NATIONAL UNIVERSITY OF SINGAPORE

CS2102 – DATABASE SYSTEMS

(Semester 1: AY2014/15)

Time Allowed : 2 Hours

INSTRUCTIONS TO STUDENTS

1. Please write your Student Number only. Do not write your name.

2. This assessment paper contains **FOUR (4)** exercises and comprises **THIRTEEN (13)** printed pages.

3. Students are required to answer **ALL** questions.

4. Students should write the answers on the OCR form or within the space provided **ONLY**, as indicated.

5. This is an OPEN BOOK assessment**.**

STUDENT NO:

This portion is for examiner's use only

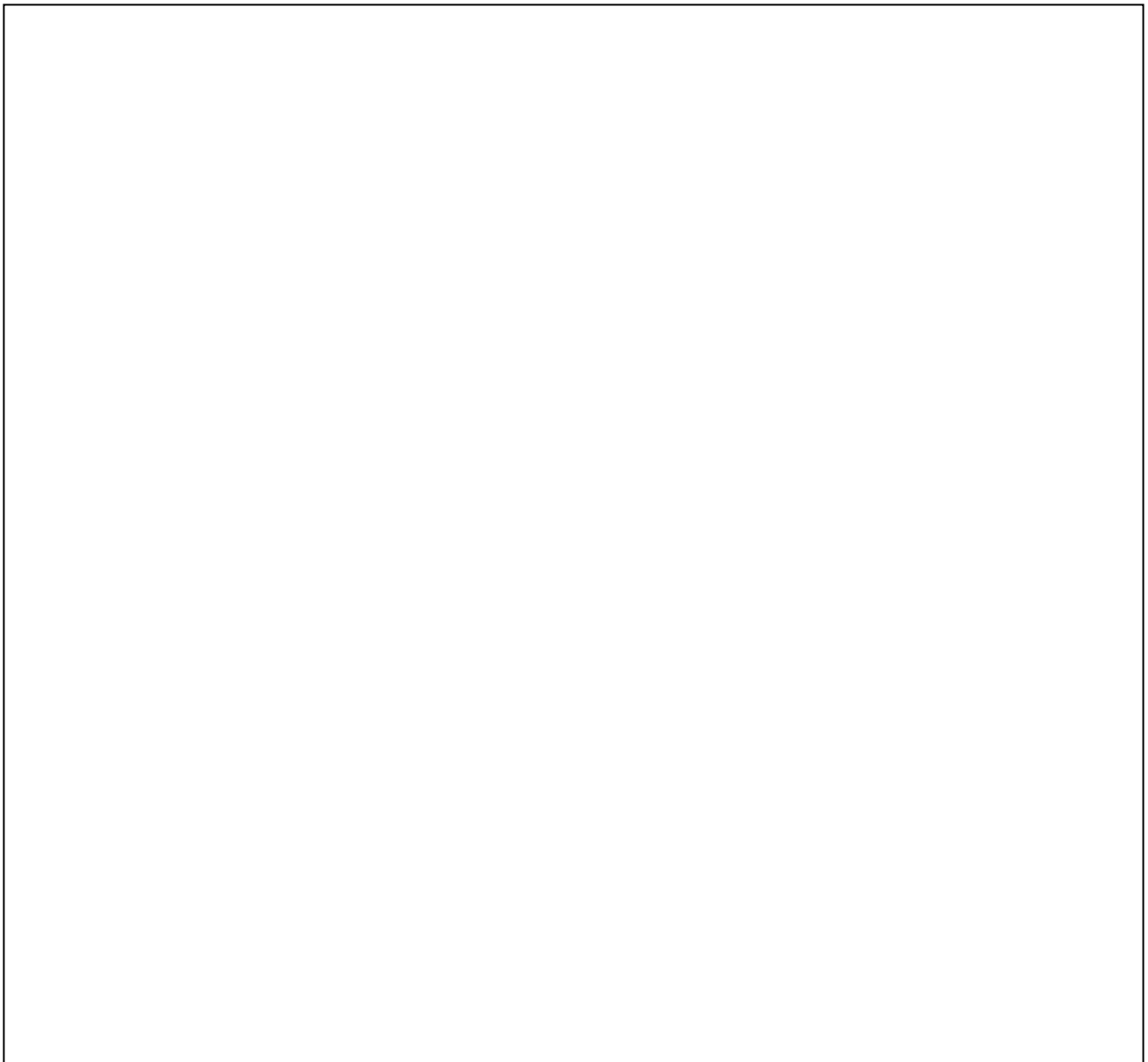|	Marks	Remarks
Exercise I	20	
Exercise II	10	
Exercise III	15	
Exercise IV	15	
Total	60	

Exercise II. (10 marks)

Suppose we want to create a database for a company that runs training courses. We need to keep information on the instructors and trainees. Each course participant is identified by an id, and we store his/her name, age, gender, current employer (name, address, telephone number), previous employers (and periods employed), the courses attended (there are about 200 courses), and the final grade for each course. The employers can be identified by their names.

Each course has a code that is unique and a title, and a course can be given any number of times. Each time a particular course is given, we number it, and call it an 'edition' of the course. For each edition, we track the start date, the end date, and the number of participants.

For each instructor, we will store his/her unique id, name, age, email, place of birth, the edition of the course(s) taught, and the courses that s/he is qualified to teach. An instructor can be permanently employed by the training company or freelance. We store the salary of an instructor if s/he is a permanent employee, otherwise we store the fees per hour of a freelance instructor.

Draw an **ER diagram** for this database application. Identify the entity types and relationship sets and their appropriate attributes. Indicate the keys for the entity types and the relationship cardinalities.

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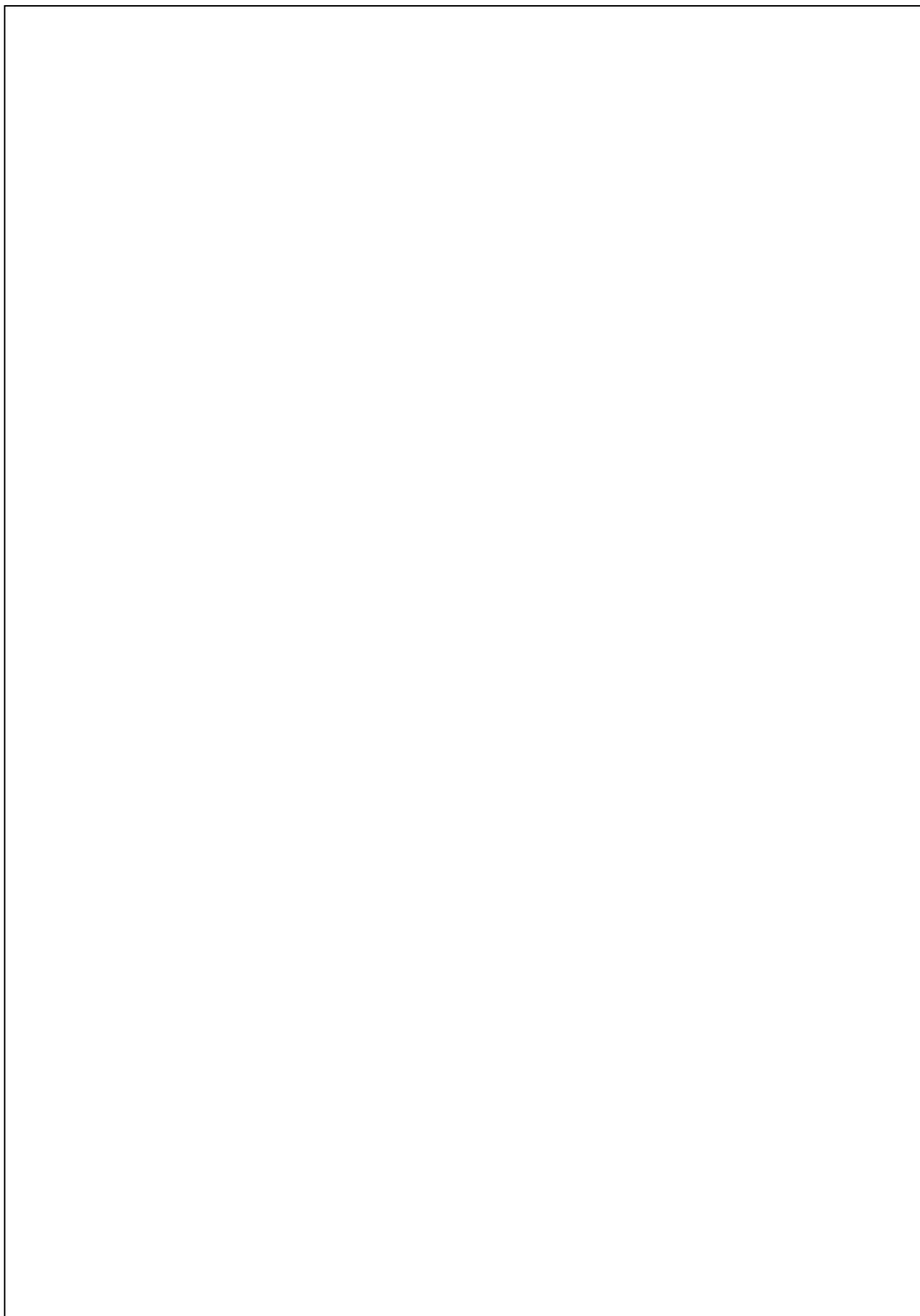
Exercise III. (15 marks) This is a series of structured questions. Give your answer in the space provided.

Map the following ER diagram into a relational schema. Use the notations that the primary keys are underlined and foreign key constraints are represented by drawing directed arcs from each foreign key to the primary key of the relation it references.   [5 marks]
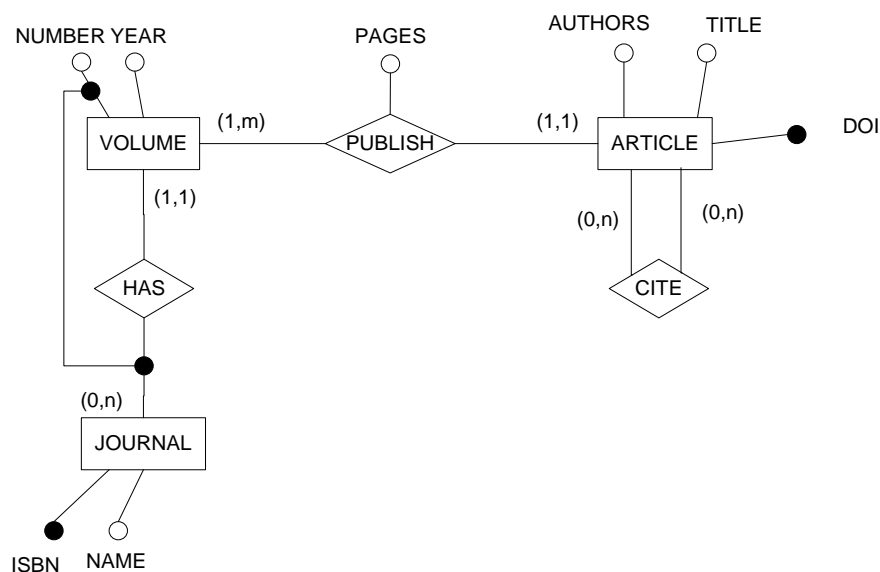
Consider the following self-descriptive relational schema (where primary keys are underlined).

AUTHOR (<u>AID</u>, NAME, AFFILIATION)
ARTICLE (<u>DOI</u>, TITLE, JOURNAL_NAME, YEAR, PAGES)
WROTE (<u>AID, DOI</u>)

Write the queries in the language indicated.

(SQL) Find the average number of pages of an article in each journal.   [3 marks]

(RA) Print the names of authors who have published articles in the "VLDB" journal after 2010.   [3 marks]

(TRC) Print the names of authors who only published in the "VLDB" journal.   [4 marks]

Exercise IV. (15 marks) Answer the following structured essay questions in the space provided. Show the steps with clear explanation.

Consider the relation R = (A, B, C, D, E) and the set of functional dependencies:
    F = { {A} → {B}, {A, B} → {C}, {A, E} → {C}, {D} → {A} }

Find all the keys of R.   [2 marks]

Find a minimal cover of F.   [4 marks]

Is R is in 3NF? Justify your answer, and give a 3NF synthesis of R based on the functional dependencies in F if R is not in 3NF. [3 marks]

Is R is in BCNF? Justify your answer, and give TWO different lossless join BCNF decompositions of R if R is not in BCNF. Explain whether the decompositions are dependency-preserving. [6 marks]

--- END OF PAPER ---