National University of Computer and Emerging Sciences

FAST School of Computing **Spring-2023** **Islamabad Campus**

CS-2005: Database Systems (AI/DS)

Serial No:

Sessional Exam-II

Total Time: 1 Hour
Total Marks: 50

Monday, 10th April 2023

Course Instructors

Dr. Waseem Shahzad, Dr. Ramoza Ahsan,
Ms. Ayesha Kamran ul Haq

_____
Signature of Invigilator

Student Name Roll No. Course Section Student Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

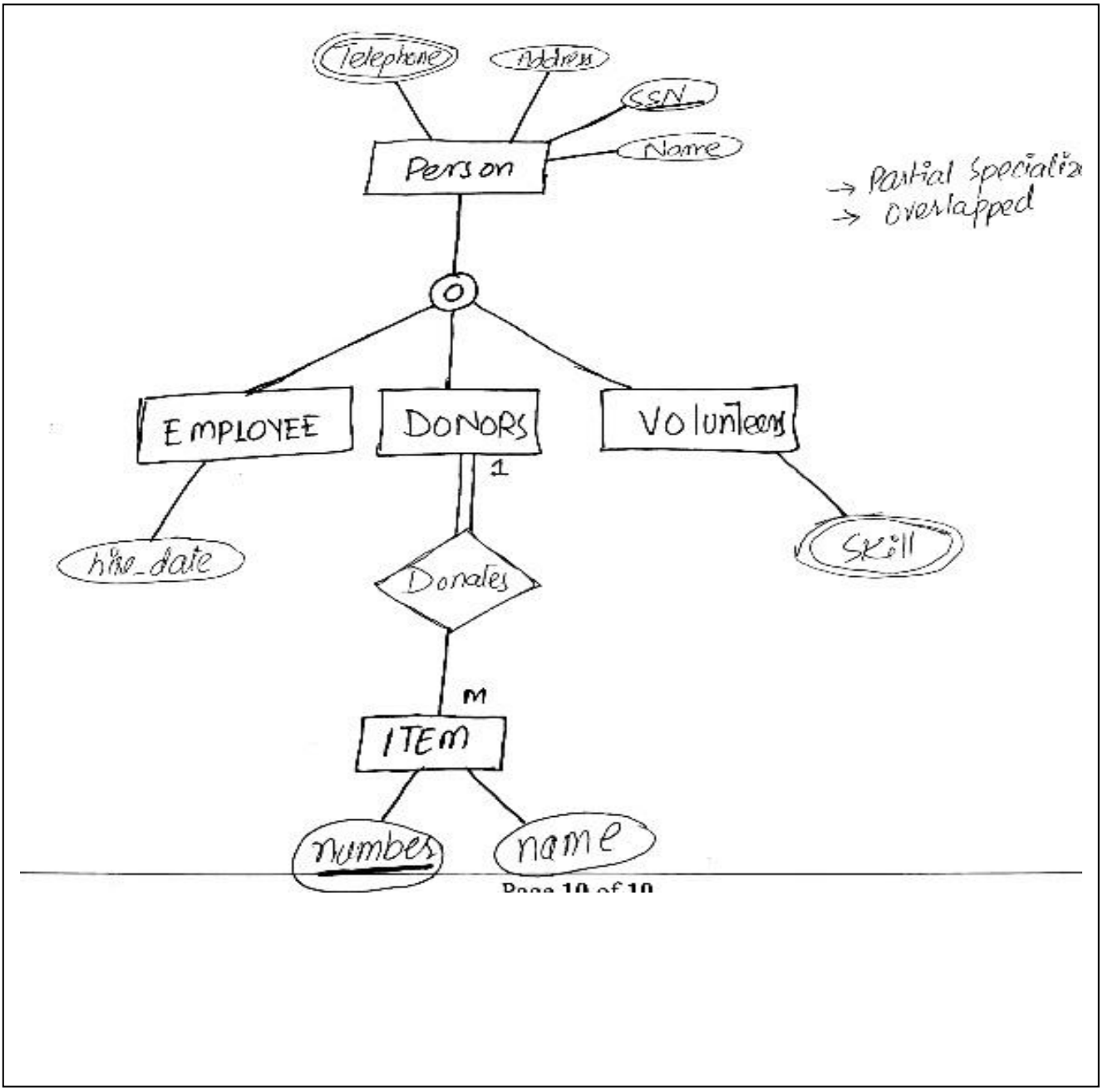
1. Attempt on the question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
2. No additional sheet will be provided for rough work. Use the back of the last page for rough work.
3. If you need more space, write on the back side of the paper and clearly mark the question and part number, etc.
4. After being asked to commence the exam, please verify that you have **eleven (11)** different printed pages including this title page. There is a total of **3** questions.
5. Calculator is strictly prohibited.
6. Use permanent ink pens only. Any part done using a soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	**Q-2**	**Q-3**	**Total**
Marks Obtained				
Total Marks	**10**	**15**	**25**	**50**

Question 1 [10 Marks]

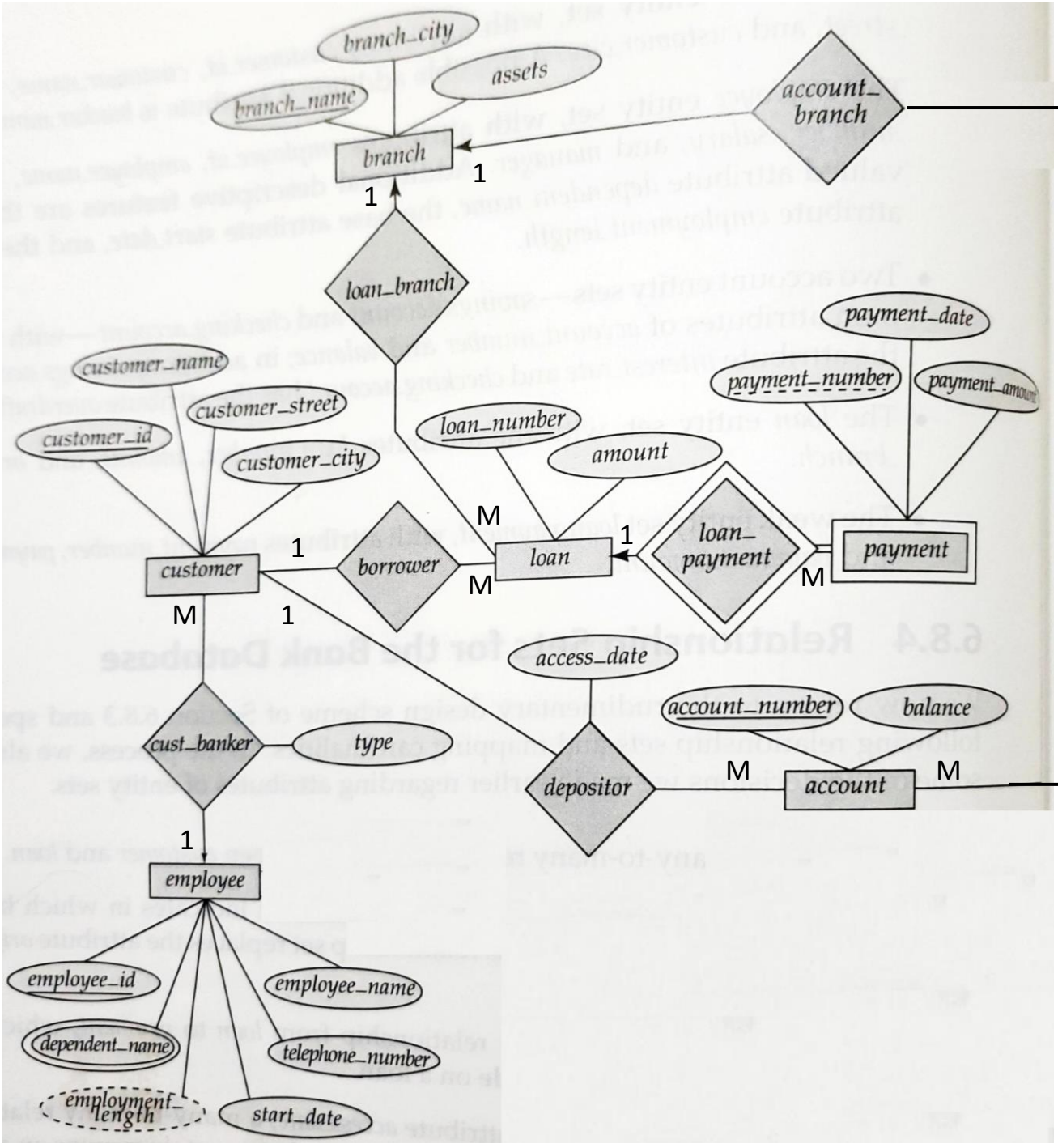
Draw an EER diagram based on the requirements below. Write down assumptions (if any) you make in your answer. Do not forget to underline the keys and mention the cardinalities.

An organization depends on a number of different types of persons for its sufficient operation. The organization is interested in the following attributes for all of these persons: SSN, Name, Address, and Telephone. A person may have multiple telephone numbers. Three types of persons are of greatest interest: employees, volunteers, and donors. Employees only have a Date Hired attribute, and volunteers only have a Skill attribute, Donors only have a relationship (named Donates) with an item that has a number and name. A donor must have donated one or more items, and an item may have no donors or one donor. There are persons other than employees, volunteers, and donors who are of interest to the organization so a person need not belong to any of these groups. On the other hand, at a given time a person may belong to two or more of these groups (for example, employees and donors).



Question 2 [15 Marks]

Consider the E-R diagram below, which models a banking enterprise. Convert the E-R diagram to a relational schema (tables and columns). Don't forget to mention primary and foreign keys.



Schemas derived from strong entities
branch= (branch_name, branch_city, assets)
customer = (customer_id, customer_name, customer_street, customer_city)
loan = (loan_number, amount)
account = (account_number, balance)
employee = (employee_id, employee_name, telephone_number, start_date)

Schemas derived from multi-valued attribute
dependent_name= (employee_id, d_name)

Schemas derived from relationship set
account_branch= (account_number, branch_name)
loan_branch= (loan_number, branch_name)
borrower = (customer_id, loan_number)
depositor= (customer_id, account_number)
cust_banker= (customer_id, employee_id, type)

Schemas derived from weak entity set
Payment= (loan_number, payment_number, payment_date, payment_amount)

Question 3 [25 Marks] Short Questions

Question 3-a: **(1 Mark)** This Query can be replaced by which one of the following?

```
SELECT name, course_id
FROM instructor i, teaches t
WHERE i. teachers_ID= t.teachers_ID;
```

a) Select name, course_id from teaches, instructor where teachers_id=course_id;

b) Select name, course_id from instructor natural join teaches;

c) Select name, course_id from instructor;

d) Select course_id from instructor join teaches;

Question 3-b: **(1 Mark)** The subclass which has more than one super class is called

a) Partial subclass

b) Shared subclass

c) Shared super class

d) Joint super class

Question 3-c: **(1 Mark)** By default, the order by clause lists items in _____ order

```
ELECT name
FROM instructor
WHERE dept name = “Physics”
ORDER BY name;
```

a) Descending

b) Any

c) Same

d) Ascending

Question 3-d: **(1 Mark)** _____ operator is used for appending two strings.

a) &

b) %

c) ||

d) _

Question 3-e: **(1 Mark)** Constraints ensure that a value that appears in one relation for a given set of attributes also appears for a certain set of attributes in another relation.

a) Logical Integrity

b) Referential Integrity

c) Domain Integrity

d) Data Integrity

Question 3-f: **(1 Mark)** Consider attributes ID, CITY, and NAME. Which one of these can be considered a super key?

a) NAME

b) ID

c) CITY

d) CITY, ID

Question 3-g: **(1 Mark)** The subset of a super key is a candidate key under what condition?

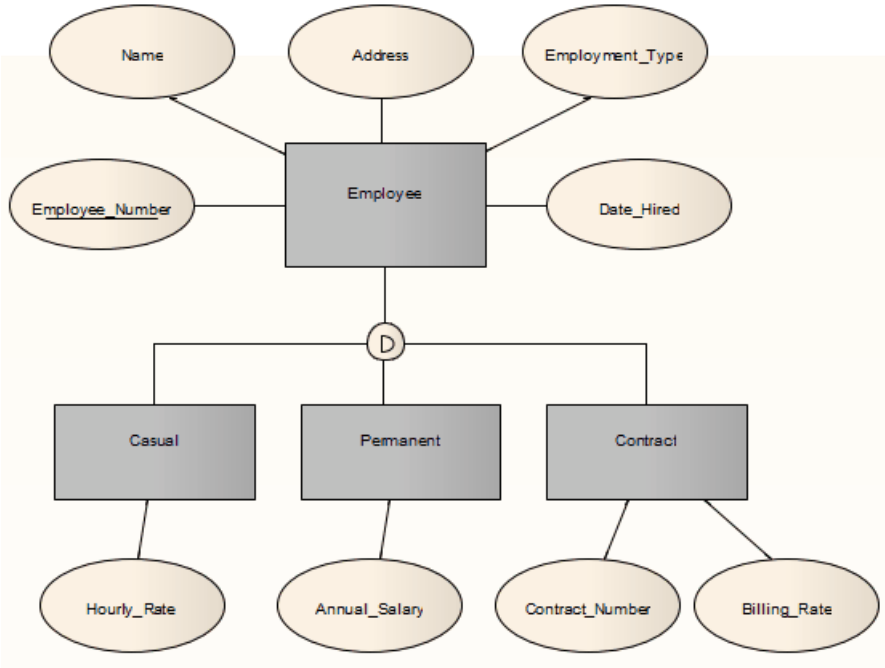
a) No proper subset is a super key

b) All subsets are super keys

c) Subset is a super key

d) Each subset is a super key

Question 3-h: **(2+2 Marks)** Consider EERD below and write down any two conversion rules (with reason) that can be applied while mapping this EERD to a relational schema.



Option 1: Multiple relations-superclass and subclasses

Steps:

- **Create a relation for superclass C and put all attributes of C in the relation.**
- **Create a relation for each subclass and put all attributes of each subclass in its corresponding relation.**
- Add the primary key of C in each subclass relation.

Reason: It works any kind of specialization(Total, partial, disjoint, overlap)

Option 3: Single relation with one type attribute

Steps:

- **Create "only one" relation. Put all attributes of superclass C in the relation.**
- **Put all attributes of each subclass in the same new relation.**
- **Add a new attribute to the relation, this attribute is used to discriminate between different entity types.**
  - Here, the primary key for our single relation is K.

Reason: It works only for disjoint

Option 4: Single relation with multiple type attributes

Steps:

- **Create "only one" relation. Put all attributes of superclass C in the relation.**
- **Put all attributes of each subclass in the same new relation.**
- **Add new attributes to the relation, each attribute corresponds to one subclass type. Each attribute is a Boolean attribute used to discriminate between different entity types.**

Reason: It is specially work for overlapped but also work for disjoint

Question 3-i: **(2 Marks)** Consider the following relations for a database that keeps track of student enrollment in courses and the books adopted for each course:

STUDENT(Ssn, Name, Major, Bdate)

COURSE(Course#, Cname, Dept)

ENROLL(Ssn, Course#, Quarter, Grade)

BOOK_ADOPTION(Course#, Quarter, Book_isbn)

TEXT(Book_isbn, Book_title, Publisher, Author)

Specify the primary and foreign keys for this schema, stating any assumptions you make

Primary keys:
STUDENT(**Ssn**, Name, Major, Bdate)
COURSE(**Course#**, Cname, Dept)
ENROLL(**Ssn, Course#**, Quarter, Grade)
BOOK_ADOPTION(**Course#**, Quarter, **Book_isbn**)
TEXT(**Book_isbn**, Book_title, Publisher, Author)

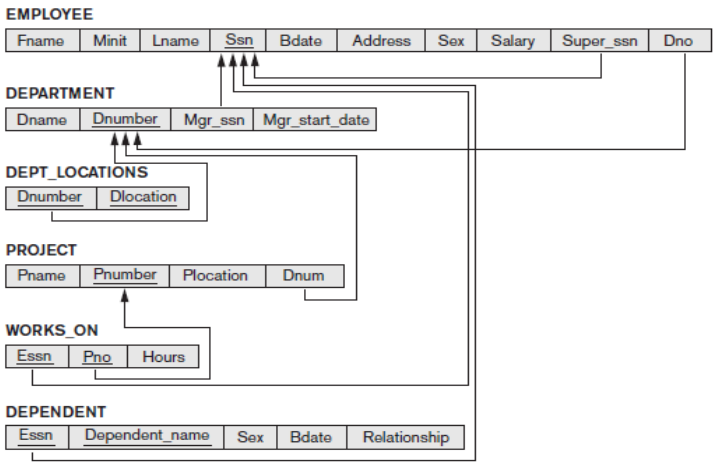
Foreign keys:
In Enroll, Ssn and Course# are foreign keys from Student and course tables.
In Book_adoption, Course# is foreign key from Course, Book_isbn from Text.

Question 3-j: **(2 Marks)** Recent changes in privacy laws have disallowed organizations from using Social Security numbers to identify individuals unless certain restrictions are satisfied. As a result, most U.S. universities cannot use SSNs as primary keys (except for financial data). In practice, Student_id, a unique identifier assigned to every student, is likely to be used as the primary key rather than SSN since Student_id can be used throughout the system.

Some database designers are reluctant to use generated keys for primary keys (such as Student_id) because they are artificial. Can you propose any natural choices of keys that can be used to identify the student record in a UNIVERSITY database?

Email address of student can be used as each student has unique email address.
Assuming that each student will have phone number, it can also be used as a key.

Question 3-k: (**2+3+2 Marks**) Specify the following queries in SQL on the COMPANY relational database schema shown below.



a) Retrieve the names of all employees in Department 5 who work more than 10 hours per week on the ProductX project.

```
SELECT DISTINCT e.ename
FROM EMPLOYEE e join WORKS_ON w ON(e.ssn = w.Essn)
Join PROJECT p ON(w.pno = p.Pnumber)
WHERE e.Dno = 5
AND p.pname = 'ProductX' AND hours >10
```

b) List the names of all employees who have a dependent with the same first name as themselves.

```
SELECT DISTINCT e.ename
FROM EMPLOYEE e, DEPENDENT d ON (e.ssn = d.Essn)
Where d.dependent_name LIKE CONCAT(e.first_name, '%');
```

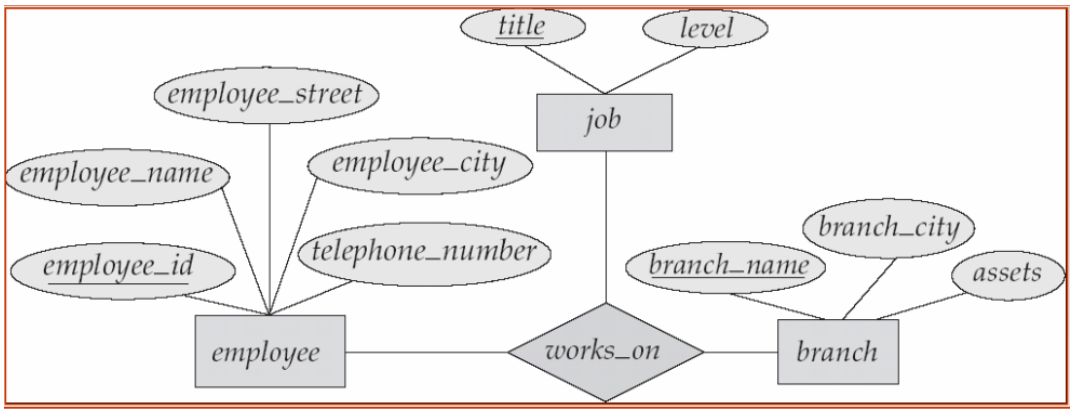
OR

```
SELECT DISTINCT e.ename
FROM EMPLOYEE e, DEPENDENT d ON (e.ssn = d.Essn)
where d.dependent_name = e.first_name;
```

c) Find the names of all employees who are directly supervised by 'Franklin Wong'.

```
SELECT e.ename
FROM EMPLOYEE e, EMPLOYEE s ON (e.SUPER_SSN = s.ssn)
where s.ename = 'Franklin Wong';
```

Question 3-l: (**3 Marks**) Convert the following ER diagram with a ternary relationship into a relational schema.



employee(employee_id, employee_name, employee_street, employee_city, telephone_number)
branch(branch_name, branch_city, assets)
job(title, level)
works_on(employee_id, branch_name, title)