UNIVERSITY OF GHANA

SCHOOL OF ENGINEERING SCIENCES
SECOND SEMESTER EXAMINATIONS: 2016/2017
LEVEL100: BACHELOR OF SCIENCE IN ENGINEERING
CPEN 102: INTRODUCTION TO DATABASE SYSTEMS [*3 CREDITS*]

TIME ALLOWED: *2½ HOURS*

INSTRUCTIONS:
ANSWER ***ALL*** QUESTIONS.

Question 1

(a) Give a brief explanation of each of the following terms: **[10 marks]**
- (i) Transaction
- (ii) Composite Key
- (iii) Normalization
- (iv) Sub-class
- (v) M:N relationship

(b) Describe any three characteristics of the database approach and contrast it with the file-based approach. **[9 marks]**

(c) Differentiate between the following concepts in relational database model. **[6 marks]**
- (i) Entity integrity and referential integrity
- (ii) Logical data independence and physical data independence
- (iii) Primary key and foreign key

Question 2

Analyze the business rules of a Wall Coverings Company carefully and use it to answer the given questions. The company has three stores that sell wallpaper and accessories. Customers place orders through a branch. The owner would like to track the following about customers: Name, Address, City, State, Zip Code, Telephone, Date of Birth, and Primary Language. A customer may place many orders. A customer does not always have to order through the same branch all the time. Customers may have one or more accounts, although they may also have no accounts. The following information needs to be recorded about accounts: Balance, Last payment date, Last payment amount and Type. A branch may have many customers. The following information about each branch needs to be recorded: Branch Number, Location (Street, City, State, Post Code), and Square Footage (area). A branch may sell all items or may only sell certain items. Orders are composed of one or more items. The following information about each order needs to be recorded: Order Date and Credit Authorization Status. Items may be

sold by one or more branches. The company wishes to record the following about each item: Description, Color, Size, Pattern, and Type. An item can be composed of multiple items; for example, a dining room wallcovering set (item id 20) may consist of wallpaper (item id 22) and borders (item id 23). The company employs 56 employees and would like to track the following information about employees: Name, Address (Street, City, State and Postcode), Telephone, Date of Hire, Title, Salary, Skill, and Age. Each employee works in one and only one branch. Each employee may have one or more dependents. The company wishes to record the name of the dependent as well as the age and relationship.

(a) Based upon the provided information, draw an Entity-Relationship (ER) Diagram using the Crow's foot model symbols and include all attributes. **[8 marks]**

(b) In the ER diagram:
   (i) Identify the main relationship types (connectivity) between the entities.
   (ii) Determine the multiplicity constraints (cardinality) for each relationship. **[4 marks]**

(c) Determine primary key and foreign key attributes for each entity. **[4 marks]**

(d) Resolve all many-to-many relationships into one-to-many relationships. **[4 marks]**

(e) Using SQL statements, create a table for the EMPLOYEE entity. Specify all constraints, if any. **[5 marks]**

Question 3

(a) Explain briefly why a table whose primary key consists of a single attribute automatically is in the 2NF when it is in the 1NF. **[2 marks]**

(b) The table 1 below lists dentist/patient appointment data. A patient is given an appointment at a specific time and date with a dentist located at a particular surgery. On each day of patient appointments, a dentist is allocated to a specific surgery for that day.

Table 1:

staffNo	dentistName	patNo	patName	appointment date	time	surgeryNo
S1011	Tony Smith	P100	Gillian White	12-Sep-01	10.00	S15
S1011	Tony Smith	P105	Jill Bell	12-Sep-01	12.00	S15
S1024	Helen Pearson	P108	Ian MacKay	12-Sep-01	10.00	S10
S1024	Helen Pearson	P108	Ian MacKay	14-Sep-01	14.00	S10
S1032	Robin Plevin	P105	Jill Bell	14-Sep-01	16.30	S15
S1032	Robin Plevin	P110	John Walker	15-Sep-01	18.00	S13

(i) The table shown above is susceptible to update anomalies. Provide examples of how insertion, deletion, and modification anomalies could occur on this table.

(ii) Identify the functional dependencies that exist between the columns of the table and primary key (PK) and any alternative key(s) (if present for the table).

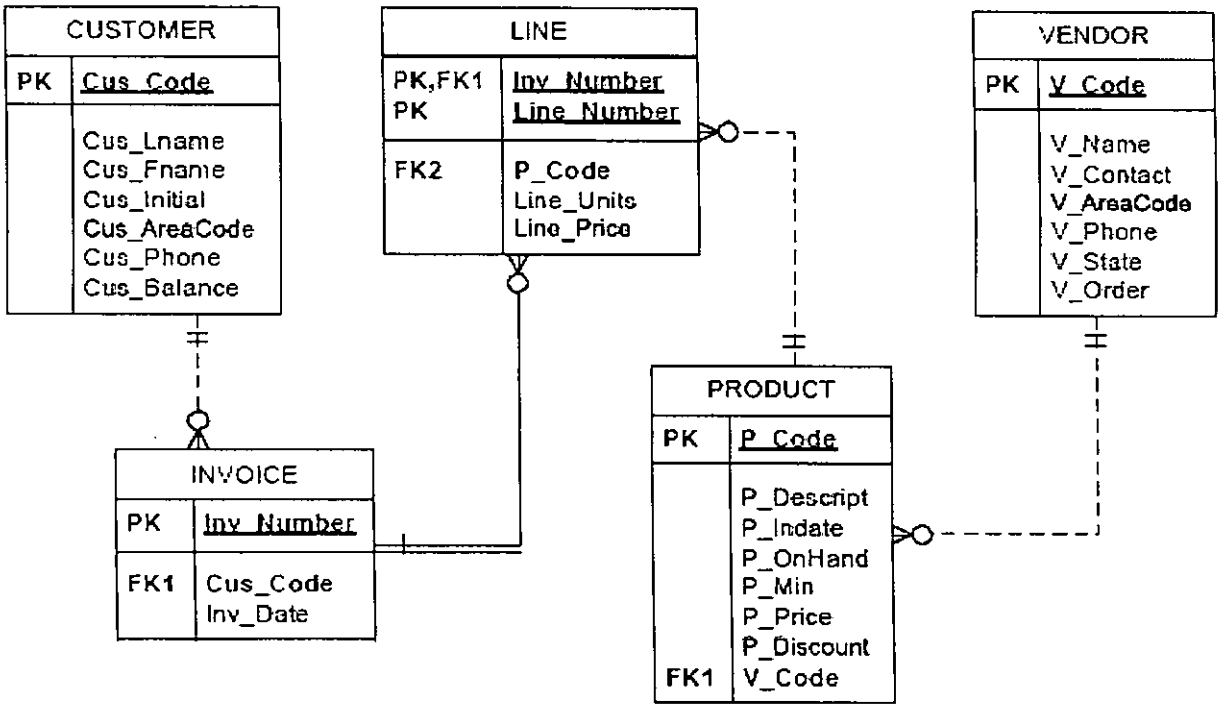
(iii) Using the functional dependencies identified in *3.b.(ii)*, convert the table to 3NF. In each of the **derived tables** in (3NF) indicate the primary keys and the foreign keys. **[18 marks]**

[*Note: Show tables with values*]

(c) List five advantages of a database system. **[5 marks]**

Question 4

(a) Use Entity Relationship Diagram below for a Sales database to answer the following SQL questions:



Write the SQL statements for the following scenarios: **[20 marks]**

(i) Write a query to count the number of customers with a customer balance less than $500.

(ii) Write a query to list all products (Product code, Description and V_Code) for which the vendor is Gomez Bros.

(iii) Write a query to list all customers (first name, last name, and phone) whose first name starts with 'O'. Sort the results alphabetically by last name.

(iv) Create a query to find the customer balance characteristics (which includes the total sum of the outstanding balances, minimum, maximum, and average balance for all customers).

(v) Add a new customer to the customer table (Use your own values).

(b) Explain briefly all the phases of the Database Development Life Cycle. **[5 marks]**