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Roll No. .....

REF NO. 054532

M. Sc. Semester III Examination
2022-23

BIOINFORMATICS

Paper No. BIM-301 : Database Management System

Time : 3 hours *Full Marks* : 70

(Write your Roll No. at the top immediately on the receipt of this question paper)

The figures in the right-hand margin indicate marks

Answer **five** questions including Question **1** which is compulsory

1. *(a)* Discuss the main characteristics of the database system and specify how it differs from the traditional file system. 7

(b) Why is concurrency control required in Databases? Explain the problems arising when the database system does not enable concurrency control. 7

2. *(a)* In the recent past, we had to fight against the deadly COVID pandemic. Draw an ER-diagram for Biological Crisis Management System encompassing all the components you think as essential. What is a weak entity type? How does it help in representing activity while drawing an ER-diagram? 7

(b) What are the similarities and differences between three key data models, i.e., hierarchical data model, network data model and relational data model? Support your answer with a simple data-driven example. 7

3. *(a)* Consider the following relation $R(A, B, C, D, E)$. The following functional dependencies hold :

$$\{A \rightarrow C, B \rightarrow D, AB \rightarrow E\}$$

Compute all possible candidate keys for this relation. Can we consider AB as a primary key to this relation? Is the above relation in second normal form? If not, how can you make it comply with that? Justify your answer. 7

(b) Explain the Boyce-Codd normal form with an example. Could you write some history around why is it named so? State how it differs from that of 3NF. 7

4. (a) Define Query Optimization. How can we optimize SQL server query performance simply by rewriting the query? Explain this using a scenario-based example. 7

(b) Define the following transaction processing concepts cohesively, preferably using an example : 7

SQL query, transaction, ACID property, transaction lifecycle, COMMIT, ABORT and locking.

5. (a) What are the different types of joins? Give any two example scenarios where self-join could be useful. 7

(b) How indices speed up query processing? Discuss use of B-Tree as a common database indexing mechanism. 7

6. *(a)* Discuss the entity integrity and referential integrity constraints. What role they play in database design? 7

(b) Consider the relational database as below :

Employee (person_name, street, city)

Works (person_name, univ_name, salary)

University (univ_name, city)

Manages (person_name, manager_name)

Here, primary keys are underlined. Write a relational algebra expression and SQL query for the following queries :

(i) Find the names of all the employees who works for BHU.

(ii) Find the names and cities of permanent residence of all the employees who works for BHU.

(iii) Find the names of all employees in this database who do not work for BHU. 7

7. *(a)* What is big data? How is 'big data management' different from general data management? 7

(b) What are the roles of advanced computer science developments, which could be cloud computing, blockchain and crowdsourcing, in the context of Bioinformatics Centred Big Data? 7

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