1. (30%) Consider the following relations for a database that keep track of the business trips of employees in a company:

   Employee(ID, Name, Start_year, Dept_No, Phone)
   Trip(Trip_ID, ID, From_city, To_city, Departure_date, Return_date)
   Expense(Trip_ID, Account#, Amount)
   Department(Dept_No, DName, Manager_ID)

   where the underlined attributes are the primary keys of the relations.

   (a) Write an SQL query to list all employees who took business trips to Los Angeles.
   (b) Write an SQL query to find the manager who took the most trips.
   (c) Write an SQL query to list the total trip expenses for each employee in 2003.
   (d) Write an SQL query to list the total trip expenses for each department in 2002.
   (e) For each employee that took more than five business trips, write an SQL query to retrieve the name of the employee and number of business trips.
   (f) Write an SQL query to retrieve the most commonly visited city for each department.

2. (20%) Consider the following relation Part_structure; a tuple <px, py> in Part_structure means that px contains py as an immediate component.

Part	Component
P1	P2
P1	P3
P2	P3
P2	P4
P3	P5
P4	P6

   (a) Write an SQL query to find all components of P1.
   (b) Write an SQL query to find all parts which contain P5.
   (c) Is it possible to write a single SQL query to find all components of some part? Is such a query applicable to every part in the database? Why or why not?
   (d) Can you suggest extensions to SQL to allow the specification of such queries in (b) and (c)?

3. (10%) Consider a slotted multiple access environment of k stations. Please answer the following questions.

   (a) Assume that for each station the probability of transmitting a frame in any time slot is p. If p can be globally controlled, please calculate the optimal throughput of the system as a function of k. What is such optimal throughput as k approaches infinity?
   (b) Assume that in a particular time slot exactly x stations among the k stations have frames for transmission. If n stations out of the k stations are randomly selected and given right of transmission, what is the probably that there is a successful transmission in this time slot?

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4. (5%) If you are asked by a company to provide advise on determining the number of outgoing telephone lines needed, what would be your approach to conduct such task?

5. (15%) Please explain the following terms.
   (a) Baud rate
   (b) Character stuffing
   (c) Binary countdown protocol
   (d) Sliding window protocols
   (e) Digital signature

6. (20%) Please answer the following questions.
   (a) Compare 1-persistent CSMA; non-persistent CSMA and *p*-persistent CSMA.
   (b) Compare IEEE 802.3 with IEEE 802.5.
   (c) Compare error-detection code with error-correcting code.
   (d) Compare link-state routing with distance-vector routing.
   (e) Compare TCP with UDP.