



## **Autumn 2017**

**Exam Code(s)** 3BCT1, SWB, EM  
**Exam(s)** Erasmus  
3<sup>rd</sup> B.Sc. Computer Science and Information Technology  
Science without Borders

**Module Code(s)** CT3532  
**Module(s)** Database Systems 2

Paper No.

**External Examiner(s)** Dr. John Power  
**Internal Examiner(s)** Dr. Michael Schukat  
Dr. Colm O’Riordan\*

**Instructions:** Answer any 3 questions

**Duration** 2 hours  
**No. of Pages** 3 including this one  
**Department(s)** Information Technology

**Requirements** None

**PTO**

**Q. 1.**

- a) Explain the term *minimal cover set*. Given a set of functional dependencies F, outline an algorithm to generate a minimal set of functional dependencies. Illustrate your answer with the following set F.

$$F = \{A \rightarrow BC, B \rightarrow D, A \rightarrow DQ, B \rightarrow Q\} \quad (11)$$

- b) Given the following relation, R, and functional dependencies, F, decompose the relation such that the resulting relations satisfy BCNF.

$$\begin{aligned} R &= \{A, B, C, D, E, F, G, H, I, J\} \\ F &= \{ \{A, B, C\} \rightarrow \{D, E, F\}, \{A, B\} \rightarrow \{G\}, \{A, C\} \rightarrow \{J\}, \\ &\quad \{C\} \rightarrow \{H\}, \{H\} \rightarrow \{I\}, \{J\} \rightarrow \{C\} \} \end{aligned} \quad (12)$$

- c) Define the term *non-additive join*. Show with a suitable example how you would check if a decomposition of a relation R into R1 and R2 has the *non-additive join property*. (10)

**Q. 2.**

- a) Linear hashing and dynamic hashing are two approaches to hashing values to a dynamically changing file. Briefly outline either approach and illustrate the approach using the following record key values. You may assume a blocking factor of two.

$$125, 124, 409, 412, 411, 415, 106, 110 \quad (13)$$

- b) Compare the structure of a B tree with the structure of a B+tree. (7)
- c) Illustrate the growth of a B+tree when the values in part (a) are inserted. You may assume an order of 3 for all nodes. (13)

**PTO**

**Q. 3.**

- a) Explain, with an example, the *lost update problem*. (6)
- b) Explain the term *conflict-serializability*. Outline an approach to guarantee conflict serializability among a set of concurrently running transactions. Illustrate the approach on the example schedule you used in part a). (9)
- c) Prove the approach outlined in b) guarantees conflict serializability. (10)
- d) With respect to recovery, explain the notion of a checkpoint of a transaction and its role in recovery for a system operating under an immediate update protocol. (8)

**Q.4.**

- a) NOSQL database model have become popular as an alternative model to the relational database model. Discuss the main motivations behind these models and discuss how they differ from relational models. Your answer should include a discussion of the data models that are adopted and differences in terms of integrity enforcement. (11)
- b) The join operator is a commonly performed operator in SQL. Outline an efficient approach to implementing this operator. (11)
- c) Parallel architectures have been used to increase the efficiency of many standard operations used in database management systems. Outline an algorithm for efficiently performing a join between two relations R and S. (11)