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KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY
KCS 2103 DATABASE DESIGN

Date: 8TH AUGUST 2024
Time: 2:30PM – 4:30PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

a) Define the following terms:
   i) Database **(1 Mark)**
   ii) Database management system **(1 Mark)**
   iii) Database design **(1 Mark)**

b) Describe four main characteristics of the database approach and contrast them with the file-based approach. **(4 Marks)**

c) Discuss the two tier client server architecture in comparison with the three tier client server architecture. **(4 Marks)**

d) Use the case study below to answer the questions that follow:
Consider the database system of an e-commerce platform. This database would keep track of products, orders, customers, and payments. The tables in the database could include:
- Products: including productId, product name, description, price, and availability.
- Orders: including OrderID, customer name, order date, items ordered, and total cost.
- Customers: including Customer number, name, address, phone number, and email.
- Payments: including payment serial number, order number, payment method, amount, and date.

This database would be designed to ensure data integrity and consistency, with relationships established between tables to ensure that data is accurately reflected in all relevant tables. For example, the database would enforce rules such as ensuring that a customer can only place one order at a time, and that an order can only be processed if the customer has provided a valid payment method.
This database design would allow e-commerce platform staff to quickly and easily retrieve information about products, orders, customers, and payments, making it easier to manage the platform and provide excellent service to customers.
   i) Describe four benefits they are likely to enjoy after implementing the database system **(4 Marks)**
   ii) Using appropriate entities, attributes and relationships between the entities, design a suitable Entity relationship diagram for the e-commerce platform database. **(6 Marks)**
   iii) Using the ER diagram above, illustrate the different types of relationships that may exist between the entities. **(4 Marks)**
   iv) For each entity in ER diagram above, identify the most appropriate primary key attribute(s). **(2 Marks)**
   v) Outline three reasons why the developers may wish to use a View in their database implementation. **(3 Marks)**

QUESTION TWO (20 MARKS)

a) Describe four major operations of a database management system. **(4 Marks)**

b) The aim of data integrity is to specify rules that implicitly or explicitly define a consistent database state or changes of state. As a database designer, describe three data integrity constraints that you can utilize. **(6 Marks)**

c) Two transactions have their operations interleaved in the following way shown below. Describe the concurrency problem that may arise and how it will arise. **(4 Marks)**

T1	T2
read-item(X);	
X:=X-N;	
	read-item(X);
	X:=X+M;
write-item(X);	
read-item(Y);	
	write-item(X);
Y:=Y+N;	
write-item(Y);	

d) Consider the table structure below.

World table

name	continent	area	population	gdp
Afghanistan	Asia	652230	25500100	20343000000
Albania	Europe	28748	2831741	12960000000
Algeria	Africa	2381741	37100000	188681000000
Andorra	Europe	468	78115	3712000000
Angola	Africa	1246700	20609294	100990000000

Write SQL commands to perform the following:

(i) Select all records in the World table **(2 Marks)**

(ii) Give the name and the per capita GDP for those countries with a population of at least 200 million. Hint: per capita GDP is the GDP divided by the population GDP/population. **(2 Marks)**

(iii) To return the total population of all African countries. **(2 Marks)**

QUESTION THREE (20 MARKS)

a) Highlight four properties of a relation. **(4 Marks)**

b) Discuss any five database application areas clearly stating how the database system will be used. **(5 Marks)**

c) Identify any four system failures that necessitate the need for database recovery. **(2 Marks)**

d) KWUST health center attends to any patient who may need medical services through their competent doctors. Personal details of both patients and doctors are recorded, however for patients, their age is recorded whilst the specialty for doctors is captured. Once doctors make a diagnosis, they issue patients with prescriptions whereby the date of prescription and amount of drugs is registered. Patients may buy drugs from a pharmacy of their choice. Due to cost implications, patients can choose to buy drugs from a drug manufacturer of their choice.

i) Using illustrations from the above scenario provide THREE anomalies that may be encountered if normalization process is not undertaken. **(3 Marks)**

ii) Create an ERD diagram for the health center database **(6 Marks)**

QUESTION FOUR (20 MARKS)

a) Discuss the major stages you are likely to follow in the development process of a database system. **(8 Marks)**

b) Describe four desirable properties of a transaction. **(4 Marks)**

c) In a database system there are four transactions T_1, T_2, T_3, T_4 having 2, 3, 4 and 5 operations respectively. Determine the number of possible concurrent schedules. **(4 Marks)**

d) Differentiate between the following keys:

i) Primary key and a foreign key **(2 Marks)**

ii) Super key and a Candidate key **(2 Marks)**

QUESTION FIVE (20 MARKS)

a) Discuss with the help of examples, two interpretations of the following data quality dimensions

i) Completeness **(2 Marks)**

ii) Accuracy **(2 Marks)**

b) As a student studying database design, describe three career opportunities in this field. **(3 Marks)**

c) Consider the Staff table structure below.

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000.00	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000.00	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000.00	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000.00	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000.00	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000.00	B005

Write SQL commands to perform the following:

i) To create the Staff table using appropriate data types. **(4 Marks)**

ii) To display female employees only. **(2 Marks)**

iii) To add another staff member Joseph Kamau, an Assistant, with a staffNo SA10, born on 12-Dec-89, a salary of 10000.00 and working in branch B005. **(3 Marks)**

iv) To modify the salary of Julie Lee to 10000.00. **(2 Marks)**

v) To provide the monthly wage bill. **(2 Marks)**