University of Ruhuna - Faculty of Technology

Bachelor of Information & Communication Technology Honours Degree
Level 3 (Semester II) End Semester Examination, November/December 2023
Academic Year 2022/2023

Course Unit: ICT 3273 – Advanced Database Management Systems (Theory)

Duration: 02 Hours

This practical examination paper contains **05** pages including this instruction page.

IMPORTANT INSTRUCTIONS:

1. The medium of this examination is **English**.
2. This is a Closed Book examination.
3. This Examination consists of **four (04) questions** that are given equal marks.
4. You must answer **all four (04) questions** in this examination.

1.

a.

i. Differentiate the **Heap file** organization and the **Sequential file** organization based on the record storage.

[08 marks]

ii. Differentiate the usage of **Heap file** organization and the **Sequential file** organization in real environment by providing ***one (01)*** example for each.

[12 marks]

b.

i. Write down ***one (01)*** advantage and ***one (01)*** disadvantage of the database **indexes**.

[08 marks]

ii. Differentiate **Sparse Primary Index** and **Secondary Index** using suitable diagrams.

[12 marks]

c.

i. Write down ***one (01)*** advantage and ***one (01)*** disadvantage of **Static Hashing** used in databases.

[08 marks]

ii. Mention ***two (02)*** differences between **Linear Dynamic Hashing** and **Extendible Dynamic Hashing** techniques.

[08 marks]

iii. Answer the questions given below by using the Linear Hashing snapshot given in Figure 01.
Split Condition: Split occurs when a new overflow page is created.

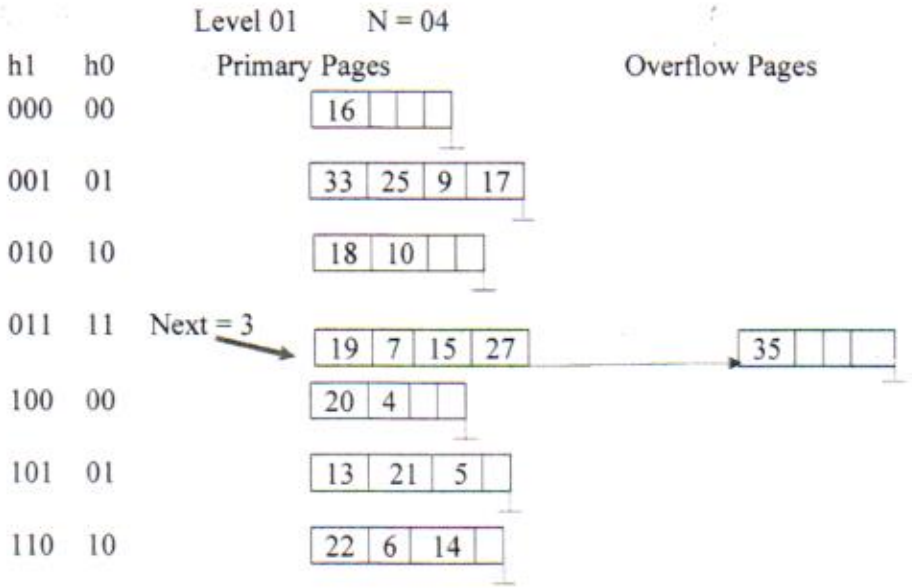

Figure 01

1. What is the **maximum** number of entries that you can enter before you are going to have a split bucket? Justify your answer.

[08 marks]

2. Redraw the file shown in above figure 01 after inserting **08, 43** and **49** key values.
Clearly show the changes in primary pages, overflow pages, changes in Level, N, Next, h0, h1 etc.

[36 marks]

2.

a.

i. Compare a **B Tree** with a **B+ tree** by using two (02) key points.

[10 marks]

ii. Construct a **B+ Tree** by using the given key values below. Assume that the fanout of the B+ Tree is **04**.
4, 28, 16, 7, 34, 22, 37, 18, 13, 31, 25

[50 marks]

b. Consider a **B+ Tree** with the following values.
Block size – 2048 bytes
Search key size – 20 bytes
Record pointer size – 10 bytes
Block pointer size – 10 bytes

Find the **maximum** number of keys that can be stored in a non-leaf internal node.

[20 marks]

c.

i. Illustrate the concept of **Query Processing** by indicating all necessary steps.

[10 marks]

ii. Differentiate **Materialized evaluation** with **Pipeline evaluation** ***using two (02)*** key points.

[10 marks]

3.

a.

i. Briefly describe a real-world scenario which violates ***one (01)*** of the ACID properties by stating the impact to the database.

[10 marks]

ii. Illustrating the **State Transition Diagram** by indicating the key states for transaction execution.

[10 marks]

b.

i. Briefly describe the need for **View Serializability** in transaction processing.

[10 marks]

ii. Briefly describe the following concepts which are used to check the view serializability.
- Initial read
- Blind write

[10 marks]

c. Consider the **five (05)** transactions T1, T2, T3, T4 and T5 and the schedule S given below.

T1 : w1(z); r1(x); r1(z);
T2 : r2(y); w2(z)
T3 : w3(y); w3(x)
T4 : r4(y); w4(x); r4(z)
T5: r5(y); w5(y);

S : r4(y); w3(y); w1(z); r2(y); r1(x); w4(x); r5(y); r4(z); r1(z); w2(z); w5(y); w3(x)

i. Write down ***two (02)*** conflict operations and ***two (02)*** non conflict operations in the given schedule S.

[08 marks]

ii. State whether the given schedule S is a complete schedule or not. Justify your answer.

[06 marks]

iii. Construct the precedence directed graph by considering the given schedule S.

[35 marks]

iv. State whether the schedule is a conflict serializable schedule or not by considering the precedence graph you have drawn in part (c) (iii). Justify your answer.

[05 marks]

v. If the given schedule is conflict serializable write down the equivalent serial schedule by using the concept of topological ordering.

[06 marks]

4.

a.

i. Briefly describe how to recover from a **catastrophic failure** in a database.

[10 marks]

ii. Differentiate **Dirty Bit** with **Pin-Unpin Bit** based on their usage in caching of disk blocks in a database.

[10 marks]

iii. State ***two (02)*** challenges encounter in maintaining database security.

[10 marks]

iv. Briefly describe the **Master Slave concept** used in MySQL replication.

[10 marks]

v. Differentiate **centralized database** with **distributed database** using ***two (02)*** key points.

[10 marks]

vi. Briefly describe ***two (02)*** problems of two-phase locking(2PL) protocols.

[10 marks]

b. Consider the given schedule in Table 01 with three transactions T1, T2 and T3. The time stamp values of transactions and data items are as follows.

TS(T1) = 40, TS(T2) = 80, TS(T3) = 120,
Initial Read time stamp of X = 0, Y = 0, Z = 0
Initial Write time stamp of X = 0, Y = 0, Z = 0

T1	T2	T3
R1(X)		
	R2(Y)	
		R3(Z)
W1(Z)		
		R3(Y)
R1(Z)		
	W2(Y)	
		W3(X)

Table 01

Calculate read time stamp values and write time stamp values of each X, Y, and Z at the end of the given schedule by applying basic time stamp ordering algorithm.

[40 marks]

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