Fundamentals of Data Engineering
(COE848)

Mid Term Exam

This is a CLOSED BOOK exam.

This is a 120-minute exam.

There are 5 questions with a total of 100 marks.

Please read each question carefully and write your answers legibly in the space provided. You may do the questions in any order you wish, but please
USE YOUR TIME WISELY.

Student Name:
Student ID:

Question	Maximum Mark	Received
1	16	
2	15	
3	27	
4	20	
5	22	
Total	100	

Question 1: Explain the following terms in 2-3 sentences:

a) Isolation

b) Database Management System (DBMS)

c) Composite Attribute

d) Right Outer Join

Question 2:

Express $R \bowtie S$ (*(Left outer join)*) using a subset of the following relational algebra operations (Project, Select, Rename, Union, Intersection, Set Difference, Cartesian product, Join (conditional or natural)). Explain your assumptions, if any.

We assume that attributes of S is denoted as ATTR(S), attributes of R is denoted as ATTR(R) and (ATTR(R)-ATTR(S)) denotes a set of attributes in R that does not belong to S. We also use the notation $M_{a1, a2, a3, .. an}$ (NULL) to denote a relation M with attributes (a1, a2, a3, ..an) with one tuple whose values are null for all attributes. For example $M_{id, name}$ (NULL) will be

Id	Name
Null	Null

Question 3: Given the following table definitions:

Enrollment (<u>stdId</u>, <u>crsNumber</u>, startDate, finalGrade)
Student (<u>stdId</u>, stdName, address, age)
Course (<u>crsNumber</u>, crsName, description)

Provide appropriate relational algebra expressions for each of the following queries:

    a. Find the name of students with a final grade more than 80.

    b. Find the name of courses that are enrolled by one or more students older than 25.

    c. Find the name of courses in which one or more students got final grade more than 80.

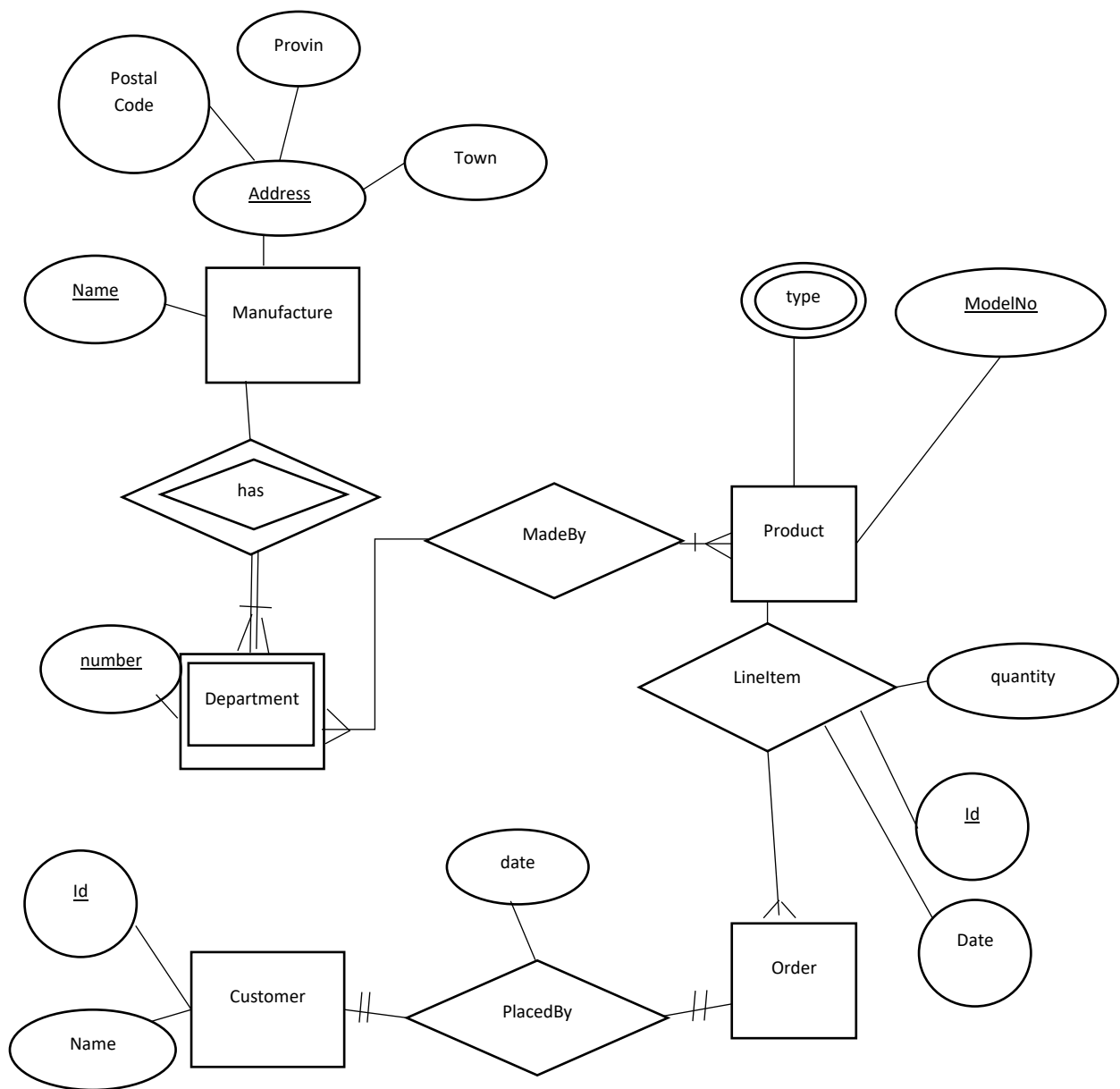d. Find the name of students who have enrolled in three or more courses.

e. Find the name of students who have enrolled in at least one course and all her grades are more than 80.

Question 4: Convert the ER diagram in the next page to a database schema. Indicate the keys for each table in your answer.

In this diagram, a Product can be in a number of orders, but an order has only one product

Note: For a table T with attributes k and p where k is the primary key, you can use the following notation in your answer:
T(k,p)

Provin

Postal Code

Town

Address

Name

Manufacture

type

ModelNo

has

MadeBy

Product

number

Department

LineItem

quantity

Id

Id

Date

date

Customer

PlacedBy

Order

Name

Response to Question 4

Question 5:

Construct a clean and concise ER diagram for the following scenario. List your assumptions and clearly indicate the cardinality mappings in your ER diagram.

- Patients are identified by SSN, and their names, addresses, and also ages.
- Doctors are identified by an SSN, name, specialty and years of experience
- Each pharmaceutical company is identified by name and has a phone number.
- For each drug, the trade name and formula must be recorded.
- Each drug is sold by a given pharmaceutical company, and the trade name identifies a drug uniquely from among the products of that company.
- If a pharmaceutical company is deleted, you need not keep track of its products any longer.
- Each pharmacy has a name, address, and phone number.
- Every patient has a primary physician.
- Every doctor has at least one patient.
- Each pharmacy sells several drugs and has a price for each.
- A drug could be sold at several pharmacies, and the price could vary from one pharmacy to another.
- Doctors prescribe drugs for patients.
- A doctor could prescribe one or more drugs for several patients, and a patient could obtain prescriptions from several doctors.
- Each prescription has a date and a quantity associated with it.
- Pharmaceutical companies have long-term contracts with pharmacies. For each contract, you have to store a start date, and end date, and the text of the contract.

Response to Question 5: