Indian Institute of Information Technology, Sri City, Chittoor

Name of the Exam: Database Management Systems Duration: 1.5hr Max. Marks: 20

Roll No.:_____Room No.: _____Seat No.: _____

Name: _____Invigilator's Signature: _____

Instructions: 1. All questions have to be answered in the box space provided only.
2. You have to do rough work in the question paper if required in the last sheet.

Q1. Multiple Choice Questions. Write the answer for the following questions in the space provided. Only one answer to be selected. (5 marks) Each one carries 1 mark.

i) Given a relational schema R

X	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies is valid?

a. XY->Z and Z->Y
b. YZ->X and Y->Z
c. YZ->X and X->Z
d. XZ->Y and Y->Z

Ans: b

ii) Consider the relation schema R(ABCDEFGH) with following functional dependencies:
A->BC, CD->E, E->C, D->AEH, ABH->BD, DH->BC, BCD->H
Find closure $(BCD)^+$?

a. ABCDEH
b. AEFGH
c. AEH
d. BCDEFH

Ans: a

iii) Clustering index is:

a. Ordered, Distinct
b. Ordered, Non-Distinct
c. Unordered, Distinct
e. Unordered, Non-Distinct

Ans: b

iv) Which of the following is the syntax for views where v is view name?

a. Create view v as “table name”;
b. Create “query expression” as view;
c. Create view v as “query expression”;
d. Create view “query expression”;

Ans: c

v) Which of the following is a physical storage media ?

a. Tape Storage
b. Optical Storage
c. Flash memory
d. All of the mentioned

Ans: d

Q2. Subjective Questions. Answer the following questions in the space provided only. (3 marks)

i) Consider the bank database as below:

branch(*branch_name*, *branch_city*, *assets*)
customer (*customer_name*, *customer_street*, *cust omer_city*)
loan (*loan_number*, *branch_name*, *amount*)
borrower (*customer_name*, *loan_number*)
account (*account_number*, *branch_name*, *balance*)
depositor (*customer_name*, *account_number*)

Let us define a view branch_cust as follows:

```
create view branch_cust as
    select branch_name, customer_name
    from depositor, account
    where depositor.account_number = account.account_number
```

Suppose that the view is materialized; that is, the view is computed and stored. Write triggers to maintain the view, that is, to keep it up-to-date on insertions to depositor or account. Do not bother about updates.

1 Mark is given only if the entire solution is correct

For inserting into the materialized view branch cust we must set a database trigger on an insert into depositor and account. We assume that the database system uses immediate binding for rule execution. Further, assume that the current version of a relation is denoted by the relation name itself, while the set of newly inserted tuples is denoted by qualifying the relation name with the prefix – inserted. The active rules for this insertion are given below –

```
define trigger insert_into_branch_cust_via_depositor
after insert on depositor
referencing new table as inserted for each statement
insert into branch_cust
    select branch_name, customer_name
    from inserted, account
    where inserted.account_number = account.account_number

define trigger insert_into_branch_cust_via_account
after insert on account
referencing new table as inserted for each statement
insert into branch_cust
    select branch_name, customer_name
    from depositor, inserted
    where depositor.account_number = inserted.account_number
```

Note that if the execution binding was deferred (instead of immediate), then the result of the join of the set of new tuples of account with the set of new tuples of depositor would have been inserted by both active rules, leading to duplication of the corresponding tuples in branch cust.

ii) Explain the different types of Single-Level Ordered Indexes giving examples of each.
½ mark for the names and definitions; ½ mark for the examples

Primary index
- Specified on the ordering key field of ordered file of records

Clustering index
- Used if numerous records can have the same value for the ordering field

Secondary index
- Can be specified on any non-ordering field
- Data file can have several secondary indexes

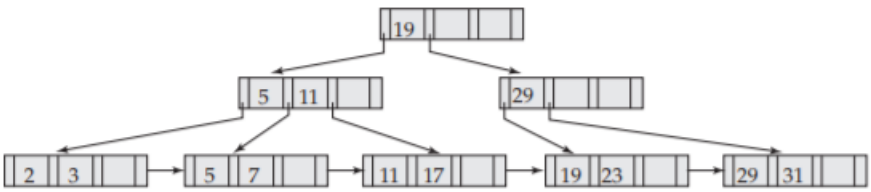
iii) Give 2 differences between SRAM and DRAM.
Each comparison gets ½ mark.

BASIS FOR COMPARISON	SRAM	DRAM
Speed	Faster	Slower
Size	Small	Large
Cost	Expensive	Cheap
Used in	Cache memory	Main memory
Density	Less dense	Highly dense
Construction	Complex and uses transistors and latches.	Simple and uses capacitors and very few transistors.
Single block of memory requires	6 transistors	Only one transistor.
Charge leakage property	Not present	Present hence require power refresh circuitry
Power consumption	Low	High

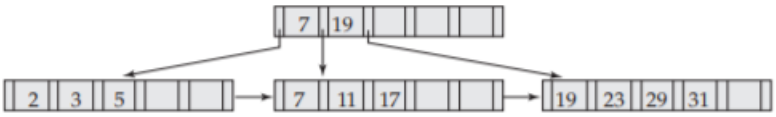
Q.3: Indexing (3 marks)
Construct a B+ tree for the following set of key values:
(2, 3, 5, 7, 11, 17, 19, 23, 29, 31)
Assume that the tree is initially empty and values are added in ascending order. Construct B+ trees for the cases where the number of pointers that will fit in one node (Order of the tree) is as follows:
a. Four 1/2
b. Six 1/2
c. Eight 1/2
For only B+ tree as above (a) part i.e. number of pointers that will fit in one node=4, show the form of the tree after each of the following series of operations:
a. Insert 9.
b. Insert 10. 1/2
c. Insert 8. 1/2
d. Delete 23.
e. Delete 19. +Presenting the correct criteria 1/2

1. The following were generated by inserting values into the B+- tree in ascending order. A node (other than the root) was never allowed to have fewer than ⌈n/2⌉ values/pointers.

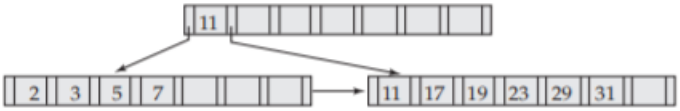
a



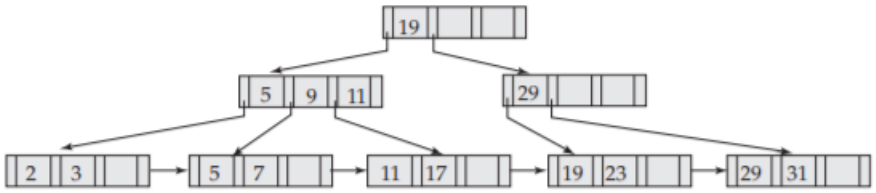
b.



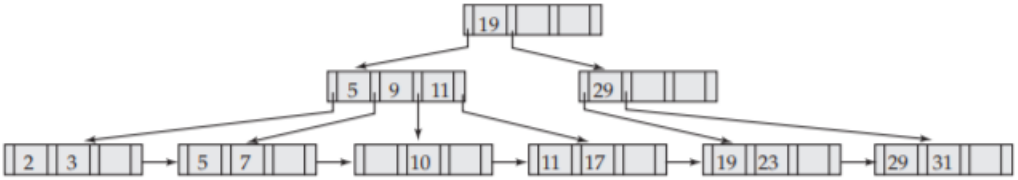
c.



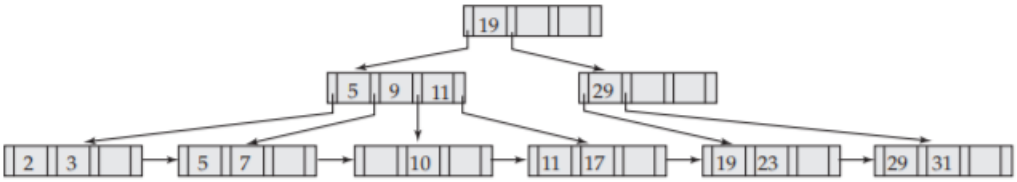
Insert 9:



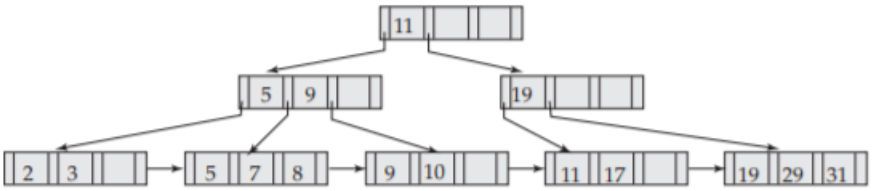
Insert 10:



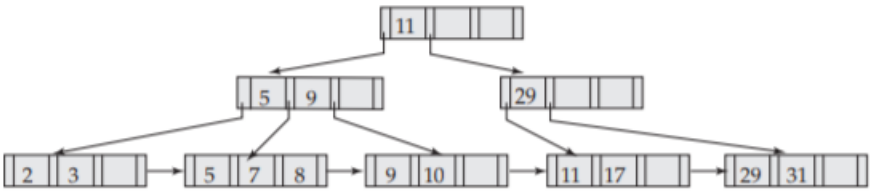
Insert 8:



Delete 23:



Delete 19:



Q. 4: Hashing (3 marks)

Suppose that we are using extendable hashing on a file that contains records with the following search-key values:

2, 3, 5, 7, 11, 17, 19, 23, 29, 31

Show the extendable hash structure for this file if the hash function is

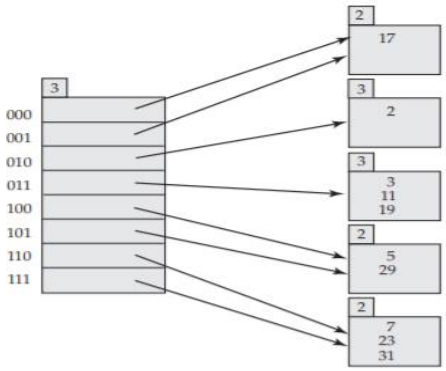
$h(x) = x \bmod 8$ and buckets can hold three records.

Show how the extendable hash structure as above changes as the result of each of the following steps:

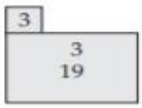
a. Delete 11. b. Delete 31. c. Insert 1. d. Insert 15.

Hash table:1 mark

a,b,c,d are given half mark each

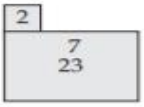


a. Delete 11: From the answer to Exercise 11.6, change the third bucket to:

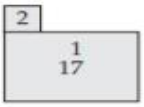


At this stage, it is possible to coalesce the second and third buckets. Then it is enough if the bucket address table has just four entries instead of eight. For the purpose of this answer, we do not do the coalescing.

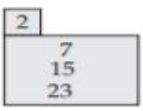
b. Delete 31: From the answer to 11.6, change the last bucket to:



c. Insert 1: From the answer to 11.6, change the first bucket to:



d. Insert 15: From the answer to 11.6, change the last bucket to:



Q5. Normalization (2+1+3=6 marks)

i) Normalize the relation table R(ABCDEFGHIJ) with following functional dependencies: AB->C, A->DE, B->F, F->GH, D->IJ. Find the default normal form in this.

Candidate keys: ½ Mark

Default Normal form Explation:1/2

1 Marks for the 5 tables.

i) AB is candidate key. In FD, AB->C AB is key therefore in 3NF . But, A->DE neither LHS is candidate key nor RHS are prime attributes. Default normal form:1NF

R1(ADEIJ) covering FDs: A->DE and D->IJ

R11(ADE) and R12(DIJ)

R2(BFGH) covering FDs: B->F andF->GH)

R21(BF) and R22(FGH)

R3(ABC) covering FDs: AB->C

ii) Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F={CH→G, A→BC, B→CFH, E→A, F→EG} is a set of functional dependencies (FDs) so that F^+ is exactly the set of FDs that hold for R. How many candidate keys does the relation R have? Explain the steps in detail.

½ Mark for 4 keys identification

½ marks for closure

4

In a relational database, a key helps to uniquely identify each record within a table . A key is a combination of one or more fields/attributes in a table. If a relational schema has multiple keys,each key is a candidate key. One of the candidate keys is chosen as the primary key. To find the candidate keys, we need to find the closure of each attribute. (If x ia an attribute(field), set of attributes determined by x under a set F of functional dependencies is the closure of x under F, denoted x+).

Thus,

A+:ABCFHGE

B+: BCFHEGA

C+:C

D+:D

E+: EABCFHG

F+:FEGABCH

G+:G

H+ : H

A+,B+,E+,F+ contains all attributes except D. Thus there are 4 candidate keys DA,DB,DE and DF.

iii) Find the normal forms in the following. Find candidate keys in each and explain the intermediate steps in detail.

a) R(ABCDEF): A->BCDEF, BC->ADEF, DEF->ABC
b) R(ABCDE): A-> B,BC->E,DE->A
c) R(ABCDEF): A->B, C->F,E->A,EC->D

½ mark for Candidate key
½ mark for Normal form

a) A,BC, DEF are candidatekeys hence BCNF since in all 3 FDs LHS is superkey.
b) ACD, BCD, CDE 3NF, in 1st FD: B (RHS) is prime attribute, in 2nd FD: E(RHS) is prime attribute, A(RHS) is prime attribute
c) CE, 1NF
In 1st FD LHS is not CK so not in BCNF also not in 3NF as RHS is not prime attribute
In C->F there is partial dependency as CE is the key so it not in 2NF

ROUGH WORK