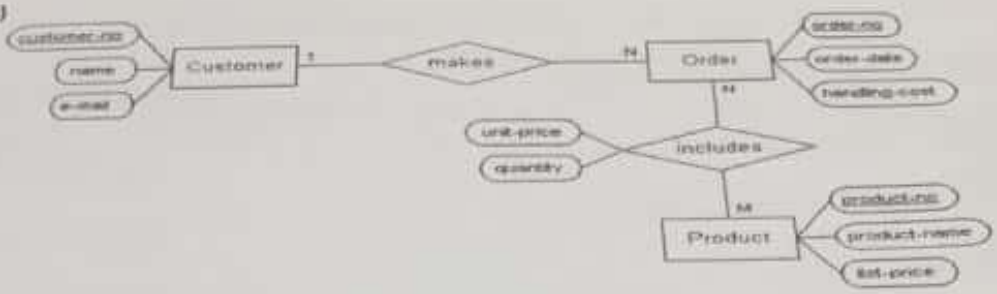
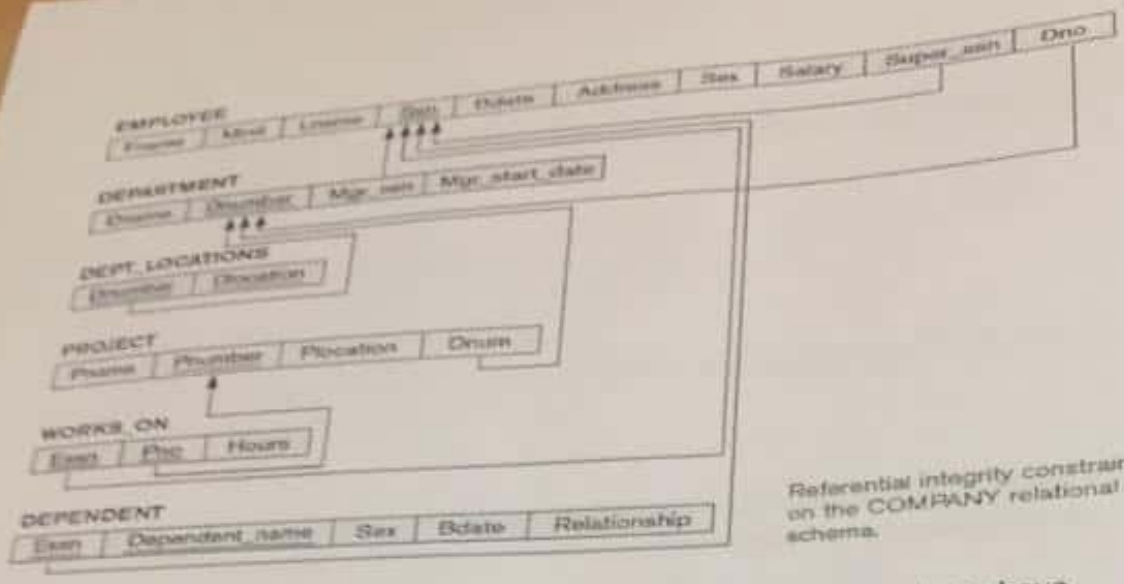
3. (20 p)



a-) (10 p) Consider the ER diagram given above. Extract from the ER diagram the requirements and constraints that produced this schema. Try to be as precise as possible in your requirements and constraints specification.

(10 p) Map the ER diagram given above into a relational schema. Do not forget to underline the keys.

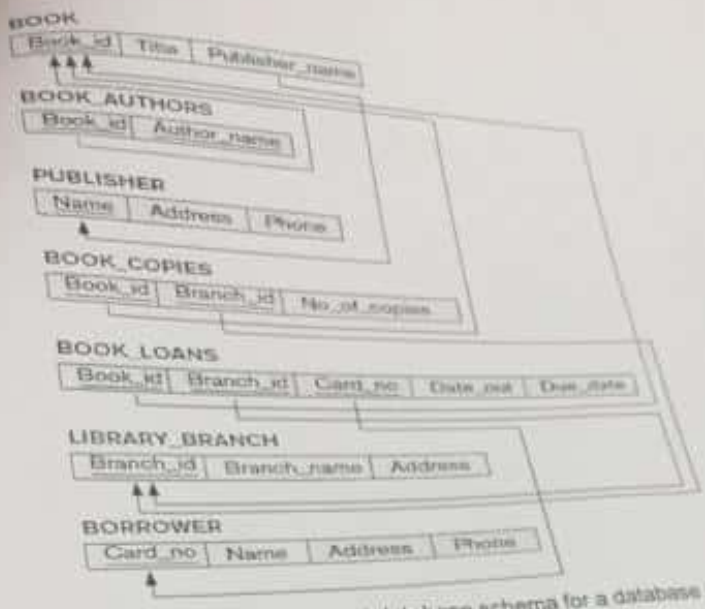


Referential integrity constraints displayed on the COMPANY relational database schema.

4. *(20 p) Write the following queries in* **SQL** *in COMPANY database given above.*
   a. *For each department whose average employee salary is more than $30000, retrieve the department name and the number of employees working for that department.*

b. *For each project, retrieve the project number, the project name, and the number of employees who work on that project.*

Retrieve the names of employees who make at least $10,000 more than the employee who is paid the least in the company.



5. **(20 p)** A relational database schema for a database is given above. Write the following queries in **Relational Algebra.**

   a. How many copies of the book titled 'The Lost Tribe' are owned by the library branch whose name is 'Sharpstown'?

   b. How many copies of the book titled 'The Lost Tribe' are owned by each library branch?

   c. Retrieve the names of all borrowers who do not have any books checked out.

   d. For each libray branch, retrieve the branch name and the total number of bo that branch.

COM258A (%30 Ing)	COM258B (Ing)

1	2	3	4	5	6

Name:
Student ID:

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(Answer only 5 questions)

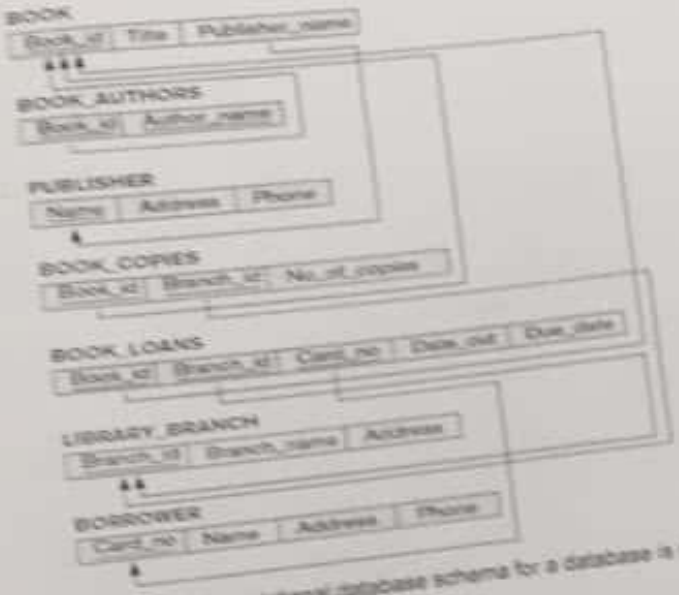
1. **(20 p)**

a-) Suppose you are given a relation R=(X, Y, Z, W, Q) with the following functional dependencies: (YZ→XWQ, W→Y, Z→Q) Find the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Explain briefly. Normalize the relation just one level higher.

b-) Suppose you are given a relation R = (X, Y, Z, W, Q) with the following functional dependencies: (ZQ →Y, W→Z, X→Q) Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Explain briefly. Normalize the relation just one level higher.

c-) Suppose you are given a relation R = (A, B, C, D) with the following functional dependencies: (C →D, C→A, B→C) Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Explain briefly. Normalize the relation just one level higher.

d-) Suppose you are given a relation R = (A, B, C, D) with the following functional dependencies: (BD →C, BD→A) Identify the best normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Explain brief Normalize the relation just one level higher.



5. **(20 p)** A relational database schema for a database is given above. Write the following queries in **Relational Algebra**.

   a. How many copies of the book titled 'The Lost Tribe' are owned by the library branch whose name is 'Sharpstown'?

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   c. Retrieve the names of all borrowers who do not have any books checked out.

   d. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.

2. **a-) (12 p)** *Consider the four transactions T_1, T_2, T_3 and T_4 and the schedule S_1 given below. Draw the serializability (precedence) graph for S_1, and state whether the schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s).*

T_1: $r_1(X)$; $r_1(Z)$; $w_1(X)$;
T_2: $r_2(Z)$; $r_2(Y)$; $w_2(Z)$; $w_2(Y)$;
T_3: $r_3(X)$; $r_3(Y)$; $w_3(Y)$;
T_4: $r_4(Z)$; $r_4(Y)$; $r_4(X)$; $w_4(Z)$; $w_4(Y)$;

S_1: $r_1(X)$; $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $r_4(Z)$; $w_1(X)$; $w_3(Y)$; $r_4(Y)$; $r_4(X)$; $r_2(Y)$; $w_2(Z)$; $w_4(Z)$; $w_2(Y)$; $w_4(Y)$

b-) (8 p) *Consider the schedules S_2 and S_3 below. Determine whether each schedule is strict, cascadeless, recoverable, or nonrecoverable. (Determine the strictest recoverability condition that each schedule satisfies).*

X); $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $r_4(Z)$; $w_1(X)$; $w_3(Y)$; $r_4(Y)$; $r_4(X)$; $r_2(Y)$; $w_2(Z)$; $w_4(Z)$; $w_2(Y)$; $w_4(Y)$ c_1, c_2, c_3, c
); $r_2(Z)$; $r_1(Z)$; $r_3(X)$; $r_3(Y)$; $r_4(Z)$; $w_1(X)$; $w_3(Y)$; $r_4(Y)$; $r_4(X)$; $r_2(Y)$; $w_2(Z)$; $w_4(Z)$; c_1; c_3; $w_2(Y)$; $w_4(Y)$; c_2; c