

Part II

COMPUTING AND COMMUNICATIONS – On-line Assessment

Available Time [23 Hours]

Recommended Completion Time [3 Hours]

SCC.201 Database

*Candidates are asked to answer **THREE** questions from **FOUR**; each question is worth a total of 25 marks.*

Question 1

Consider the following database which shows TV series fictional characters, the houses they belong to and their favourite restaurants. The database shows the number of times each character has ordered from a certain restaurant. It is worth noting that in those old times each restaurant had only one branch and they used to prepare one and only one type of food.

Characters	CharID	Character	House	Restaurant	Location	Meal	Orders
	111	Cersei Lannister	Lannister	Bella Valyria	Valyria	Lasagne	135
				Dragonstone Kebab	King's Landing	Shawarma	120
				Westeros Chippy	Westeros	Fish & Chips	110
	222	Daenerys Targaryen	Targaryen	Westeros Chippy	Westeros	Fish & Chips	135
				Dragonstone Kebab	King's Landing	Shawarma	135
				Bella Valyria	Valyria	Lasagne	120
	333	Kevan Lannister	Lannister	Westeros Chippy	Westeros	Fish & Chips	842

1.a State the requirements for a relation being in First Normal Form (1NF) and show how a simple modification to the Characters relation would easily convert it into 1NF (show the modified relationship).

[2 marks]

1.b Explain what we mean by:

- i. non-trivial dependency
- ii. non-transitive dependency
- iii. functional dependency

[3 marks]

1.c Using the solution from part **1.a**, convert the relation into Second Normal Form (2NF) explaining your steps by showing dependencies and the normalised relations. Remember to underline the primary keys.

[4 marks]

Question 1 continues on next page...

Question 1 continued.

1.d Consider the three relations below for an online shop called 'The Breaking Deal'. The relations show order details for items purchased by certain customers. The shop allows each customer to place as many orders as they like, but each order can contain only one item. Also bear in mind that the same item can be purchased by different customers.

Please note that this sub-question contains several parts: i, ii, iii, iv, and v as detailed below)

Customers	Customer #	Name	Street	City	Country
	WW1	Walter White	3828 Piermont Drive	Albuquerque	USA
	JP1	Jesse Pinkman	322 16th St	Albuquerque	USA
	GF1	Gus Fring	12 Los Pollos Hermanos	Albuquerque	USA
	HS2	Hank Schrader	4901 Cumbre Del Sur	Santa Fe	UK
	ME4	Mike Ehrmantraut	666 Covent Gardens	London	UK
	SG7	Saul Goodman	9800 Montgomery Blvd	Albuquerque	USA

Items	Item#	Description	Category
	0001	XL Pizza	Food
	0002	Robot vacuum	House
	0003	Air Fryer	Kitchen
	0004	Travel Flask	Kitchen
	0005	Orange Shirt	Clothes

Orders	Order#	Item#	Customer#	Date	Quantity
	Or0022	0002	JP1	2021-02-10	1
	Or0024	0001	WW1	2021-02-05	1
	Or0025	0004	SG7	2021-02-06	1
	Or0026	0003	GF1	2021-02-01	3
	Or0027	0005	HS2	2021-02-03	6
	Or0031	0005	WW1	2021-04-05	3

- i. Describe Relational Algebra's **Select**, **Project** and **Natural Join** operators, give examples but do not print any results.

[3 marks]

- ii. List the primary and foreign keys (if applicable) for each relation shown above.

[2 marks]

- iii. Using natural join in relational algebra, find all customers who live in the UK and have an order with a Quantity > 1

[2 marks]

Question 1 continues on next page...

Question 1 continues on next page...

iv. Find all items that fall into the Kitchen or Food Categories.

[2 marks]

v. Show only Name and city of all customers living in the UK.

[2 marks]

1.e) Produce an Entity-Relationship (ER) model for the relationships above including all entities and their relationships. Make sure the primary keys are the same as in your answer to **1.d.ii**.

[5 marks]

[Total 25 marks]

Question 2

Consider the two relations below which show best female writers from all around the globe and the corresponding publishers they are contracted to.

Writers	WriterID	Name	Age	Country	Genre	#Books	PublisherID
	W1	Ana Morrison	26	Australia	Mysteries	10	P1
	W2	Joanne Atwood	28	UK	Romance	20	P2
	W3	Virginia Woolf	34	USA	Thrillers	35	P3
	W4	Roseline Adichie	35	Nigeria	Sci-Fi	49	P4
	W5	Zadie Lee	29	Algeria	Fantasy	31	P5
	W6	Harper Smith	29	Belgium	Sci-Fi	29	P4
	W7	Salma Walker	29	Ireland	Thrillers	30	P3
	W8	Nadine Rowling	32	Jordan	Sci-Fi	40	P2
	W9	Yaa Ali	28	Kenya	Fantasy	60	P2
	W10	Ghada Ahmed	30	Syria	Thrillers	42	P1
	W11	Sahar Hadid	27	Morocco	Fantasy	49	P3

Publishers	PublisherID	Publisher	Location
	P1	The Writers	New York
	P2	Super Books	Edinburgh
	P3	Books R Us	Dallas
	P4	Bellevue	Seattle
	P5	Catapult	Madrid
	P6	City Lights	London

2.a Using the **Publishers** relation and assuming a relational model give examples for each of the following:

- i. Attribute [1 mark]
- ii. Tuple [1 mark]
- iii. Domain [1 mark]

Question 2 continues on next page...

Question 2 continued.

2.b What is the degree for each of the Writers and Publishers relations.

[1 mark]

2.c Give the SQL statement needed to create the Writers relation declaring primary and foreign keys.

[4 marks]

2.d Publishing agency Bellevue has just signed a new contract with the famous writer Zadie Lee who will in turn stop writing for the Catapult publisher. Following that, the Catapult publisher has gone into administration and closed its only branch in Madrid. Produce two SQL statements to:

i. reflect the new contract for Zadie Lee

[2 marks]

ii. to remove Catapult's records from the publishers list.

[2 marks]

2.e Convert the following diagram into a set of the following relationships showing and underlining keys as appropriate:

i. Entities to relation(s)

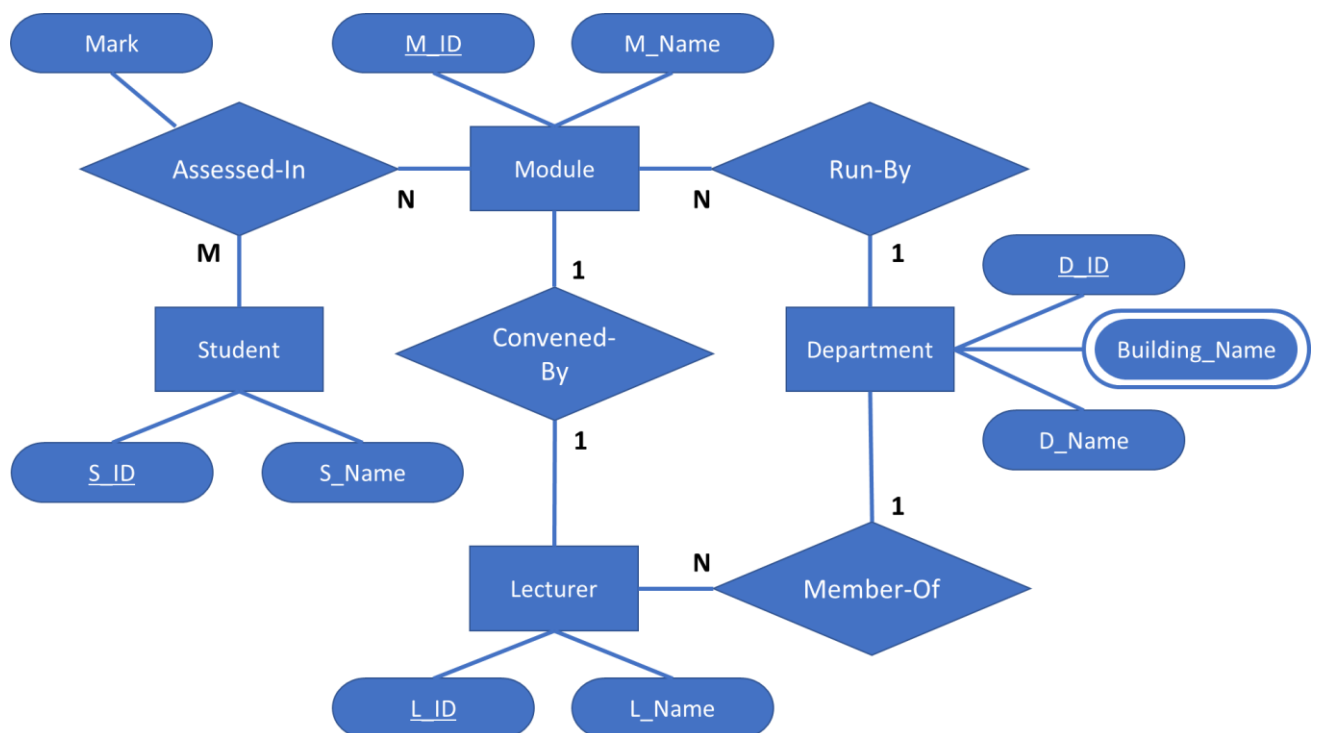
[3 marks]

ii. 1:1 relation(s)

[1 mark]

iii. 1:N relation(s)

[2 marks]



Question 2 continues on next page...

Question 2 continued.

2.f Consider the following two relations that shows details about each house in Game of Thrones and when they were founded and whether that was "Before Conquest" or after conquest "AC".

Houses	HouseID	House	Head	Founded	WeaponID	Population
	H1	Targaryen	Queen Daenerys I	1 AC	W1	200000
	H2	Lannister	Lady Cersei Lannister	10000 BC	W1	150000
	H3	Stark	King Bran Stark	10000 BC	W1	30000
	H4	Tyrell	Lord Mace Tyrell	299 AC	W2	80000
	H5	Baratheon	King Tommen I Baratheon	114 BC	W1	55000

Weapons	WeaponID	Weapon	Coat-of-arms
	W1	Sword	Three-headed dragon
	W1	Sword	Gold lion
	W1	Sword	Running grey wolf
	W2	Hammer	Golden rose
	W2	Hammer	Black crowned stag

- i. Give the SQL statement that will show the Coat-of-arms and Total-Population for houses using Sword as a weapon and year founded before the conquest.

[4 marks]

- ii. Give the SQL statement to show the head of the house for all houses where coat of arm contains either rose or lion.

[3 marks]

[Total 25 marks]

Question 3

This question uses the following hospital relations:

Patient (pno, title, pname, dob, children, GP)

Drug (dno, dname, doi, unit, cost)

Dose (pno*, dno*, dosedate, qty)

The question relates to **DEADLOCKS and transactions**.

3.a With reasons, explain what is the impact on COST of the following two command sequences:

i. BEGIN
UPDATE Drug set **COST=COST+2**;
COMMIT; [2 mark]

ii. BEGIN
UPDATE Drug set **COST=COST+2**;
ROLLBACK; [2 mark]

3.b With the use of examples, show how **Strict two phase locking** results in atomistic and concurrent transaction schedules. (no more than 1 page)

[6 marks]

3.c Using possible queries for the relations above, give two possible scenarios where a sequence of queries may lead to inconsistent states if transaction management was not used.

[4 marks]

3.d What is a 'deadlock' in a database schedule?

[1 mark]

3.e Using possible queries for the relations above. Describe with examples how deadlocks can be determined, and how they can be dealt with (no more than 1 page).

[6 marks]

3.f Define extra relations which would allow the hospital to record the each consultation of a hospital worker with a patient. NB, the consultation may result in a prescription which involves more than one drug.

[4 marks]

[Total 25 marks]

Question 4

This question uses the following hospital relations:

Patient (pno, title, pname, dob, children, GP)
Drug (dno, dname, doi, unit, cost)
Dose (pno*, dno*, dosedate, qty)
Doctor (drno, title, dname, salary, yrOfQualication)
Nurse (nno, title, nname, salary, yrOfQualification)

Main Applications

App1 SELECT Dno, Dname from Drug WHERE Cost > <value>
App2 SELECT Dname, Unit from Drug WHERE DOI < <value>
App3 SELECT Dname, DOI Drug WHERE Unit = <value>

Application Frequencies

App1=60, App2=10, App3=1

The question relates to **optimisation and security**.

4.a With reasons, explain what indexes may be added to the Drug relation

[6 mark]

4.b Explain what types should be chosen for each attribute in Drug

[6 marks]

4.c It is possible to fragment the Drug relation into two related relations:

Drug1(dno, dname, cost)
Drug2(dno, doi, unit)

i. Explain why this might give a performance boost

[2 marks]

ii. With relevant parse trees, explain how the performance of each application may be affected

[6 marks]

Question 4 continues on next page...

Question 4 continued.

4.d Consider the following users of the hospital system:

- A. Doctor
- B. Patient
- C. Nurse
- D. Drug sales person
- E. Pharmacist

- i. Create appropriate SQL commands which will create the relevant views needed by:
patient and a Drug sales person.

[2 marks]

- ii. Create appropriate SQL commands which will create the relevant grants for the users: patient and a Drug sales person.

[3 marks]

[Total 25 marks]

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