UNIVERSITI TEKNOLOGI MARA
FINAL EXAMINATION

COURSE	:	**DATABASE ENGINEERING**
COURSE CODE	:	**ICT502/ITS571**
EXAMINATION	:	**JULY 2025**
TIME	:	**3 HOURS**

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of five (5) questions.
2. Answer ALL questions in the Answer Booklet. Start each answer on a new page.
3. Do not bring any material into the examination room unless permission is given by the invigilator.
4. Please check to make sure that this examination pack consists of:
   i) the Question Paper
   ii) an Answer Booklet – provided by the Faculty
5. Answer ALL questions in English.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of 6 printed pages

QUESTION 1

a) Differentiate between logical and physical data independence in the ANSI-SPARC three-level architecture.

(4 marks)

b) Study the following schema in WeMart.

FOOD	**(FoodID, FoodName, FoodPrice, FoodCategory, FoodExpiryDate)**
BRANCH	**(BranchID, BranchName, BranchPhone, BranchAddress, StateID)**
STAFF	**(StaffID, StaffName, StaffEmail, StaffPhone, StaffSalary, BranchID)**
SALES	**(SalesID, SalesDate, FoodID, StaffID, Quantity)**
STATE	**(StateID, StateName)**

A staff at the branch will be responsible for the sales of the food in the company. Answer the following questions.

i) Suggest the suitable ROLAP model for the schema above.

(2 marks)

ii) Illustrate the ROLAP schema that you have suggested in (i).

(6 marks)

iii) If these tables are added to the current schema, explain the ROLAP model that could exist.

PURCHASES	**(PrID, PrDate, Quantity, FoodID, StaffID, SuppID)**
SUPPLIER	**(SuppID, Supp, SuppPhone, SuppAddress, StateID)**

(2 marks)

iv) Draw the complete ROLAP schema as in (iii).

(6 marks)

QUESTION 2

a) Based on Schedule 1, five (5) different transactions are running concurrently in the database to process transactions in the STAFF table. At Time 7, the system makes a checkpoint. However, during Time 12, the database fails.

Schedule 1

Transaction ID	Time	Action	Table	Row	Column	Old	New
T1	1	Start					
T1	2	Insert	Staff	20	*		101,102,..
T2	2	Start					
T2	3	Update	Staff	1	deptid	10	90
T1	4	Commit					
T3	4	Start					
T3	5	Update	Staff	5	salary	2000	3500
T3	6	Commit					
T3	7	CHECKPOINT					
T5	8	Start					
T5	9	Update	Staff	3	salary	3400	2100
T4	9	Start					
T4	10	Update	Staff	5	city	Jasin	Tapah
T4	11	Commit					
T2	11	Update	Staff	34	deptid	20	10
	12	CRASH					

Based on the schedule above, answer the following questions.

i) Draw a recovery timeline according to Schedule 1.

(4 marks)

ii) If an immediate update is applied as the recovery process, state the value of Transaction 2 on rows 1 and 34 after the crash.

(4 marks)

iii) Justify the answer in (ii).

(2 marks)

b) Study the following transaction data.

R1(A), W2(A), R3(B), W1(C), R4(C), W2(B), R3(A), W4(B), W3(C), W4(A)

Transaction data 1

i) According to the schedule, show the transaction table.

(2 marks)

ii) Draw a precedence graph according to the transaction table in b(i) and state its serializability.

(8 marks)

QUESTION 3

a) Differentiate between type incorrect and semantically incorrect in semantic analysis of query decomposition.

(4 marks)

b) Explain **TWO (2)** strategies of data allocation in the distributed database concept.

(4 marks)

c) The relational schema below represents the database structure for FreshMart, an online grocery store that delivers fresh products to customers.

CUSTOMER (CNo, CName, CPhone, CAddress, CState, RNo)
PRODUCT (PNo, PName, PCategory, PPrice, PQuantity)
ORDER (Ono, ODate, OTotal, CNo, PNo, DNo)
DELIVERY (DNo, DDate, DTime, DGuy)
REGION (RNo, RName)

FreshMart currently operates in four major regions: 1-North, 2-South, 3-East, and 4-West. Due to its expansion, the company wants to improve its database management by distributing data based on its operational regions.

i) Identify the most suitable fragmentation type if the company decides to divide the CUSTOMER table based on its region.

(2 marks)

ii) Show the relational algebra for the fragmentation type in (i).

(4 marks)

iii) Identify the most suitable fragmentation type if the company decides to divide the ORDER table based on their customer's region.

(2 marks)

iv) Show the relational algebra for the suggestion of fragments in (iii) for the West and North regions.

(2 marks)

v) Explain the suitable fragmentation to the REGION table.

(2 marks)

QUESTION 4

a) Zenith University is developing a Student Internship Management System (SIMS) to manage the internship process for its students. Currently, the process is handled manually, causing inefficiencies. The university has outlined the following requirements:

- Each internship must have a start date, end date, and duration recorded in the database.
- A student must have an internship record in the database.
- The company where the students go for the internship must be recorded.
- Each company must provide a contact person for each student.
- The contact person from the company can also supervise many other students available.
- Each internship must be monitored or rejected by a lecturer who is assigned to the student.
- One lecturer may monitor multiple students at a time.
- A lecturer must have a backup lecturer in case they cannot do the monitoring at a certain time. They also must be a backup to another lecturer.
- Companies belong to different industries.
- If the company belongs to the medical industry, the data of the medical license number and regulatory approval body must be recorded.

As the database designer, draw a complete Entity Relationship Diagram (ERD) that includes entities, attributes, and relationships with appropriate cardinalities and modalities. You may assume additional attributes as needed.

(16 marks)

b) Explain **TWO (2)** examples of general constraints that can be applied to the database based on the ERD in (a).

(4 marks)

QUESTION 5

Jasin Badminton Association organizes multiple tournaments to identify and nurture badminton talents in Melaka state. Players compete against each other to win tournaments and earn the opportunity to represent Melaka in national and international competitions. During each match, a player can have a coach sitting with them for support. The association maintains a database to record tournament details, structured as follows:

PLAYERS	**(PlyID, PlyName, PlyDOB, PlyHand, PlyPhone, PlyEmail, CoachID)**
COACH	**(CoachID, CoachName, CoachPhone, CoachEmail, CoachExpertise)**
TOURNAMENT	**(TourID, TourName, TourStartDate, TourEndDate, TourPrizePool)**
MATCH	**(MatchID, MatchDate, MatchStartTime, MatchEndTime, Player1, Player2, WinnerPlayer, Set1, Set2, Set3, TourID)**

The database stores player information together, including their playing hand of whether they are right-handed or left-handed. It also stores details of coaches, including their expertise (e.g., singles, doubles, defense, etc.). For the matches, the players involved in the match, winner of the match, set scores (up to three sets), and tournament ID linking the match to a specific tournament. The default date format in the database is `DD-Mon-YYYY`.

a) By using Structured Query Language (SQL), create the `TOURNAMENT` table with these requirements.

- `TourID` is a number column that is assigned as a primary key with a size of 10.
- `TourName` is a character column with size 20 and cannot be null.
- `TourStartDate` and `TourEndDate` are date columns.
- `TourEndDate` value cannot be less than the `TourStartDate` value.
- `TourPrizePool` is a number column with a size of 10 and its value must be at least 10000.

(5 marks)

b) Answer the following questions by using **SQL** and **Relational Algebra.**

i) Display the match details, including tournament name, player names, and the winner's name if the winner is a right-handed player as in the excerpt of output (the winner is a right-handed player.

MatchID	TourName	Name Player 1	Name Player 2	Winner
101	Bemban Open	Haikal Radzi	John Kim	Haikal Radzi
102	Merlimau Open	Eric Chua	Danish Yui	Danish Yui

(10 marks)

ii) Find the number of players who are still less than 20 years old and their coach's expertise is not recorded in the database.

(5 marks)

END OF QUESTION PAPER