Unit 4: Entity Relationship Modelling

Part 2

Learning Objectives

- In this chapter, you will learn:
  - The main characteristics of entity relationship components
  - How relationships between entities are defined, refined, and incorporated into the database design process
  - How ERD components affect database design and implementation
  - That real-world database design often requires the reconciliation of conflicting goals

Developing an ER Diagram

- Create a detailed narrative of the organization's description of operations
- Identify business rules based on the descriptions
- Identify main entities and relationships from the business rules
- Develop the initial ERD
- Identify the attributes and primary keys that adequately describe entities
- Revise and review ERD

Case Study – Tiny College

- See the resource on Ulwazi for details on the case study.
  - Developing an ER Diagram
  - https://ulwazi.wits.ac.za/courses/48750/modules/items/550813
- Open the file to view the Business rules.

Business Rule 1

- A 1:1 relationship exists between PROFESSOR and SCHOOL.
- Note that the cardinality can be expressed by writing (1,1) next to the entity PROFESSOR and (0,1) next to the entity SCHOOL.

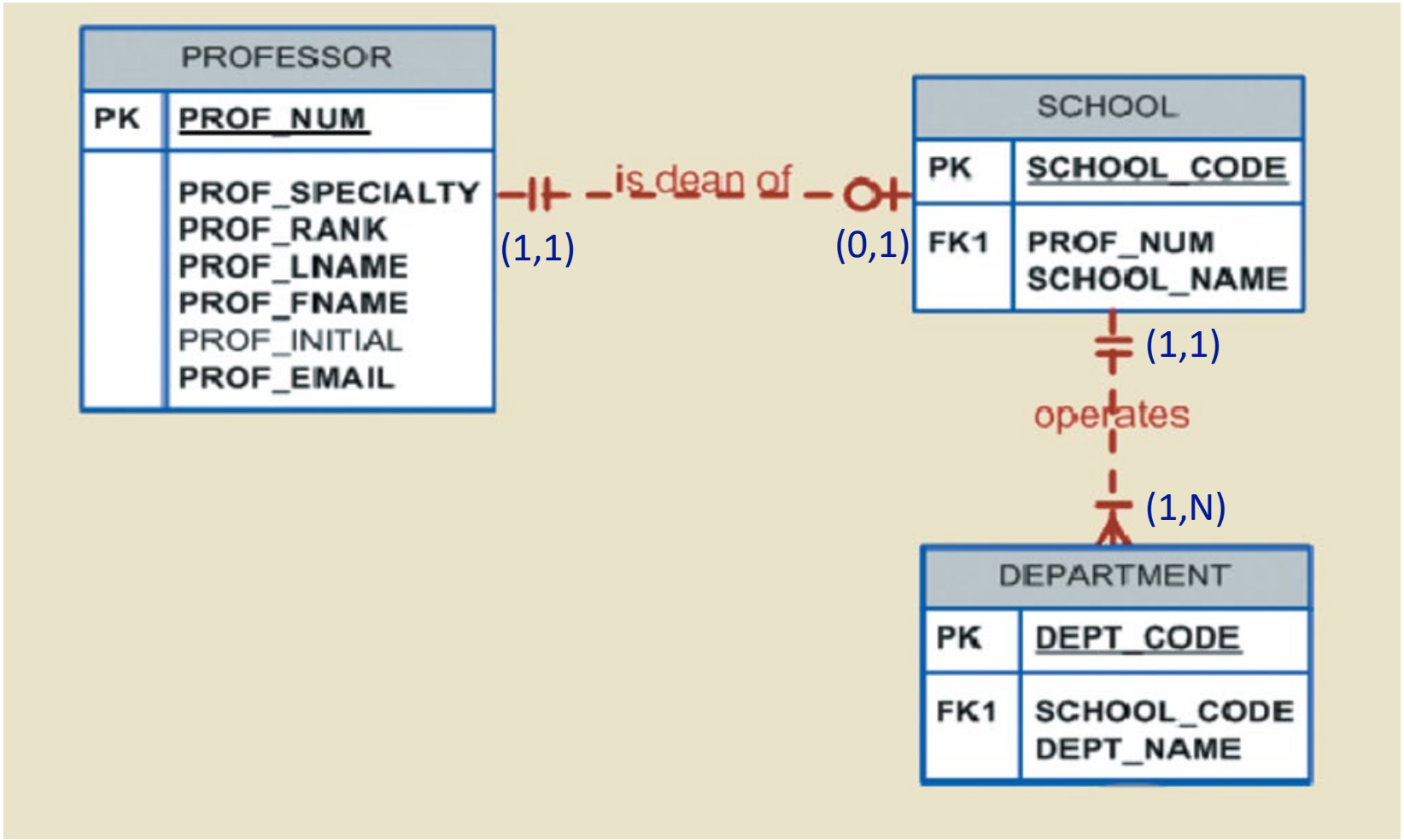
Business Rule 1

- 3a: Entities: SCHOOL, PROFESSOR
- 3b: SCHOOL, PROFESSOR
- 3c: A SCHOOL is administered by a PROFESSOR; A PROFESSOR can be the dean of a school
- 3d: A 1:1 relationship exists between PROFESSOR and SCHOOL.
- 3e: SCHOOL (0,1); PROFESSOR (1,1)

Business Rule 2

- 3a: Entities: SCHOOL, DEPARTMENT
- 3b: SCHOOL, DEPARTMENT
- 3c: A SCHOOL comprises many DEPARTMENT; A DEPARTMENT belongs to one and only one school
- 3d: A 1:M relationship exists between SCHOOL and DEPARTMENT.
- 3e: SCHOOL (1,1); DEAPRTMENT (1,M)

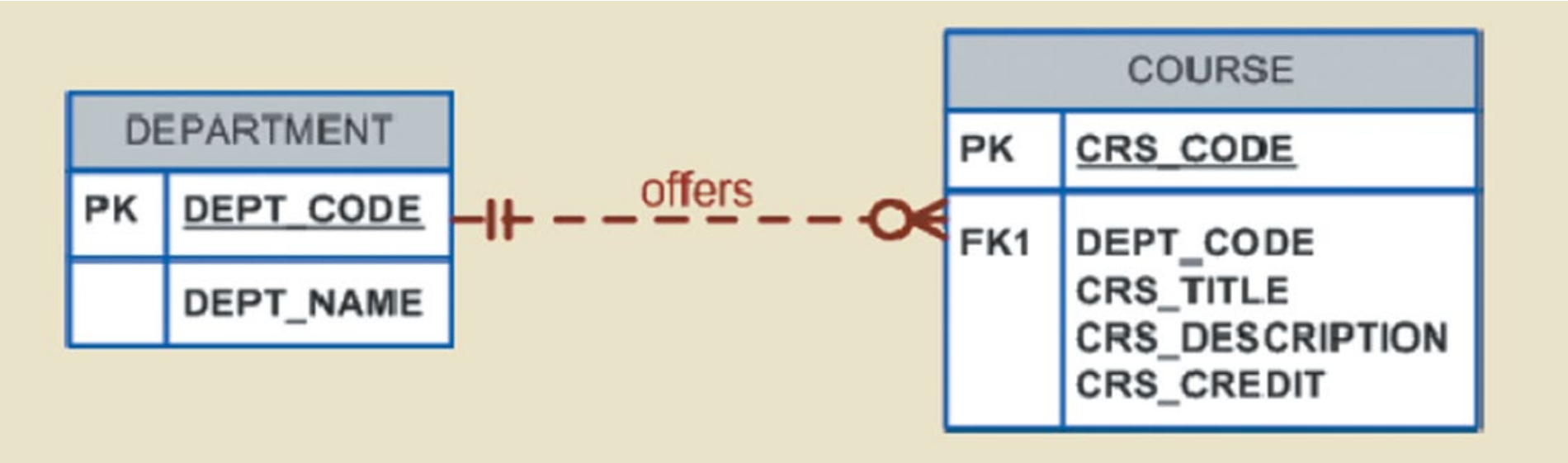
Figure 4.26 - The First Tiny College ERD Segment



Business Rule 3

- 3a: DEPARTMENT, COURSE
- 3b: DEPARTMENT, COURSE
- 3c: One DEPARTMENT can offer many (or zero) COURSEs
- One COURSE offered by one DEPARTMENT
- 3d: A 1:M relationship exists between DEPARTMENT and COURSE
- 3e: DEPARTMENT (1,1); COURSES (0:M)

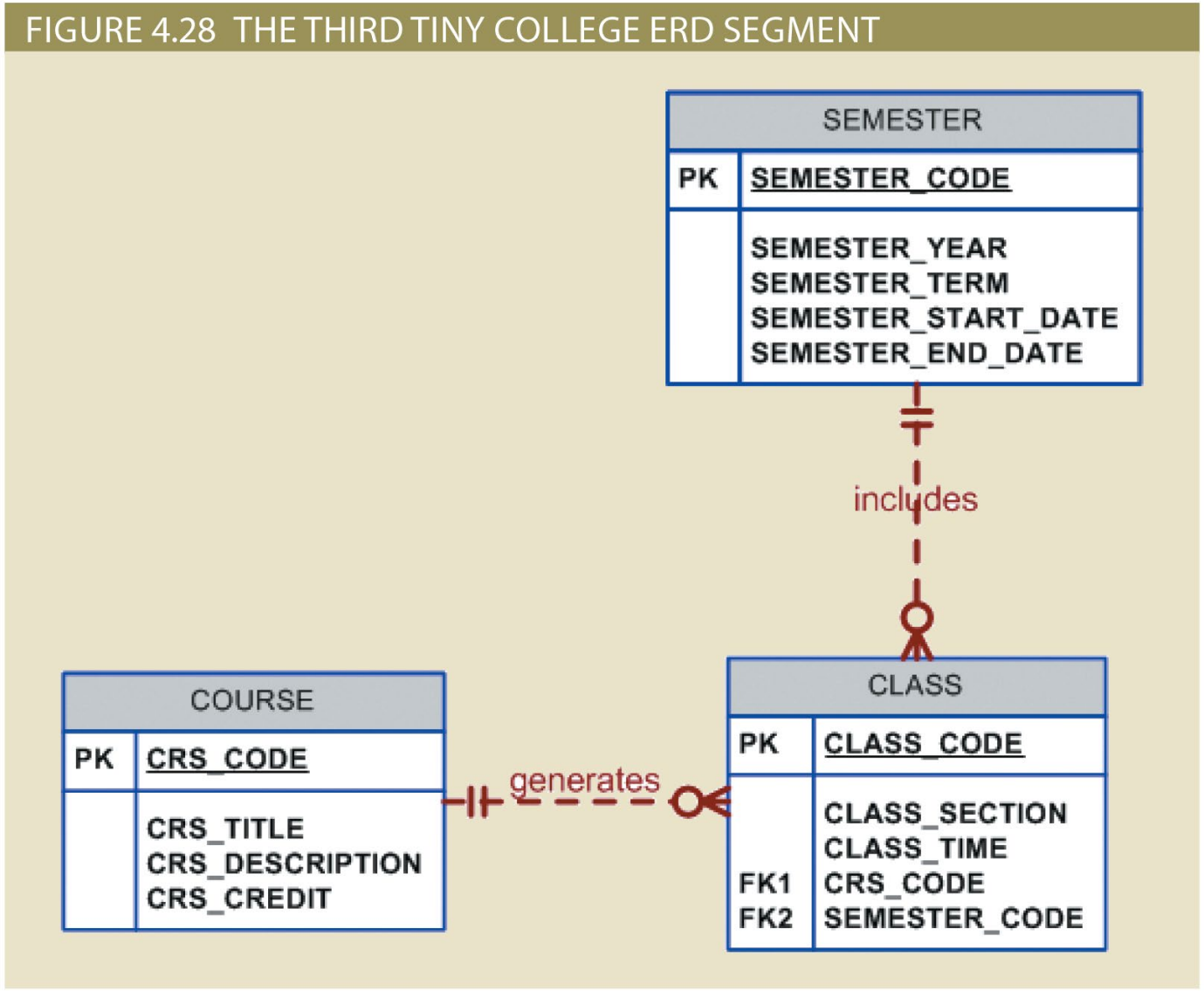
Figure 4.27 - The Second Tiny College ERD Segment



Business Rule 4

- 3a: CLASS, COURSE, SEMESTER
- 3b: CLASS –COURSE; SEMESTER - CLASS
- 3c: A COURSE can have many CLASSES; A CLASS is a section of one COURSE.
  - A CLASS is offered in a SEMESTER; A semester can offer many CLASSes.
- 3d:COURSE – CLASS 1:M Relationship
  - SEMESTER – CLASS 1:M Relationship
- 3e: CLASS(0,M) SEMESTER(1,1); CLASS(0:M) COURSE (1,1)

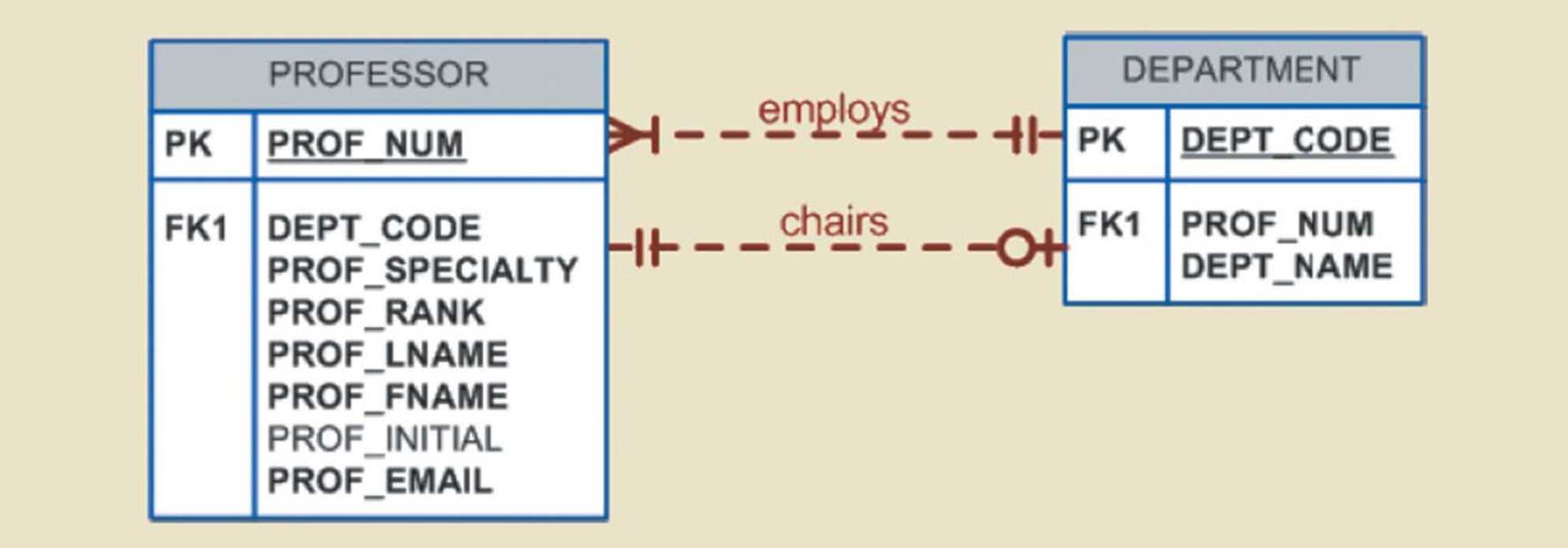
Figure 4.28 - The Third Tiny College ERD Segment



Business Rule 5

- 3a: DEPARTMENT, PROFESSOR
- 3b:
- 3c: A DEPARTMENT has one or more PROFESSORS ; A PROFESSOR belongs to only one DEPARTMENT (employs).
  - One and only one PROFESSOR chairs a DEPARTMENT; A DEPARTMENT is chaired by only one PROFESSOR
- 3d: DEPARTMENT – PROFESSOR (employs) 1:M relationship
  - DEPARTMENT – PROFESSOR (chairs) 1:1 relationship
- 3e: DEPARTMENT (1,1) –(employs) PROFESSOR (1,M)
  - DEPARTMENT (0,1) –(chairs) PROFESSOR (1,1)

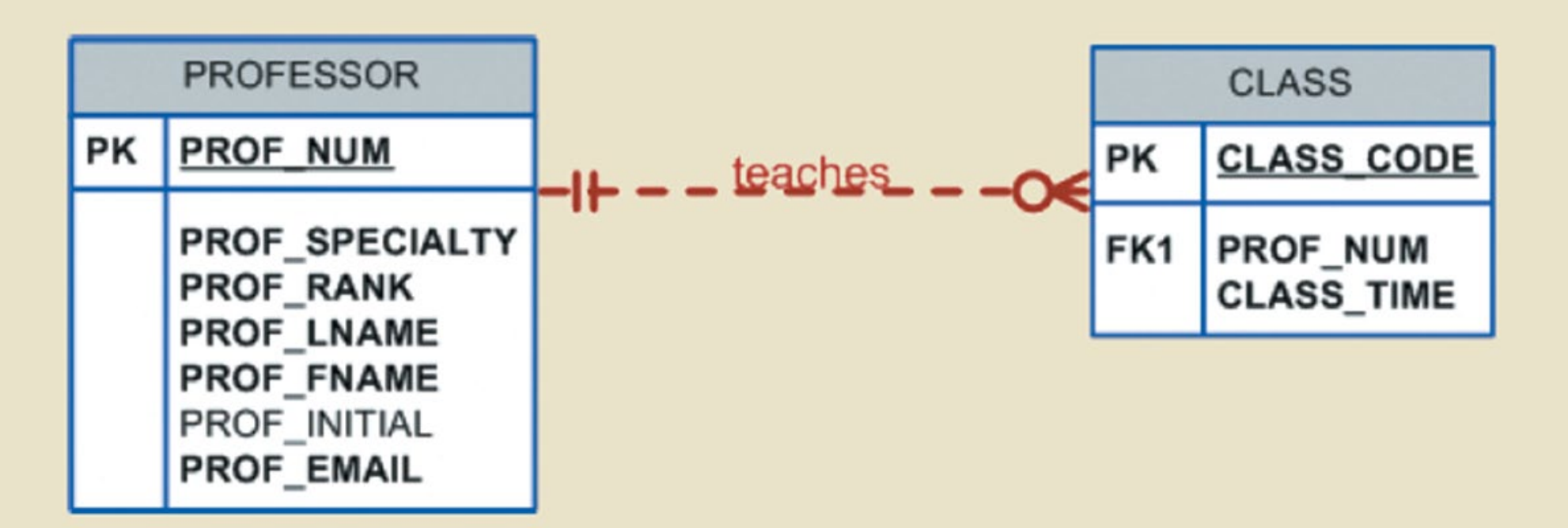
Figure 4.29 - The Fourth Tiny College ERD Segment



Business Rule 6

- 3a: PROFESSOR, CLASS
- 3b: PROFESSOR, CLASS
- 3c: One PROFESSOR teaches one or many (four) CLASSes; One CLASS is taught by one PROFESSOR
- 3d: PROFESSOR – CLASS; 1:M relationship
- 3e: PROFESSOR (1,1) - CLASS (0,4)

Figure 4.30 - The Fifth Tiny College ERD Segment



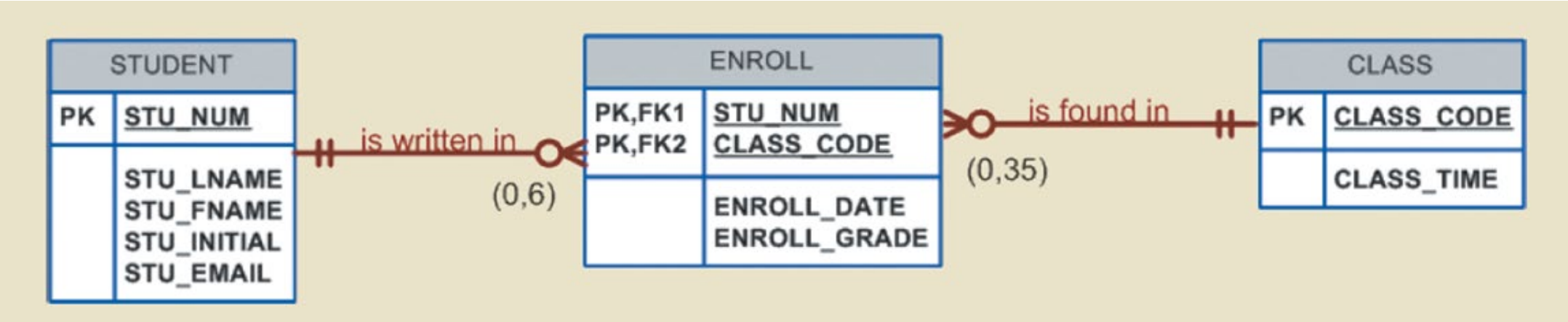
Business Rule 7

- 3a: STUDENT, CLASS
- 3b: STUDENT, CLASS
- 3c: A STUDENT can enroll in many (six) classes; A class can enroll many (35) students.
- 3d: STUDENT – CLASS; One to many relationship.
- 3e: Since this is a M:N relationship, we need a bridge entity and the bridge entity will show the cardinality.

Refining the M:N Relationship

- The STUDENT and CLASS entities had a M:N relationship.
- This M:N relationship must be divided into two 1:M relationships through the use of another entity - ENROLL.
- However, note that the optional symbol will be shown next to ENROLL.
- If a class exists but has no students enrolled in it, that class does not occur in the ENROLL table.

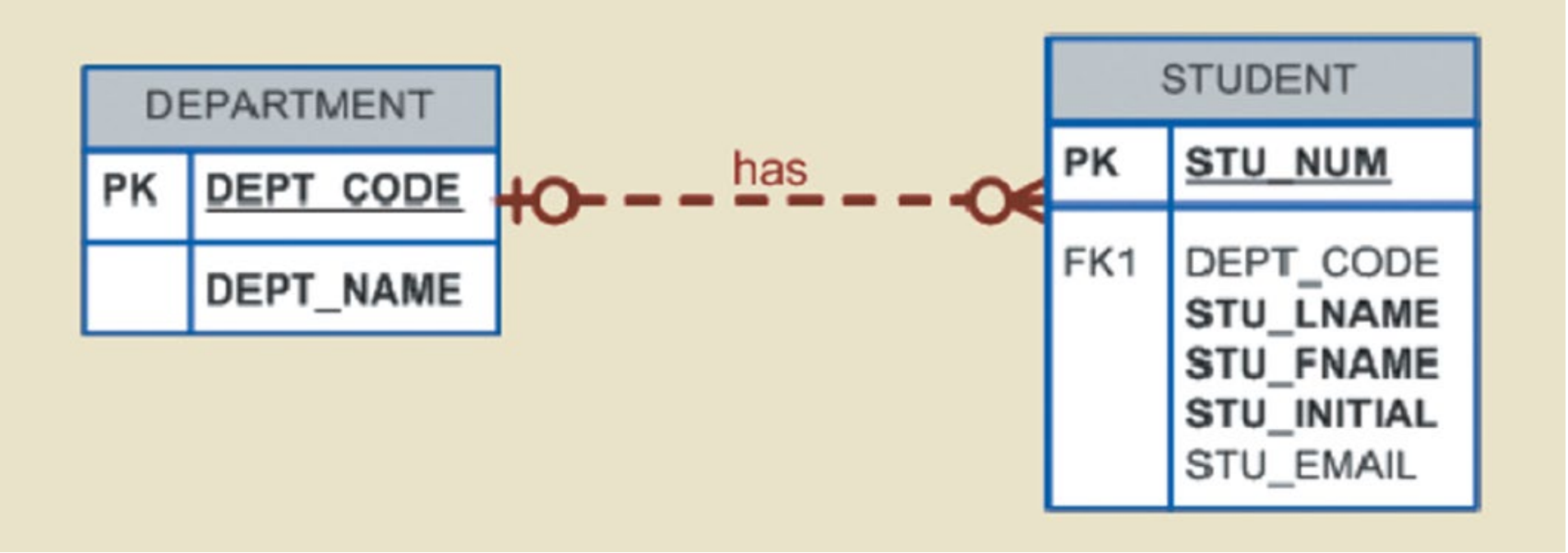
Figure 4.31 - The Sixth Tiny College ERD Segment



Business Rule 8

- 3a: DEPARTMENT, STUDENT
- 3b: DEPARTMENT, STUDENT
- 3c: A DEPARTMENT has many STUDENT; A STUDENT belongs to only one DEPARTMENT.
- 3d: DEPARTMENT – STUDENT; 1:M Relationship
- 3e: DEPARTMENT (0,1) STUDENT (1,M)

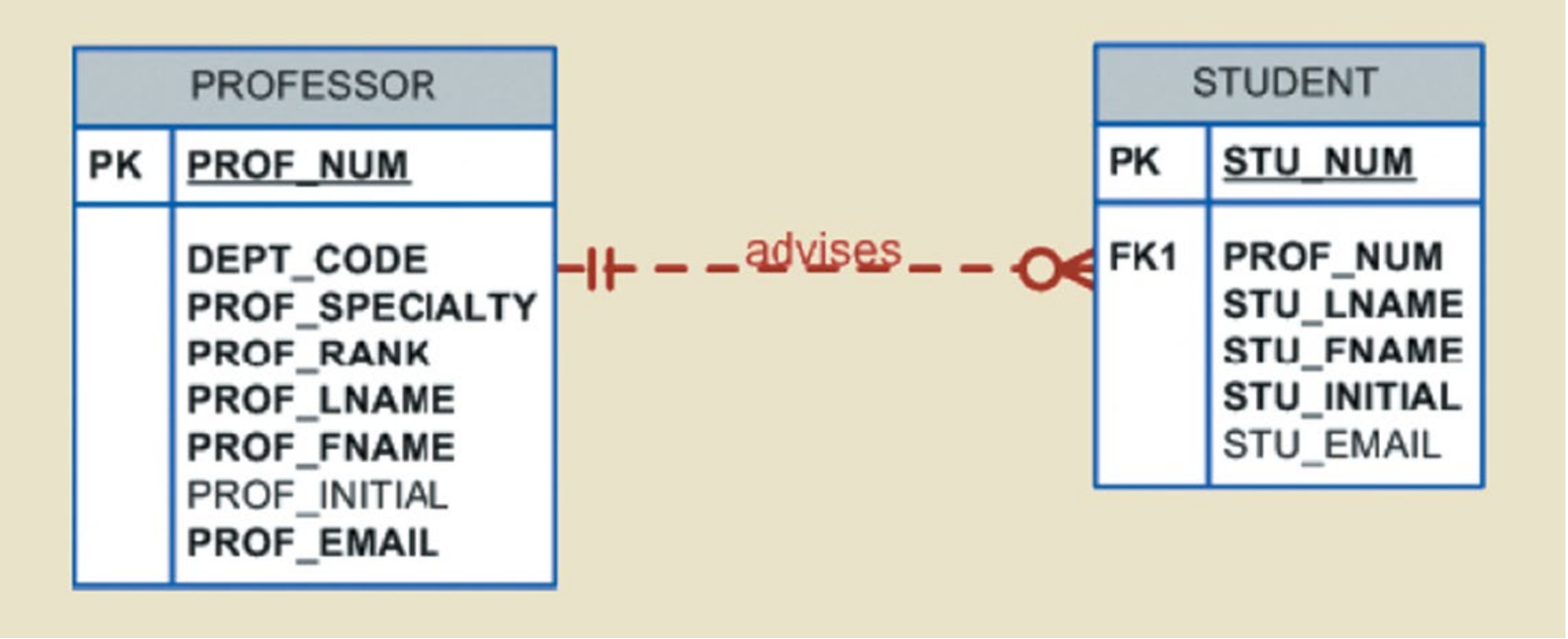
Figure 4.32 - The Seventh Tiny College ERD Segment



Business Rule 9

- 3a: STUDENT, PROFESSOR (Advisor)
- 3b: STUDENT, PROFESSOR
- 3c: A student is advised by a PROFESSOR, A PROFESSOR advises many students
- 3d: STUDENT – PROFESSOR; 1:M relationship.
- 3e: STUDENT (0,M) – PROFESSOR (1,1)

Figure 4.33 - The Eighth Tiny College ERD Segment



Business Rule 10

- 3a: BUILDING, ROOM, CLASS
- 3b: BUILDING – ROOM; ROOM - CLASS
- 3c: A BUILDING can contain many ROOMS; A ROOM is found in a single building
  - A CLASS is taught in a ROOM; A ROOM can be used to teach many CLASSes.
- 3d: BUILDING – ROOM 1:M relationship
  - ROOM – CLASS 1:M relationship
- 3e: BUILDING (1,1) – ROOM (0,M)
  - ROOM(1,1) – CLASS (0,M)

Figure 4.34 - The Ninth Tiny College ERD Segment

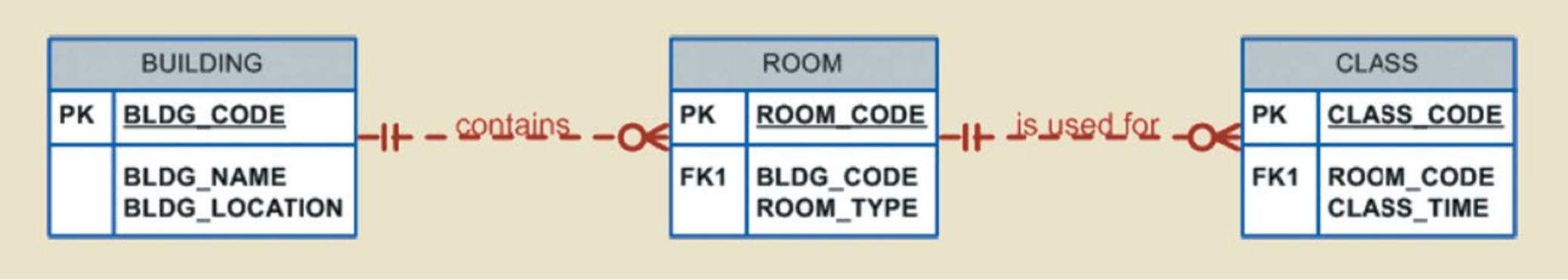
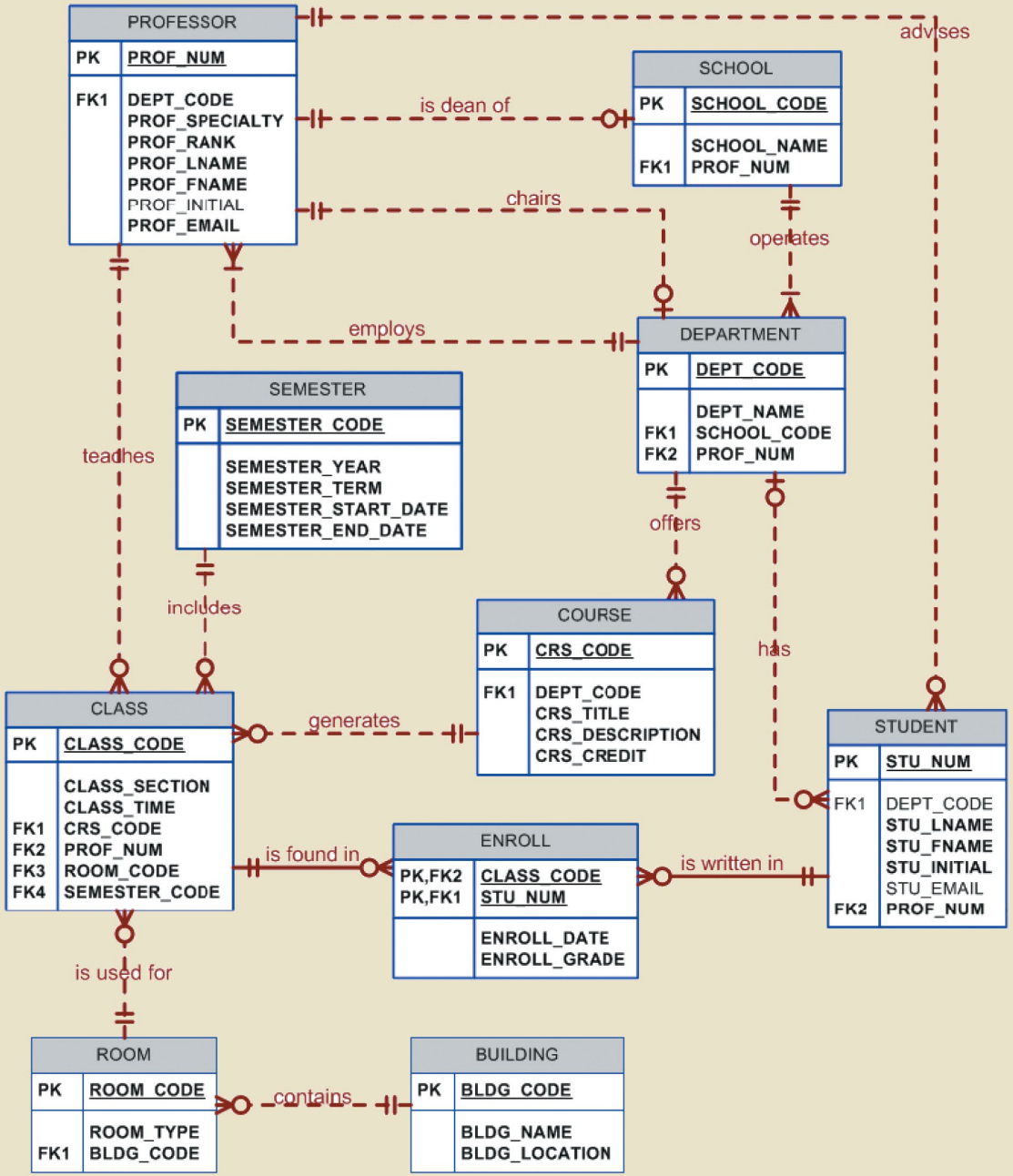


FIGURE 4.35 THE COMPLETED TINY COLLEGE ERD



Draw the ER diagrams

- Using the relationships and their cardinalities, draw the ER diagram for the Tiny college.
- Watch the video on how to use diagrams.net (formerly draw.io)
- Class demonstration

Table 4.4 - Components of the ERM

ENTITY	RELATIONSHIP	CONNECTIVITY	ENTITY
SCHOOL	operates	1:M	DEPARTMENT
DEPARTMENT	has	1:M	STUDENT
DEPARTMENT	employs	1:M	PROFESSOR
DEPARTMENT	offers	1:M	COURSE
COURSE	generates	1:M	CLASS
SEMESTER	includes	1:M	CLASS
PROFESSOR	is dean of	1:1	SCHOOL
PROFESSOR	chairs	1:1	DEPARTMENT
PROFESSOR	teaches	1:M	CLASS
PROFESSOR	advises	1:M	STUDENT
STUDENT	enrolls in	M:N	CLASS
BUILDING	contains	1:M	ROOM
ROOM	is used for	1:M	CLASS

Note: ENROLL is the composite entity that implements the M:N relationship “STUDENT enrolls in CLASS.”

Database Design Challenges: Conflicting Goals

- Database design must conform to design standards
- Need for high processing speed may limit the number and complexity of logically desirable relationships
- Need for maximum information generation may lead to loss of clean design structures and high transaction speed