NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING
FINAL ASSESSMENT FOR
Semester 1 AY2018/2019

CS2102 – DATABASE SYSTEMS

Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This assessment paper contains **THREE (3)** exercises and comprises **EIGHT (8)** printed pages.
2. Answer **ALL** questions.
3. Answer **ALL** questions within the **space provided ONLY**, as indicated.
4. This is a closed book assessment.
5. You may consult one A4 cheat sheet.
6. **Please write your Student Number Below. Don not write your name.**

STUDENT NO: | | | | | | | | | | |

This portion is for examiner's use only

EXERCISE	MARKS	REMARK
Exercise I (20) (OCR)		
Exercise II (6) (OCR)		
Exercise II (12)		
Exercise III (12)		
Total (50)		

We continue to consider the following self-describing schema.

```
CREATE TABLE customers (
nric         CHAR(9)      PRIMARY KEY,
first_name   VARCHAR(32)  NOT NULL,
last_name    VARCHAR(32)  NOT NULL,
country      VARCHAR(16)  NOT NULL);

CREATE TABLE purchases(
nric         CHAR(9)      NOT NULL REFERENCES customers(nric),
code         CHAR(10)     NOT NULL REFERENCES merchants(code),
datetime     TIMESTAMP    NOT NULL,
amount       NUMERIC      NOT NULL);

CREATE TABLE merchants (
code         CHAR(10)     PRIMARY KEY,
name         VARCHAR(64)  NOT NULL,
country      VARCHAR(16)  NOT NULL);
```

Translate the following queries in the indicated language. Answer the following questions in the space indicated in the script.

Question 14. (4 marks) (Tuple Relational Calculus) Print the names of the merchants in Singapore from which every customer made at least one purchase (every customer made a purchase from these merchants).

Question 15. (4 marks) (Algebra) Print the nric of the customers in Singapore who never purchased anything from any merchant in Thailand (the Singapore customers who never bought anything in Thailand). You may draw a tree. Draw a single expression.

Question 16. (4 marks) (SQL) Print the code of the merchants who have the largest total sales. Ignore total amounts of 0.

Exercise III. (12 marks) Consider the relational schema R = {A, B, C, D, E, G} with the set of functional dependencies F={{A, B, C}→{D}, {D}→{A, B, E}}.

Question 17. (3 marks) What are the candidate keys of R with F? Do not show any detail. Just give the candidate keys.

Question 18. (3 marks) What can be said about the decomposition of R into R1 = {A, B, C, D, G} and R2 = {D, E}, with respect to R with F? Just indicate the properties and the normal form of the decomposition. Do not justify your answer.

Question 19. (6 marks) Normalise R with F into a lossless BCNF decomposition using the decomposition algorithm of the lecture. Is the decomposition dependency preserving? Show the steps. Indicate the candidate keys and projected functional dependencies of the fragments. Write from left to right and top to bottom. Do not draw trees or graphics.

--- END OF PAPER ---