

NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING

**Final Examination for
Semester 1 AY2013/2014**

CS2102 – DATABASE SYSTEMS

November 2013

Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **FOUR (4)** exercises and comprises **TEN (10)** printed pages.
2. Answer **ALL** questions.
3. Answer **ALL** questions on the OCR form or within the space provided **ONLY**, as indicated.
4. **Unnecessary** comments will be penalised.
5. This is a **Closed Book** examination.
6. **Please write your Matriculation Number Below.**

MATRICULATION NO:

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This portion is for examiner's use only

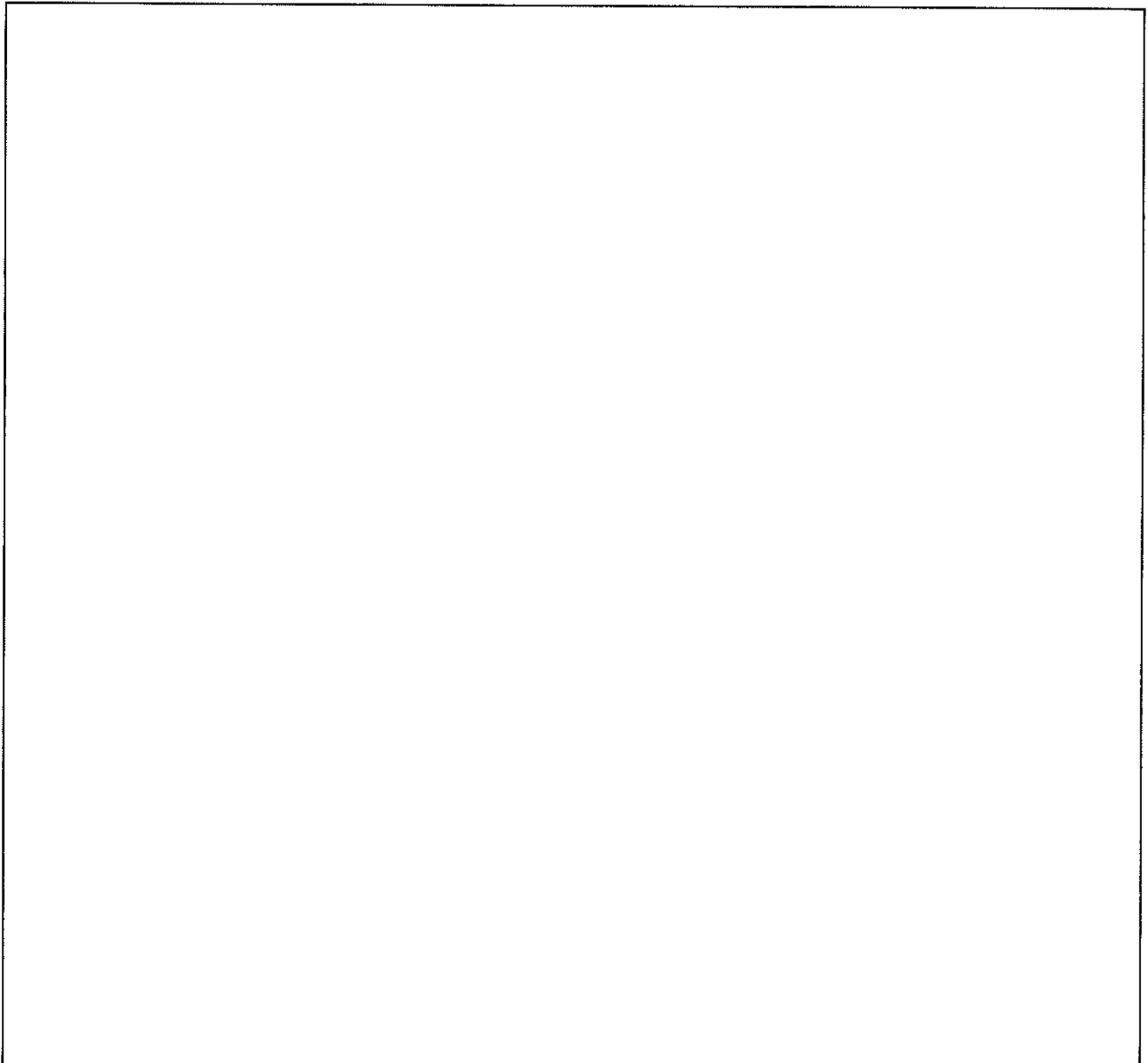
	Marks	Remarks
Exercise I	15	
Exercise II	10	
Exercise III	15	
Exercise IV	20	
Total	60	

Exercise II. (10 marks) The Association of Football Clubs (AoFC) needs your help to design a database to keep track of information about its clubs, as well as the various events. Each club has an ID, club name and country. Each club also has a team of players and a coach. Each player has an ID, name, shirt number (the number print on the shirt), nationality, salary and age. We also keep information about the dependents of each player: name, age, relationship (e.g., spouse/son/daughter). We assume that the dependents of each player have unique names.

The coach manages the administration of the team and trains the players. Each coach has an ID, name and years of experience. A player must join a club if he wants to participate in events. Each player can only play in one club, and a coach can only manage one club. The clubs, players and coaches are identified by their corresponding ID.

The Association of Clubs regularly organizes events for the clubs to take part. Clubs may choose whether to participate in the events. Each event has a title, start date and location where it is held. Besides recording the winner of the event, we also record the results for each participating club.

Draw an **ER diagram** for database application. Identify the entity types and relationship sets and their appropriate attributes. Indicate the keys for the entity types and the relationship cardinalities. Discuss any assumptions you made, and justify your ER design choices.



Exercise III. (15 marks) This is a series of structured questions. Give your answer in the space provided. Marks may be deducted for unnecessary long or complicated answers and wrong answers.

Consider the following self-explanatory database schema.

Student (sid, sname, email)

Course (code, title, credit, prereq)

Enrol (sid, code, grade)

Give the following queries in the language indicated.

(TRC) Print the course titles that both John and Mary have enrolled in.

(TRC) Print the codes of courses that John can enroll in because he has already taken the pre-requisites of these courses.

(RA) Print the emails of students who have taken all the courses that Mary has taken.

(RA) Print the sid of students who have taken exactly the same set of courses as Mary.

(SQL) Print the sid of students who have taken exactly the same set of courses as Mary.

Exercise IV. (20 marks) Answer the following structured essay questions in the space provided. Show the steps with clear explanation. Marks may be deducted for unnecessary comments and wrong answers.

One of the steps in the algorithm to compute a minimal cover involves the minimization of the right hand side of functional dependencies. This step uses the following decomposition axiom.

Given a relation scheme R , $\forall X \subseteq R$, $\forall Y \subseteq R$, $\forall A \in R$, if $X \rightarrow Y \cup \{A\}$ then $X \rightarrow \{A\}$.

Use Armstrong's axioms to prove that the decomposition axiom is correct.

[2 marks]

Consider the relation $R = \{A, B, C, D, E, W, X, Y, Z\}$ and the set of functional dependencies:

$FD = \{ \{A\} \rightarrow \{D\}, \{A\} \rightarrow \{D, E\}, \{A, B\} \rightarrow \{C\}, \{A, B\} \rightarrow \{X, Z\}, \{A, C\} \rightarrow \{Z\}, \\ \{B\} \rightarrow \{W\}, \{W\} \rightarrow \{X, Y\}, \{D\} \rightarrow \{Z\} \}$

Find all the keys of R .

[2 marks]

Find a minimal cover of FD.

[8 marks]

Is R in 3NF? Justify your answer.

[2 marks]

Give a 3NF synthesis of R based on the functional dependencies in F.

[6 marks]

--- END OF PAPER ---