National University of Computer and Emerging Sciences

Islamabad Campus

0045

Database Systems (CS2005) Sessional I

Date: September 21, 2024

Total Time (Hrs): 1

Total Marks: 60

Total Questions: 6

CS-(A,B,C,D)

Course Instructor(s):

Noor ul Ain, Hira Mastoor

[redacted] A

Roll No Course Section

[redacted]

Student Signature

Do not write anything on the question paper except the information required above.

Instructions:

1. Read the question carefully, understand the question, and then attempt your answers in the provided answer booklet.
2. Verify that you have **Six (6)** printed page of the question paper including this page. There are **Six (6)** questions.
3. Calculator sharing is strictly prohibited.
4. Clearly mark your question number and part number in the answer sheet. Attempt the questions on your answer sheet in sequential order; answering out of order may result in **negative marking.** Answer all parts of questions together.
5. There are two bonus marks if you solve questions in sequential order.
6. Avoid long stories and irrelevant code while answering your question

Attempt all the questions.

Q1: [CLO1: Describe the storage and retrieval mechanism in different databases]

Consider a scenario where a university manages student and course information in a database. The "Students" table stores details about students, including their StudentID, Name, MajorID, and Year of Study. The "Majors" table contains information about different majors, such as MajorID and MajorName. **[10 marks]**

Students Table:

StudentID	Name	MajorID	Year of Study
2001	John Smith	3001	1st Year
2002	Alice Brown	3002	2nd Year
2003	Michael Johnson	3002	3rd Year
2004	Emma Davis	3003	4th Year
2005	Robert Wilson	3004	2nd Year
2006	Sarah Thompson	3001	4th Year

Major Table:

MajorID	MajorName
3001	Business
3002	Computer Science
3003	Electrical Engineering
3004	Data Science

I. **For the above database, is it safe to perform the following operations on University database. Does it violate any constraints?**
II. **In case of violation explain what is the violation and how it can be solved?**
III. **Discuss in terms of database consistency and integrity constraints.**

A. A new student record with StudentID 2007, Name "Emily Carter", MajorID 3006, and Year of Study "1st Year" is inserted into the "Students" table.
B. An update operation is performed on the "Students" table, changing StudentID 2004's MajorID from 3003 (Electrical Engineering) to 3005 (Mechanical Engineering).
C. A request is made to delete a major record from the "Majors" table. Specifically, the major record with MajorID 3002, corresponding to "Computer Science", is targeted for deletion.
D. An update operation is executed to change MajorID from 3004 (Data Science) to for StudentID 2005
E. A batch delete operation is performed on the "Students" table to remove all students who are in their 4th Year.

Q2: [CLO1: Describe the storage and retrieval mechanism in different databases] [10 marks]
You are designing a new e-commerce platform's database. The development team is discussing the structure and querying capabilities of the database. They are debating over schema levels and how to efficiently manage data independence.

[Note: Make sure to provide to the point from the given list.]

Security Layers ,Forms Interface ,View Layer, Client Layer ,Administrator Access ,Application Layer, ~~DDL (Data Definition Language)~~, Users Roles, ~~Data~~ Structure, Backup Utility ,Casual User, Performance Monitoring, Logical Data Independence, User Access, Meta Data, Encryption, ~~SQL~~ Queries, Data Manipulation, ~~Business Logic Layer, n~~-tier Architecture, Access Control, Developers, Schema, Data Storage, Role-Based Access Control, ~~SQL~~, ~~Storage Structure~~, User-Friendly Interface, ~~Physical Data Independence~~, ~~DML (Data Manipulation Language)~~, Command line interface

A. You are asked to ensure that any changes to the database's storage structures do not affect the application layer. Which type of data independence are you focusing on?
B. The system requires users to query the database for sales data. What language will they use for these queries?
C. The developer needs to define the structure of tables and relationships between them. Which language is used for this task?
D. To manipulate and retrieve data from the database, the developer will use a different language. What is the name of this language?
E. A utility is needed to back up the database and monitor its performance. What kind of database utility would you recommend?
F. What type of user-friendly interface would a casual user need for querying sales data?
G. In an n-tier architecture, which layer would be responsible for handling business logic?
H. Multiple database users, including developers, customer service agents, and administrators, need access to different parts of the database. How would you implement role-based access control in this scenario?
I. What does logical data independence deal with?
J. What does physical data independence deal with?

Q1

A: It is not safe to perform this operation as there does not exist any MajorID 3006 in the Major Table, which violates the integrity constraints. Can be solved by adding Major ID 3006 in Major Table

B: Violates integrity constraints as Major ID 3005 does not exist. Can also lead to database inconsistency. Solving by first inserting 3005 in Major Table mapped with Mechanical Engineering

C: Violates integrity Constraints, as there exists Students currently enrolled in Major ID 3002. Can lead to DB Inconsistency. To solve ensure no students enrolled in 3002 Major

Assumption: Major ID changed to any other found in Major Table

D: Does not lead to any Integrity violation if the new Major ID is present in the Major Table. Safe operation

E: Does not lead to any integrity violation. However, must ensure to data consistency when removing Student. Safe Operation

Q2:

A: Physical Data Independence

B: DML

C: DDL

D: SQL ~~Queries~~

E: Backup Utility - Performance Monitoring

F: ~~Forms~~ User Friendly Interface

G: Business Logic Layer

H: Role Based Access Control

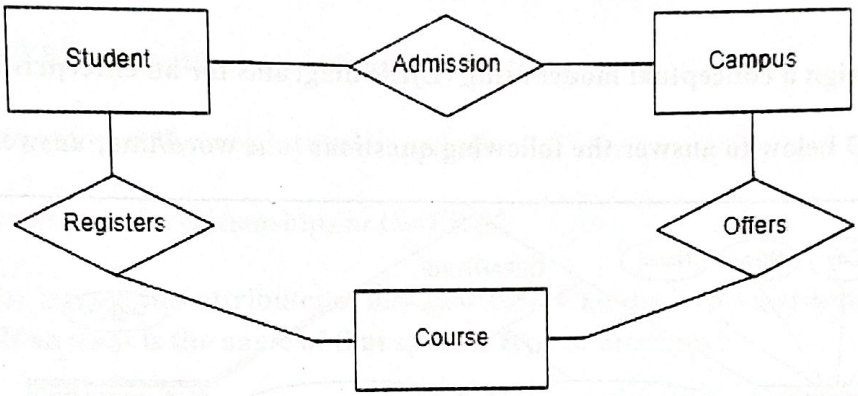
I: Application Layer

J: Storage Structure

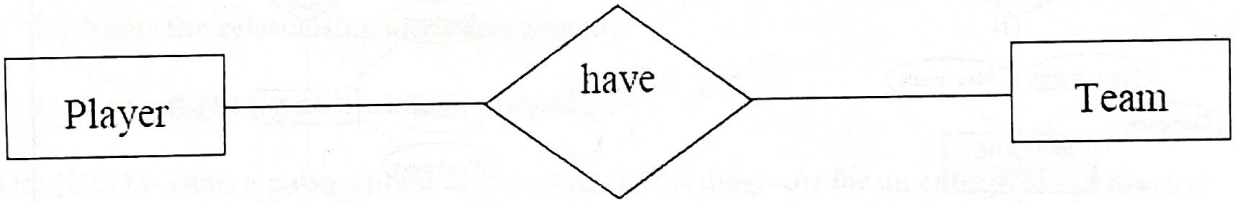
Q3: [CLO2- Design a conceptual model using (E)ER diagrams for an enterprise] [13 Marks]

Complete the following relationships in ER diagram with Cardinality ratio and Participation constraint for part A,B & C **[7 Marks]**

A. FAST university has campuses in Islamabad, Lahore, Karachi, Peshawar and Faisalabad. Student can take admission in any campus of FAST. Student can also take course(s) in any campus.



B. Each Player may play in 0 to 1 team, and each Team should have many Players. All teams must have players and a player may have not team.

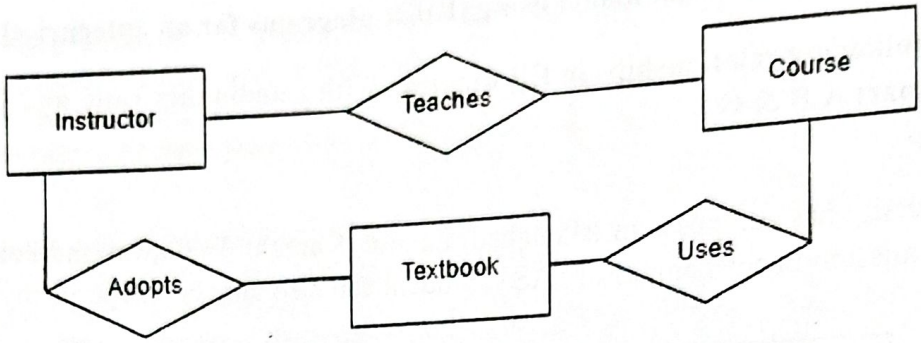


C. Each Student may lead 0 to 1 Group, and each Group should be led by only one Student. Not all students can lead groups. All groups must be led.

D. Consider the following database schema and Show min-max constraints on the following ER diagram **[6 Marks]**

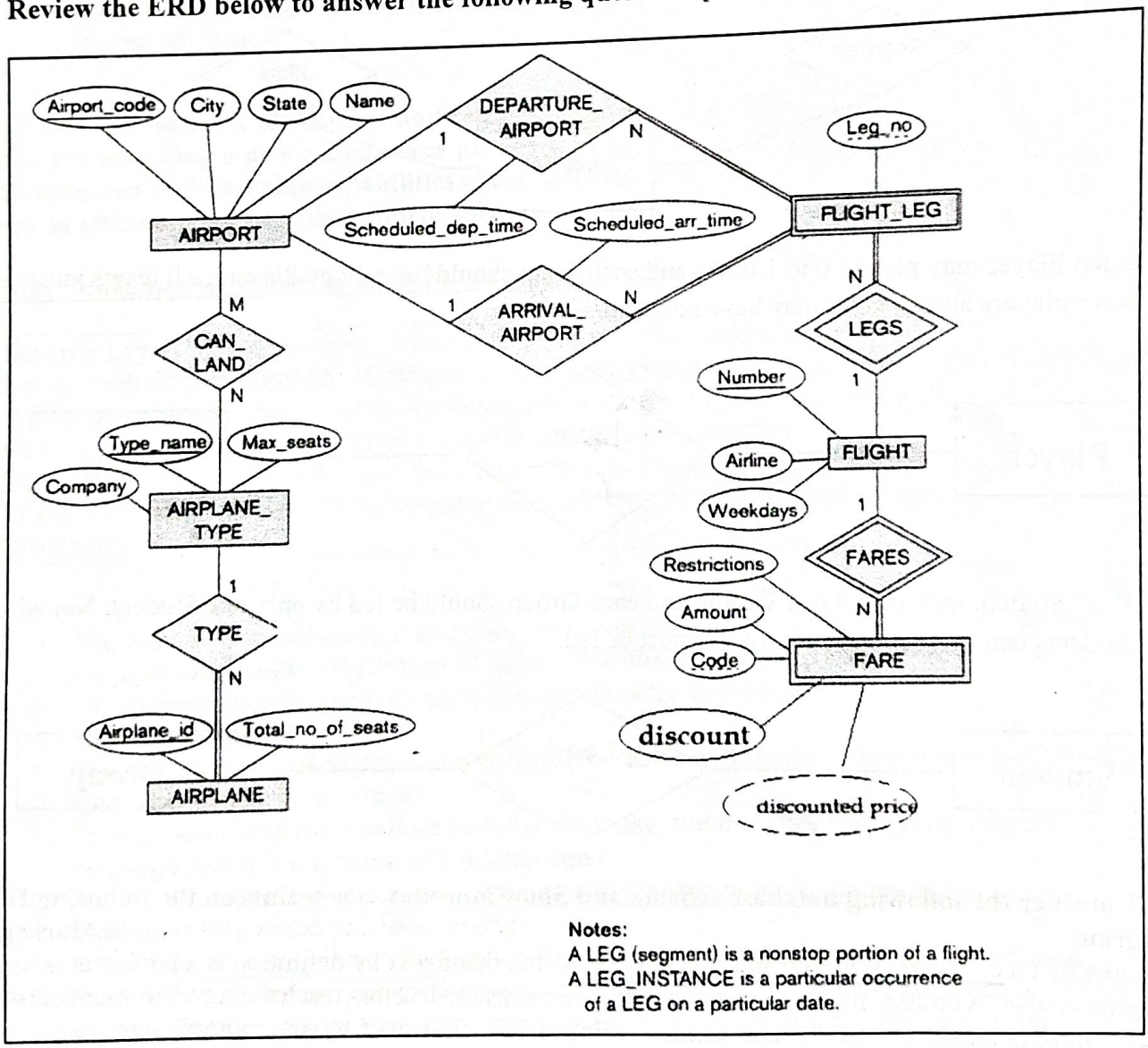
Assume that a course may or may not use a textbook, but that a text by definition is a book that is used in some course. A course may not use more than five books. Instructors teach from two to four courses. Each course is taught by exactly one instructor. Each textbook is used by one and only one course. An instructor does not have to adopt a textbook for all courses.

- If a text exists, it is used in some course, hence it is adopted by some instructor who teaches that course. An instructor is considered to adopt a text if it is used in some course taught by that instructor.



Q4: [CLO2- Design a conceptual model using (E)ER diagrams for an enterprise] [14 marks]

Review the ERD below to answer the following questions [one word/liner answer only]



1. **Can an airplane type land at more than one airport?**
2. **Is it necessary for an airline to operate flights for all the flight legs in the system?**

3. Can a Flight exist with no fare?

4. What is the type of relationship between flight and fare?

5. Can a fare exist without a flight? Give one-line explanation

6. What is the type of relationship between fare and flight?

7. Does this ERD have any weak entities? Name them

8. The relationship with a weak entity is called?

9. Can you name such relationships in the ERD?

10. The entity airport has attributes of city and state. Can these two attributes be represented as one? If so what is the name of that specific type of attribute?

11. Name the derived attribute in the ERD

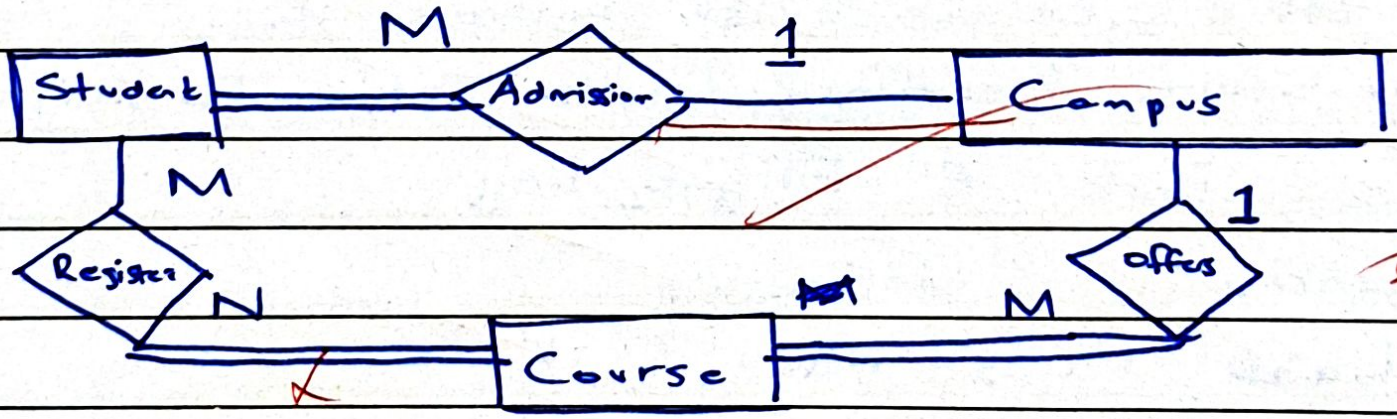
12. What uniquely identifies the airport entity?

13. Name the relationship attributes present

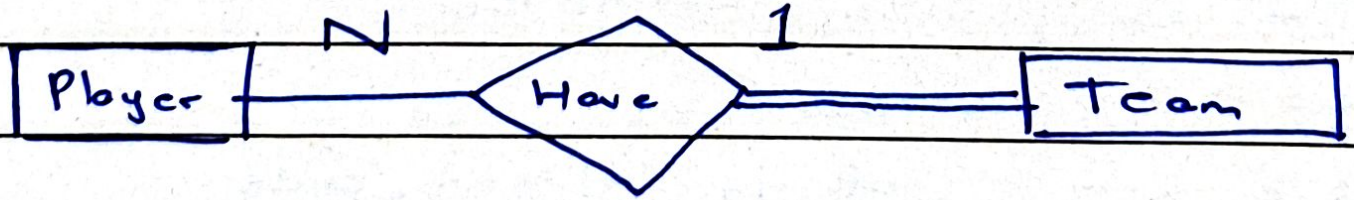
14. Can a flight leg exist without a flight?

Q3:

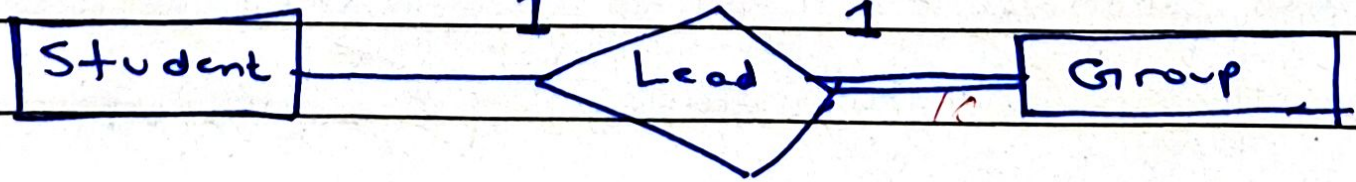
A:


Student
Admission
Campus
Register
offers
Course
M
1
M
1
N
M

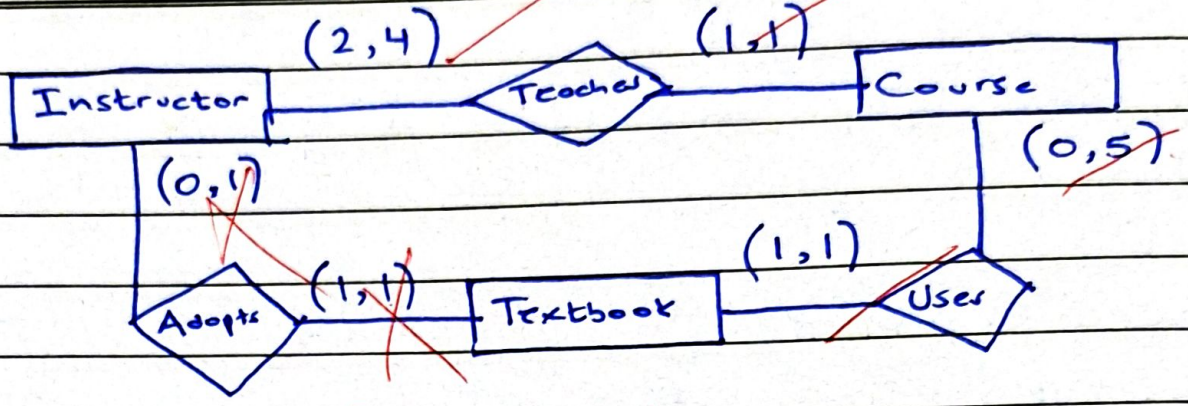
B:


Player
Have
Team
N
1

C:


Student
Lead
Group
1
1

D:



Q4

1. Yes
2. Not necessary
3. Yes
4. Identifying Relationship with Partial Participation
5. Fare is a weak entity having owner Flight therefore, cannot exist without it.
6. Identifying Relationship with Total Participation
7. Yes, Fare & Flight_Leg
8. Identifying Relationship
9. Flight Fares Fare &
   Flight Legs Flight Leg
10. Yes - Composite Attribute
11. discounted price
12. Unique Key that is Airport_code
13. Scheduled_dep_time & Scheduled_arr_time
14. Cannot exist.

11.5/14

Q5: [CLO2- Design a conceptual model using (E)ER diagrams for an enterprise] [4 marks]
Cardinality ratios often dictate the detailed design of a database. The cardinality ratio depends on the real-world meaning of the entity types involved and is defined by the specific application. For the following binary relationships, suggest cardinality ratios based on the common-sense meaning of the entity types.

Part #	Entity 1	Cardinality Ratio	Entity 2
A	COMPANY		CEO
B	TEACHER		STUDENT
C	RESEARCH_LAB		RESEARCH_PROJECT
D	DOCTOR		HOSPITAL
E	STARTUP_COMPANY		INVESTOR
F	SOFTWARE_DEVELOPER		PROJECT
G	UNIVERSITY		DEPARTMENT
H	USER		SMART_DEVICE

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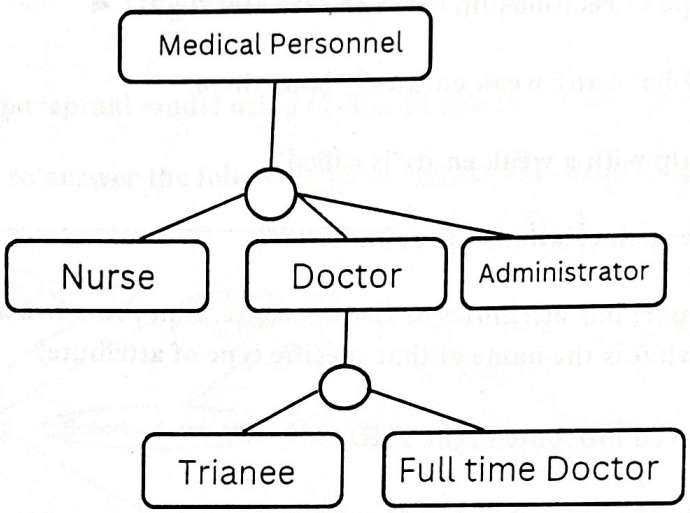
Q6: [CLO2- Design a conceptual model using (E)ER diagrams for an enterprise] [9 marks]

PART A

Complete the Enhanced Entity Relationship diagram below. You only need to specify the constraints and participation, there is no need to specify the attributes. Please note that the nurse and doctor can be administrators simultaneously. [2 Marks]



PART B

Draw ER diagram only for the following requirement **[7 Marks]**

Design a database schema for an e-commerce platform that sells a wide variety of products. The platform offers Electronics, Clothing, Books, and Furniture as product categories.

Each product type has its own specific characteristics. For example, electronics have details like warranty, voltage and brand, clothing includes information like size and material, books store details such as author and ISBN, and furniture includes dimensions and weight. However, all products share common information such as a name, price, and description. However, some products, like Smart Wearables, belong to multiple categories.

A Smart Wearable product combines the characteristics of both Electronics and Clothing. For instance, a smartwatch is considered both an electronic device (with WarrantyPeriod and Voltage) and a wearable item (with Size and Material).

Marked correct on rechecking

Q5 :

A : 1 : 1 ✓

B : M : N ✓

C : 1 : N ✓

D : N : 1 ✗

E : M : N ✗ → Investors can invert in multiple startups

F : M : N ✓ → 1 Dev can work on multiple projects

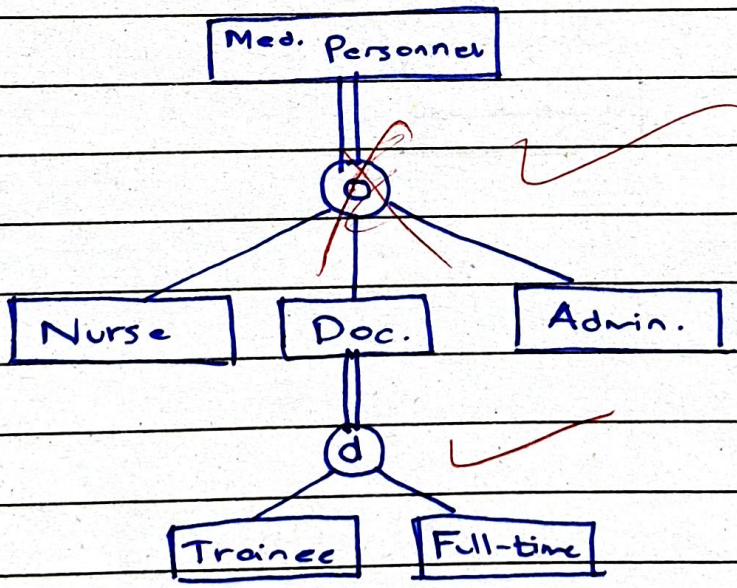
G : 1 : N ✓

H : N : 1 ✗

2.5/4

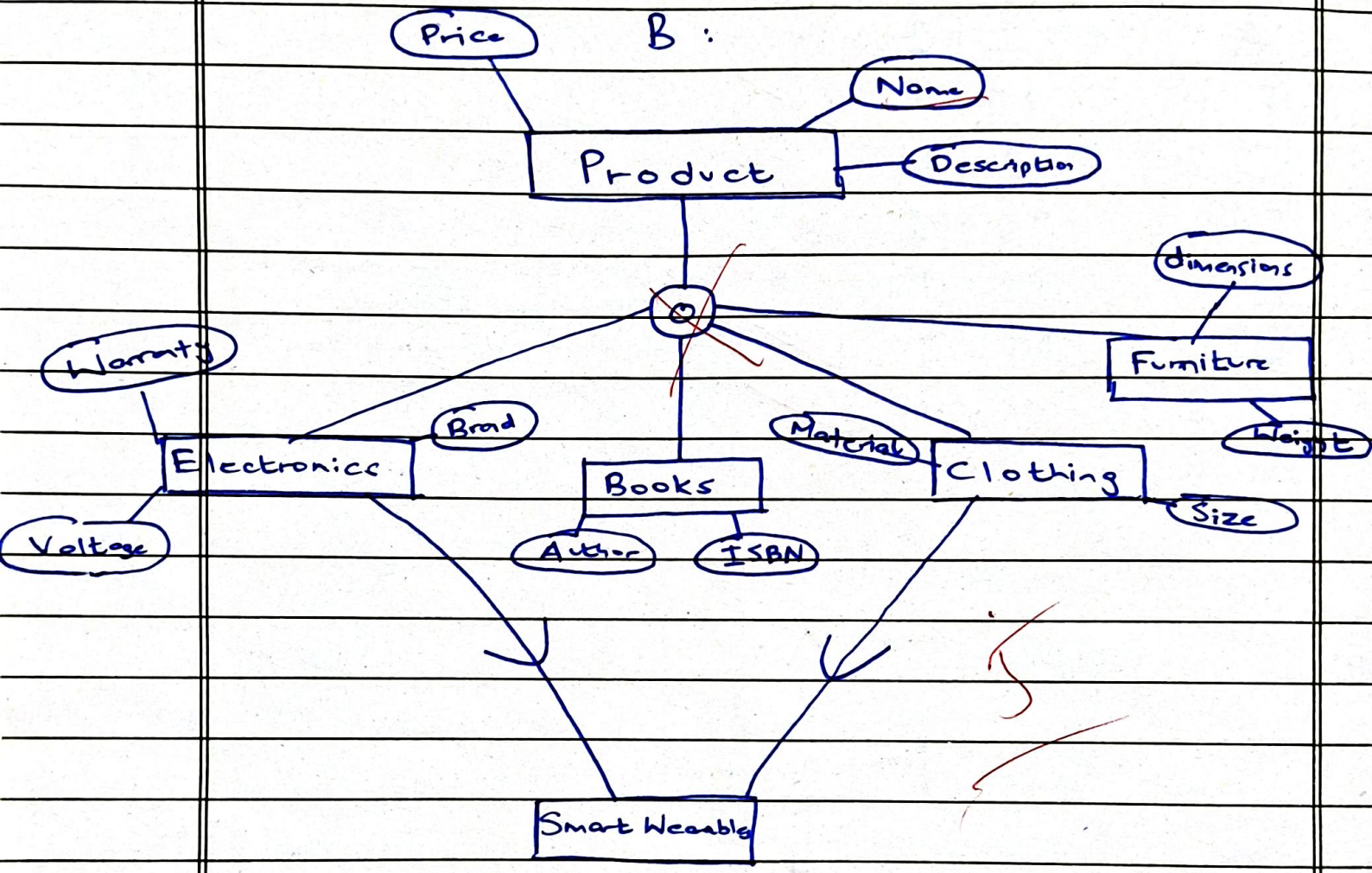
Q6:

A :



4/5

B :


Price
Name
Product
Description
dimensions
Warranty
Furniture
Brand
Material
Weight
Electronics
Books
Clothing
Size
Voltage
Author
ISBN
Smart Wearable