National University of Computer and Emerging Sciences

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

CS-2004: Database Systems

CS - A , B , C , D

Saturday, 7th November, 2023

Course Instructors

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Serial No:

2nd Sessional Exam

Total Time: 1 Hour

Total Marks: 70

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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 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 question and part number etc.
4. After asked to commence the exam, please verify that you have **ten** different printed pages including this title page. There are total of **4** questions.
5. Calculator sharing is strictly prohibited.
6. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	**Q-2**	**Q-3**	**Q-4**	**Total**
Marks Obtained					
Total Marks	**20**	**25**	**10**	**20**	**70**

Question 1 [4x5=15 Marks]

Marking Criteria = Correct = 4 marls else zero

Consider the database of the art gallery below and answer the following queries.

Paintings

Painting_ID	Name	Artist_ID	Listed_Price
P1	Sunshine	A1	3000
P2	Mountains	A2	5000
P3	Barbie	A1	2500
P4	Black Mirror	A3	2700
P5	Night sky	A2	1000
P6	Blue Moon	A4	4500

Artists

Artist_ID	First_Name	Last_Name
A1	Thomas	Black
A2	Kate	Smith
A3	Natali	Wein
A4	Jon	Benelli

Collectors

Collectors_ID	First_Name	Last_Name
101	Brandon	Cooper
102	Laura	Fisher
103	Christina	Buffet
104	Steve	Stevenson

Sales

Sales_ID	Date	Painting_ID	Artist_ID	Coll_ID	Sales_Price
1001	2-2-2023	P1	A1	104	2800
1002	3-4-2023	P5	A2	102	1000
1003	4-5-2023	P2	A2	103	4500
1004	1-4-2023	P6	A4	103	4350
1005	15-8-2023	P3	A1	102	2500
1006	23-7-2023	P4	A3	103	2600

a. List paintings that are priced higher than the average

```
SELECT Name, Listed_Price FROM Paintings
WHERE Listed_Price >( SELECT AVG(listed_price) FROM paintings
);
```

b. List the names of all collectors who purchased paintings from the art gallery.

```
SELECT First_Name, Last_Name FROM collectors
WHERE id IN ( SELECT collector_id FROM sales
);
```

c. List the artist's name who have sold only 1 painting in the gallery.

```
SELECT First_Name, Last_Name
FROM artists
Inner join (SELECT Artist_ID, count(*)
 FROM sales
 group by Artist_ID having count(*)=1) AS sales ON Artists.Artist_ID =
sales.Artist_ID;
```

d. Show the first names and the last names of the artists who had zero sales with the art gallery

```
SELECT First_Name, Last_Name
FROM Artists
WHERE NOT EXISTS (SELECT * FROM sales WHERE sales.Artist_ID = artists.Artist_ID);
```

e. Write the output of the following query.

```
SELECT First_Name, Last_Name
FROM collectors
NATURAL JOIN (
Select max(cnt), Collector_ID from (SELECT Collector_ID,count(*) as
cnt FROM sales group by Collector_ID));
```

Output:

First_Name	Last_Name
Christina	Buffet

Question 2 [25 Marks]

Consider the table given below containing the details of patient dental appointments.

StaffNo	DentistName	PatientNo	PatientName	AppointmentDate	SurgeryNo
S1011	Tony Smith	P100	Gilli White	12 Aug 2023	S10
S1011	Tony Smith	P105	Jill Bell	13 Aug 2023	S15
S1024	Helen Pearson	P108	John Walker	13 Aug 2023	S10
S1024	Helen Pearson	P108	John Walker	13 Sept 2023	S10
S1032	Robin Pleven	P105	Jill Bell	1 Oct 2023	S15
S1032	Robin Pleven	P110	Henry Klein	10 Oct 2023	S13
S1051	Kenry Jell	P111	Henry Klein	30 Oct 2023	S12

a. Is the above relation in 1 NF? Answer in yes or no. [2]

No 3 marks or zero

b. If the answer of **part a** is NO then convert the relation into 1 NF and write the schema of 1 NF relations. If the relation is already in 1 NF, then write the schema of above relation as it is. [3]

SOL 1 : depending on how much solution is correct, 0 -3 marks

We'll make composite primary key {StaffNo,PatientNo}

StaffNo	**PatientNo**	DentistName	PatientName	AppointmentDate	SurgeryNo
S1011	P100	Tony Smith	Gilli White	12 Aug 2023	S10
S1011	P105	Tony Smith	Jill Bell	13 Aug 2023	S15
S1024	P108	Helen Pearson	John Walker	13 Aug 2023	S10
S1024	P109	Helen Pearson	John Cruise	13 Sept 2023	S9
S1032	P105	Robin Pleven	Jill Bell	1 Oct 2023	S15
S1032	P110	Robin Pleven	Henry Klein	10 Oct 2023	S13
S1051	P111	Kenry Jell	Henry Klein	30 Oct 2023	S12

SOL 2:

We'll separate multivalued attributes

StaffNo	DentistName

S1011	Tony Smith		
S1024	Helen Pearson		
S1032	Robin Pleven		
S1051	Kenry Jell		

StaffNo	**PatientNo**	**PatientName**	**AppointmentDate**	**SurgeryNo**
S1011	P100	Gilli White	12 Aug 2023	S10
S1011	P105	Jill Bell	13 Aug 2023	S15
S1024	P108	John Walker	13 Aug 2023	S10
S1024	P109	John Cruise	13 Sept 2023	S9
S1032	P105	Jill Bell	1 Oct 2023	S15
S1032	P110	Henry Klein	10 Oct 2023	S13
S1051	P111	Henry Klein	30 Oct 2023	S12

c. Identify the functional dependencies from the relation mentioned in **part b**. [3]

{StaffNo} → DentistName
{PatientNo} → PatientName
{StaffNo,PatientNo} → AppointmentDate
{StaffNo,PatientNo} → Surgery

depending on how much solution is correct, 0 -3 marks

d. Mention the FDs that have been identified in **part d** as full or partial. [3]

depending on how much solution is correct, 0 -3 marks

FDs	FULL or PARTIAL
Sol 1: {StaffNo} → DentistName {PatientNo} → PatientName {StaffNo,PatientNo} → AppointmentDate {StaffNo,PatientNo} → Surgery	 Partial Partial Full Full
Sol 2: {StaffNo} → DentistName {PatientNo} → PatientName {StaffNo,PatientNo} → AppointmentDate {StaffNo,PatientNo} → Surgery	 Full FD Partial Full Full

e. Is/Are the relation(s) mentioned in answer of **part b** in 2NF? Answer in YES or NO. [2]

NO zero or 3 marks

f. Convert the relation into 2NF if the answer of **part c** is NO. [3]

Table 1: **depending on how much solution is correct, 0 -3 marks**

StaffNo	DentistName

Table 2:

PatientNo	PatientName

Table 3:

StaffNo	PatientNo	AppointmentDate	SurgeryNo

g. Are the relations mentioned in **part f** in 3 NF? (YES or NO) [2]

Yes

3 marks or zero

h. What are the transitive dependencies in the relations mentioned in **part f**. [3]

3 marks or zero

NONE

i. If the answer of **part g** is NO , then convert the relations into 3 NF. [3]

3 marks or zero

Relations are already in 3NF

j. Write the final normalized schema in the space below. [1]

0.5 marks if at least 2 correct

StaffNo	DentistName

Table 2:

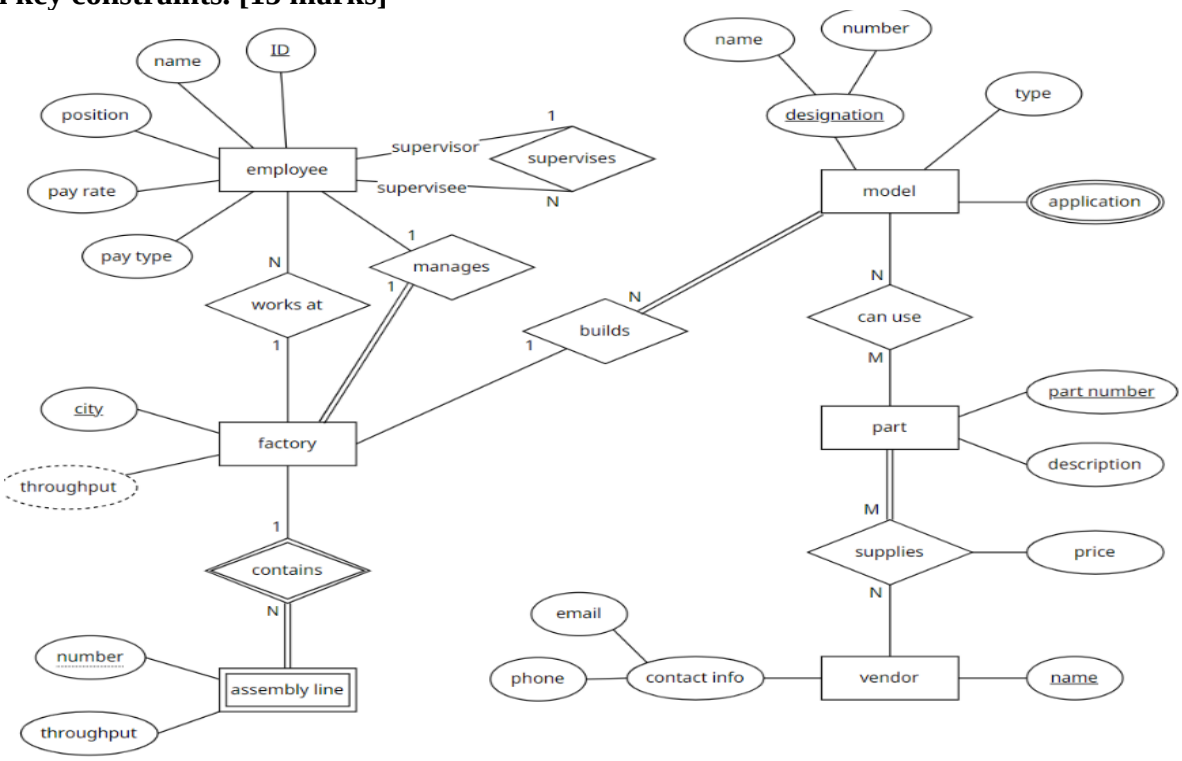
PatientNo	PatientName

Table 3:

StaffNo	PatientNo	AppointmentDate	SurgeryNo

Question 3 [25 Marks]

a. Production tracking is important in many manufacturing environments (e.g., the pharmaceuticals industry, children's toys, etc.). The following ER diagram captures important information in the tracking of production. Specifically, the ER diagram captures relationships between production lots (or batches), individual production units, and raw materials. Please convert the ER diagram into a relational database schema. Be certain to indicate primary key and foreign key constraints. [15 marks]



All highlighted portion contains marks

Employee (ID (pk) , name, position, payrate, pay type, supervisor (FK), factory city (fk)) 2 marks

Factory (city (pk) or fid as pk, throughput, managerID (fk) 1 mark

Assembly Line (number (pk), throughput, factory (fk) 1 mark

Model (name (pk), number (pk), number, name, type, factory city(fk 2 mark

Application (ID (pk), name (fk), number (fk),) 1 mark

Model_part(partno (fK) , name (fk), number (fk),) // both make composite primary key 2 marks (1 for mapping relations and one for correct pk and fk)

Part (partno (pk), description

Vendor (name (pk), email, phone no) 1 mark

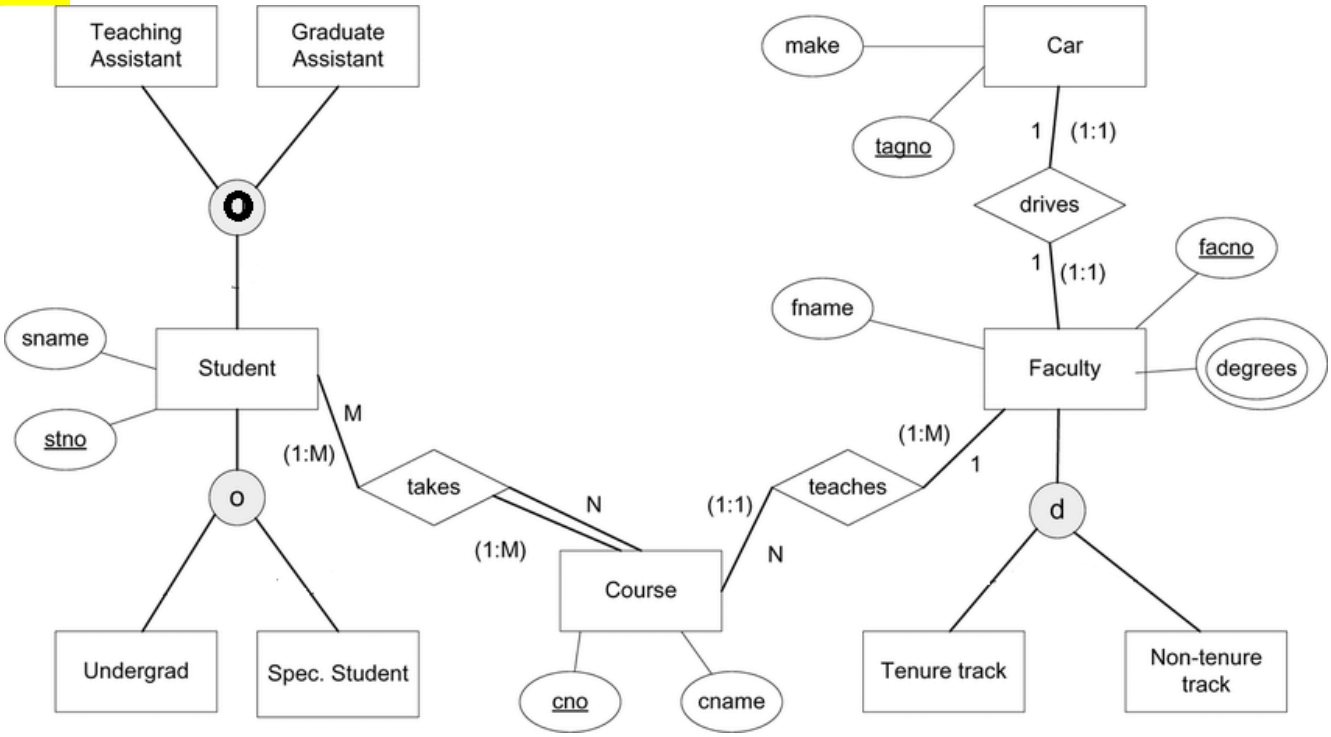
Supplier (partno (fk), (name (fk), price) // both make composite primary key 2 marks (1 for mapping relations and one for correct pk and fk)

3 marks for all other tables and pk

b. Complete the following enhanced ERD for a university management system by adding completeness and disjoint constraints.

The following EERD depicts the university management system. The university has three types of faculty members i.e., Tenure Track faculty (contract based) and non-tenure track. Faculty can also opt to work as visiting faculty for a semester. Faculty members can choose only one of the above-mentioned roles. Faculty car data is recorded and stored in the database for security reasons. Faculty can teach courses to the students. The university has both undergraduate students and graduate students which can also opt for specializations other than the courses that they have enrolled in. During the semesters, students can also opt to become either teaching assistants for undergraduate students or graduate students. Students can take both roles in the same semester.

Solution



Marking criteria
1 incorrect = – 1.5
2 incorrect = -3
3 incorrect = -5
4 incorrect= -6.5
5 incorrect = -8.5
6 incorrect = zero

Question 4 [10 Marks]

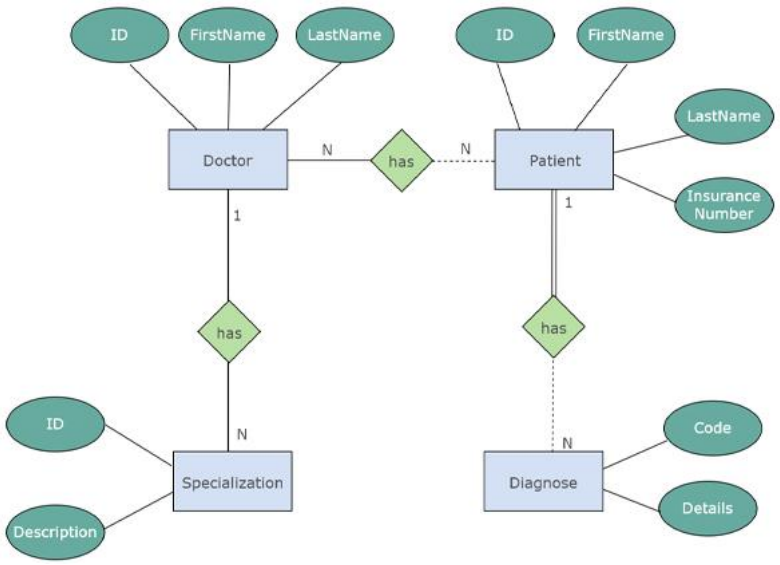
Fill the answer in the answer table (with correct option A/B/C/D). Overwriting and cutting will result in zero marks.

Answer Table 1 mark for each Missing/cutting/overwriting = 0	
1	B
2	B
3	A
4	B
5	A
6	B
7	C
8	C
9	B
10	A

1. Which of the following best represents the purpose of an Entity-Relationship Diagram (ERD)?

a) To design the physical database schema.
b) To visualize the high-level structure of a database.
c) To write SQL queries for data retrieval.
d) To create user interfaces for a database.

For 2 – 5 use the following ERD



2. What does a diamond shape represent in an ERD?

a) An entity.
b) A relationship.
c) An attribute.
d) A constraint.

3. In an ERD, what does a double line connecting two entities represent?

a) A one-to-one relationship.
b) A one-to-many relationship.
c) A many-to-many relationship.
d) A unique constraint.

4. When creating an ERD, what is an attribute?

a) A table in the database.
b) A property or characteristic of an entity.
c) A foreign key.
d) A relationship between entities.

5. What does an ellipse represent in an ERD?

a) An attribute.
b) A relationship.
c) An entity.
d) A constraint.

6. Which of the following represents an example of a recursive relationship in an ERD?

a) A student enrolls in a course.
b) An employee manages other employees.
c) A department has employees.
d) A customer purchases products.

7. What is the purpose of a super-type and sub-type relationship in an ERD?

a) To represent complex attributes.
b) To represent optional attributes.
c) To model specialization and generalization of entities.
d) To create composite keys.

8. In an ERD, what is a composite attribute?

a) An attribute that can have multiple values.
b) An attribute that is derived from other attributes.
c) An attribute that cannot be divided into smaller sub-attributes.
d) An attribute that is the primary key of an entity.

9. What is the primary purpose of a relational schema in database design?

a) To represent high-level conceptual relationships between entities.
b) To create a physical database structure with tables, keys, and constraints.
c) To define the relationships between entities using graphical notation.
d) To specify the cardinality of a relationship.

10. In a relational schema, what does a foreign key establish?

a) It establishes a relationship between two tables.
b) It specifies a primary key for a table.
c) It defines the data type for a column.
d) It adds constraints to a table.