



**Strathmore**  
UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES  
END OF SEMESTER EXAMINATION  
MST8202 – ADVANCED DATABASE & ENTERPRISE SYSTEMS

DATE: 23<sup>rd</sup> January 2024

Time: 2 Hours

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**Instructions**

1. This examination consists of **SEVEN** questions. You can get up to **50 points**.
2. Answer **all** the questions.
3. For each question, provide the answers according to the **instructions in brackets** (the instructions describe a style of the answers and how long each should be).

**Questions**

1. What is a primary key and what are alternate keys in the relational data mode? What (three) criteria should be considered when selecting an effective primary key? (5 points)
2. Let D be a relation of the following schema for departments identified by “deptno”,  $D = \{\text{deptno} : \text{number}, \text{building} : \text{text}\}$ . Let E be a relation of the following schema for employees identified by “name”,  $E = \{\text{name} : \text{text}, \text{deptno} : \text{number}, \text{salary} : \text{number}\}$  where “deptno” is a foreign key of department for each employee. Using suitable operations of the relational algebra, write a correct expression in the relational algebra (not in SQL) to answer the following query: get names of employees with salary greater than \$100000 who work for departments located in building “A”. (8 points)
3. Let PRODUCT be a table of products with columns NAME (primary key), CATEGORY (text) and PRICE (number). Make an SQL SELECT query to get average price of products in each category which has less than 10 products. (8 points)
4. What is a schedule, serial schedule, and a serializable schedule? Why is the serializable schedule (or serializability) important for the concurrency control? (6 points)
5. What are an aggregation and a composition (of entities) relationships in the entity-relationship model? Demonstrate differences between the aggregation and composition on a simple example (about three entities). (7 points)
6. When is a relation in the third normal form (3NF; one sentence)? Provide a simple example of a relation (or an entity of an entity-relationship model) which is not in the 3NF (it is only in the 2NF). Describe why the provided relation is not in the 3NF and describe also a result of its normalization into the 3NF (the corresponding relations that are in the 3NF). (8 points)

7. What is a CAP theorem for distributed systems? Explain also components of the CAP acronym. How is the CAP theorem affecting NoSQL databases and how they address the consequences of the CAP theorem by a BASE approach (explain also the BASE acronym). (8 points)