G.C.E. O/L Grade 10 ICT · Lesson 9

9.4 Relational Database Design: Primary Key, Foreign Key and Relationships

If we typed the class teacher's name and room into every student record, the same data would be repeated many times. A **relational design** stores each kind of data in its own table and **links the tables** with keys. In this note you will learn the **primary key**, the **foreign key**, and the three kinds of **relationship** – mainly **one-to-many** – using our school's **Class–Student** and **Book–Borrow–Student** tables.

1. Why split data into tables?

In one big table, 'Mrs. N. Perera, Room 12' would be typed for all 4 students of 10A. If the teacher changes, 4 records must be edited – a missed one makes the data **inconsistent**. In a relational design, the teacher is stored **once** in tblClass, and each student only stores **ClassID**.

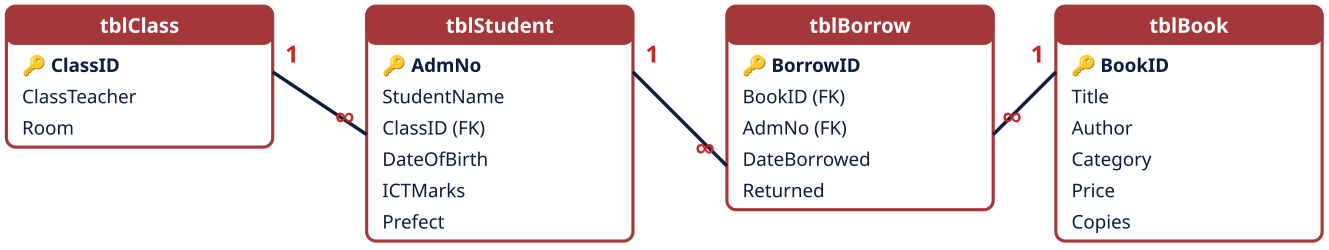
2. Primary key and foreign key

Primary key (PK)
A field (or fields) whose value is **unique and not empty** for every record of a table. tblClass → ClassID; tblStudent → AdmNo; tblBook → BookID; tblBorrow → BorrowID.

Foreign key (FK)
A field in one table that holds the **primary key value of another table**, creating the link. ClassID in tblStudent; BookID and AdmNo in tblBorrow.

Composite key
A primary key made of **two or more fields** together (e.g. AdmNo + SubjectID in a marks table).

Rule
A FK value must **match an existing PK value** (or be empty). This is **referential integrity**.



1 = one side (primary key) ∞ = many side (foreign key) – Enforce Referential Integrity is ticked
One class has many students · one student has many loans · one book has many loans

Figure 9.4: Relationships in the school database. The '1' end is the primary key; the '∞' (many) end is the foreign key.

3. Types of relationships

Type	Meaning	Example

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One-to-many (1–∞)	One record in table A matches **many** in table B; each B matches only one A	One class – many students; one student – many loans
One-to-one (1–1)	One record matches exactly one record	One student – one school ID card; one school – one principal
Many-to-many (∞–∞)	Many A match many B; built with a **link (junction) table** and two 1–∞ relationships	Students and books: tblBorrow links them

4. One-to-many in our data

ClassID (PK in tblClass)	Class teacher	Number of students (FK matches in tblStudent)
10A	Mrs. N. Perera	4
10B	Mr. S. Kumara	3
10C	Mrs. F. Rizwan	3
11A	Mr. R. Silva	0

💡 **11A has 0 students** – that is allowed: the 'many' side can be zero. But a student with ClassID '12Z' is **not** allowed, because 12Z is not in tblClass. Book **B001** was borrowed **2 times**, so one book has many loans.

5. Many-to-many: Book – Borrow – Student

A student can borrow many books and a book can be borrowed by many students, so Student–Book is **many-to-many**. A DBMS cannot link them directly; we add **tblBorrow** with two foreign keys (BookID, AdmNo). Now Book 1–∞ Borrow and Student 1–∞ Borrow. Student 24101 has **2** loans and 24103 has **2**.

NEW 2026 **2026: real Sri Lankan systems are relational.** The **NIC** number links a citizen to records in banks, the Department of Motor Traffic and elections; a hospital **e-channelling** system links Doctor 1–∞ Session 1–∞ Appointment; **school admission** systems link Applicant 1–∞ Application. Good keys keep these huge systems accurate.

Key Words

Primary key – Unique, non-empty field identifying each record.

Foreign key – A field holding the primary key of another table.

Composite key – A primary key made of two or more fields.

Relationship – A link between two tables through common fields.

One-to-many – One record in A matches many in B.

One-to-one – One record matches exactly one record.

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Many-to-many – Many records match many; needs a link table.

Link table – A table with two FKs that breaks a many-to-many, e.g. tblBorrow.

Referential integrity – Every FK value matches an existing PK value.

Entity – A thing we store data about – student, class, book.

ER diagram – A drawing of tables (entities) and their relationships.

Inconsistency – Copies of the same data having different values.

Sample Q&A

1. Define a foreign key.

> **Answer:** A field in one table that holds the primary key value of another table, linking them.

2. Name the PK and FK that link tblClass and tblStudent.

> **Answer:** PK: ClassID in tblClass; FK: ClassID in tblStudent.

3. What type of relationship is Class–Student?

> **Answer:** One-to-many: one class has many students.

4. How is a many-to-many relationship built?

> **Answer:** With a link table holding the two foreign keys, giving two one-to-many relationships.

5. Give an example of a one-to-one relationship.

> **Answer:** One student – one school ID card (or school – principal).

6. Why not store the class teacher in tblStudent?

> **Answer:** It would be repeated for every student (redundancy) and could become inconsistent.

MCQ

1. A field that links to the primary key of another table is a…

A. Foreign key
B. Caption
C. Primary key
D. AutoNumber

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2. In tblStudent, ClassID is a…

A. Primary key
B. Foreign key
C. Yes/No field
D. Composite key

3. The primary key of tblBorrow is…

A. BookID
B. DateBorrowed
C. BorrowID
D. AdmNo

4. tblBorrow has how many foreign keys?

A. 0
B. 4
C. 2
D. 1

5. One class has many students. This is…

A. Many-to-many
B. One-to-one
C. No relationship
D. One-to-many

6. How many students are in class 10A in the sample data?

A. 2
B. 10
C. 4
D. 5

7. Class 11A has 0 students in tblStudent. This is…

A. a duplicate key
B. a one-to-one error
C. a referential integrity error
D. allowed – the many side can be zero

8. Adding a student with ClassID '12Z' (not in tblClass) is refused because of…

A. Referential integrity
B. Data redundancy
C. Sorting
D. Field size

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9. Students and books (a student borrows many books, a book is borrowed by many students) is…

A. None
B. Many-to-many
C. One-to-one
D. One-to-many

10. A many-to-many relationship is created using…

A. a link table with two foreign keys
B. a report
C. one big table
D. two primary keys in one field

11. One school has one principal. This is…

A. One-to-many
B. Many-to-one only
C. Many-to-many
D. One-to-one

12. In Figure 9.4, the '∞' symbol is at the side of the…

A. AutoNumber only
B. primary key
C. foreign key
D. report

13. Book B001 appears in tblBorrow…

A. 2 times
B. 0 times
C. 5 times
D. 4 times

14. A primary key made of AdmNo + SubjectID is a…

A. AutoNumber
B. Composite key
C. Caption
D. Foreign key

15. In an e-channelling system, one doctor has many appointment sessions. The FK DoctorID is in the…

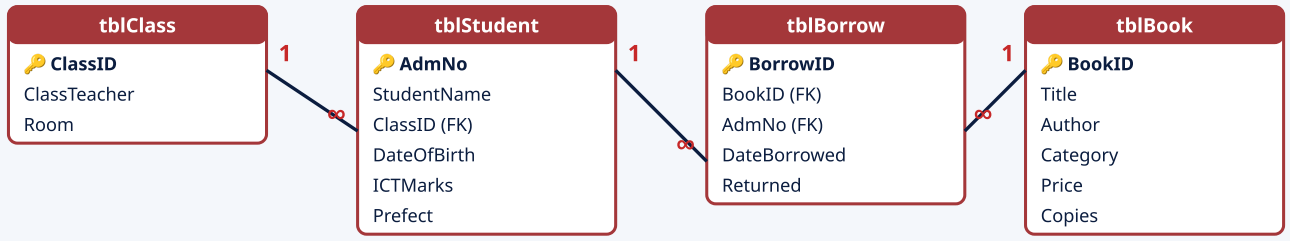
A. Report header
B. Session table
C. Hospital logo
D. Doctor table only

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Structured Questions

1. Using Figure 9.4, name the primary key of each table and the foreign keys. (5 marks) *(5 marks)*

PKs: tblClass ClassID, tblStudent AdmNo, tblBook BookID, tblBorrow BorrowID. FKs: ClassID in tblStudent; BookID and AdmNo in tblBorrow.



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Model answer

2. (i) Define a one-to-many relationship. (1 mark)
(ii) Give two examples from a school. (2 marks) *(3 marks)*

(i) One record in one table matches many records in another. (ii) Class–Student; Student–Borrow; Book–Borrow; Teacher–Class.

3. Explain why Student–Book is many-to-many and how tblBorrow solves it. (3 marks) *(3 marks)*

A student can borrow many books and a book can be borrowed by many students. tblBorrow holds BookID and AdmNo as FKs, giving Book 1–∞ Borrow and Student 1–∞ Borrow.

4. Using the sample data, how many students does each class have? Which class shows that the 'many' side can be zero? (3 marks) *(3 marks)*

10A – 4, 10B – 3, 10C – 3, 11A – 0; 11A has zero students.

5. State referential integrity and give one example of data it rejects. (2 marks) *(2 marks)*

Every foreign key value must match an existing primary key value. Example: a loan for BookID B099 or a student in class 12Z.

Summary

- Relational design: one table per entity, linked by keys.
- PK = unique, not empty (ClassID, AdmNo, BookID).
- FK = another table's PK (ClassID in tblStudent).

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- 1–∞: one class, many students (most common).
- 1–1: school – principal; ∞–∞ needs a link table.
- tblBorrow links Student and Book (two FKs).
- Referential integrity: FK must match a PK.
- NIC, e-channelling, admissions use keys.

MCQ answer key – 9.4

1. **A** – FK.
2. **B** – Links to tblClass.
3. **C** – AutoNumber PK.
4. **C** – BookID and AdmNo.
5. **D** – 1–∞.
6. **C** – Count FK = 10A.
7. **D** – Zero is fine.
8. **A** – FK must match a PK.
9. **B** – ∞–∞.
10. **A** – Junction table.
11. **D** – 1–1.
12. **C** – Many = FK side.
13. **A** – Count.
14. **B** – Two fields.
15. **B** – Many side holds the FK.

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