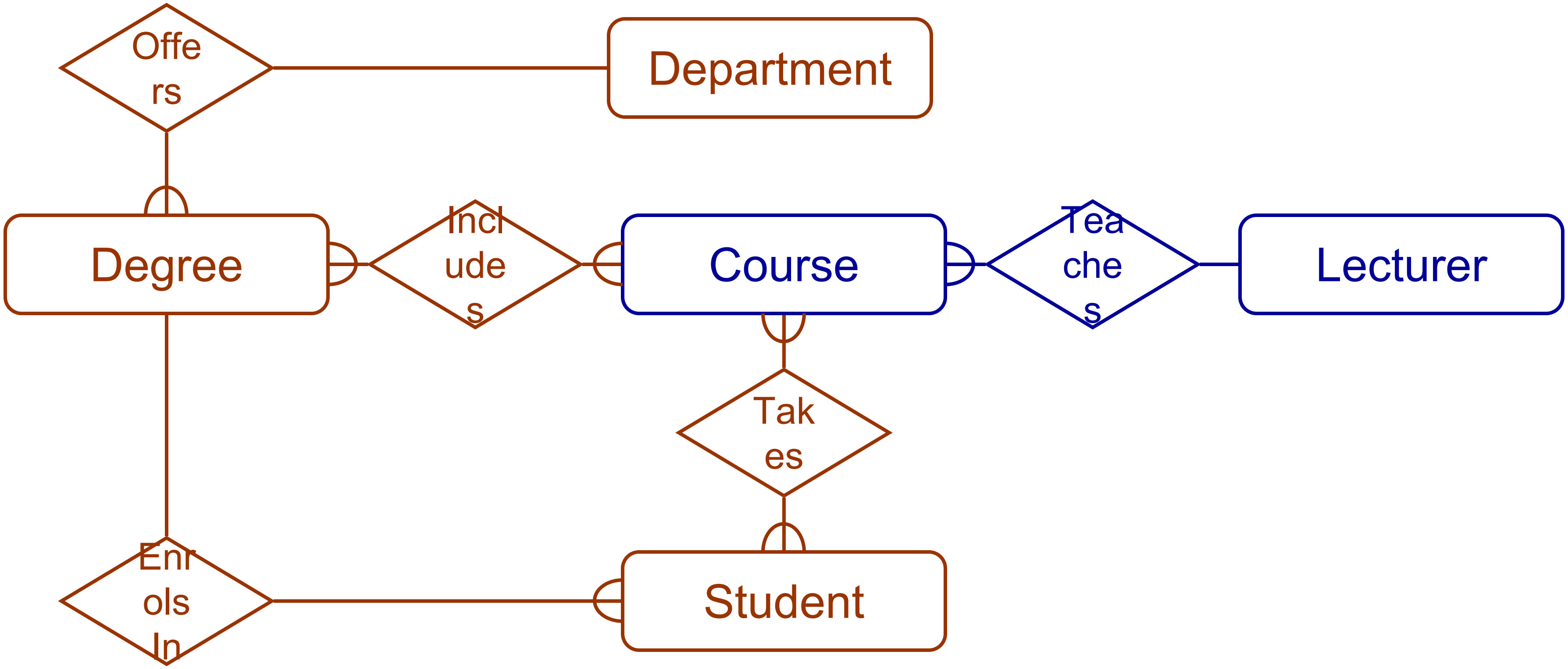
Example - E/R Diagram

Students … take modules



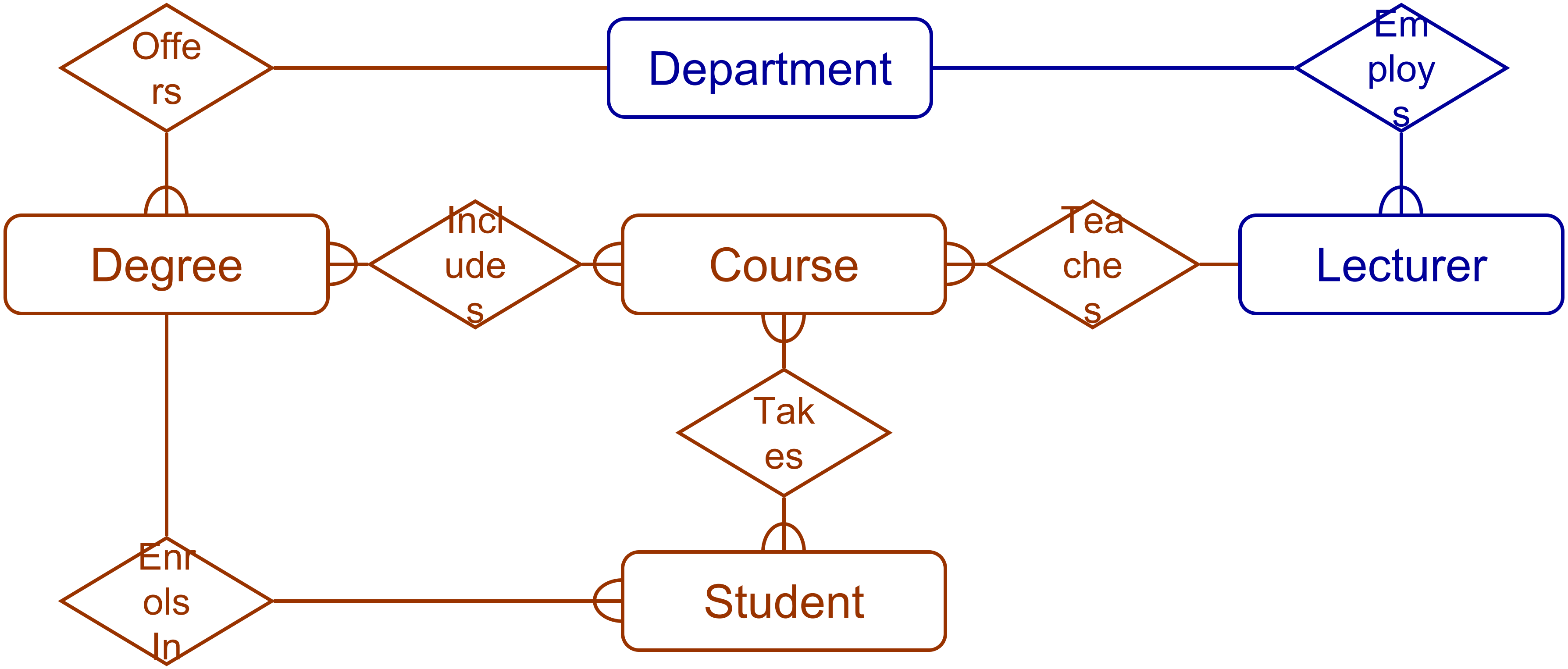
Example - E/R Diagram

Each module is taught by a lecturer



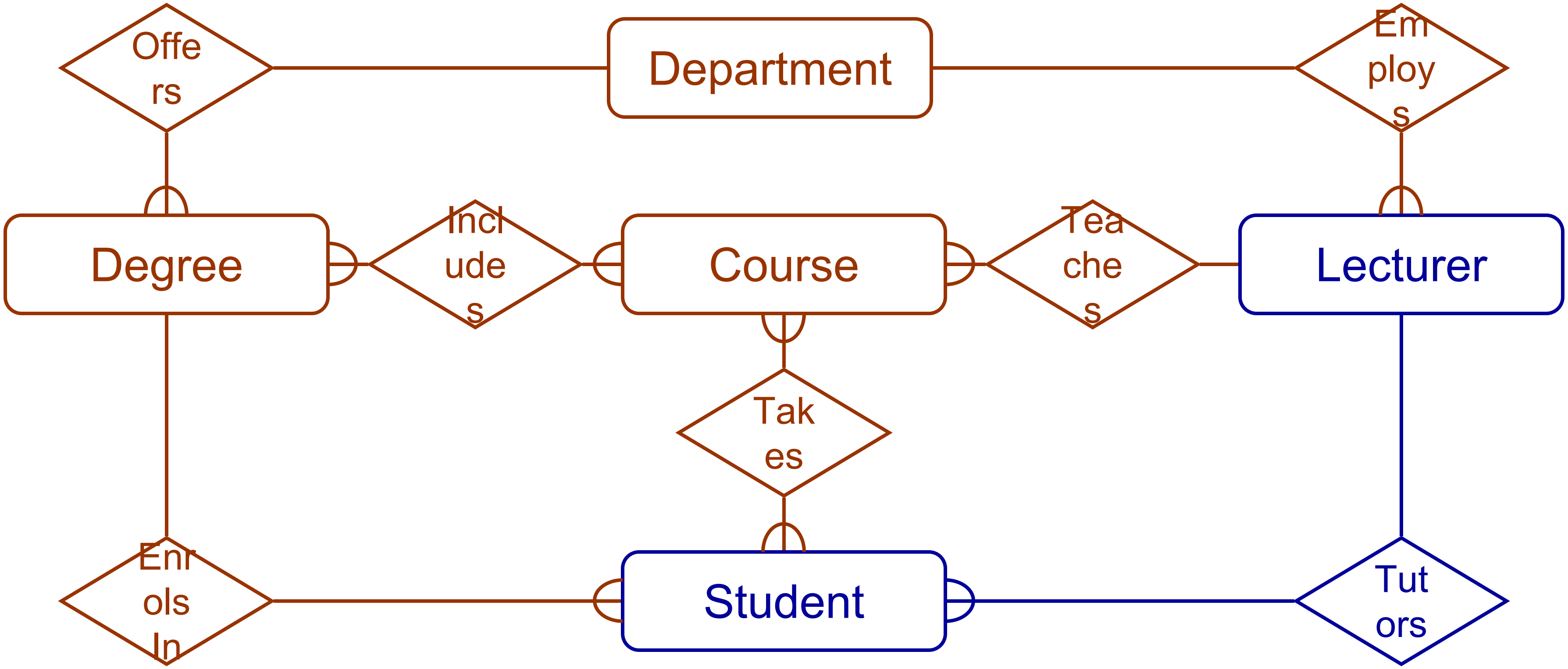
Example - E/R Diagram

a lecturer from the appropriate department

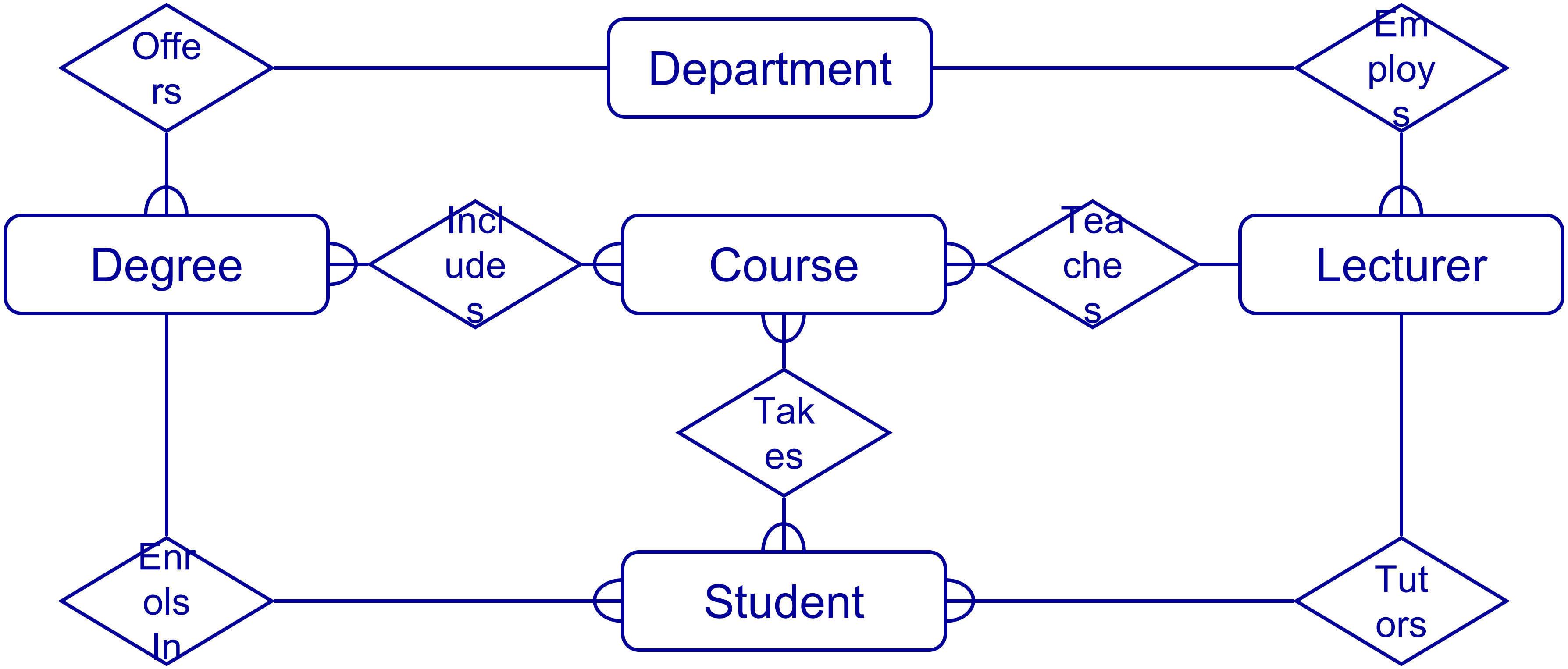


Example - E/R Diagram

each lecturer tutors a group of students



Example - E/R Diagram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