CLASS TEST

S.No. : 01JPCS_29062024

MADE EASY
India's Best Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune | Kolkata

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

COMPUTER SCIENCE & IT

DBMS

Duration : 1:00 hr. **Maximum Marks : 50**

Read the following instructions carefully

1. This question paper contains **30** objective questions. **Q.1-10** carry one mark each and **Q.11-30** carry two marks each.
2. Answer all the questions.
3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked **A**, **B**, **C**, **D**) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.
4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.
5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.
6. No charts or tables will be provided in the examination hall.
7. Choose the **Closest** numerical answer among the choices given.
8. If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that questions.
9. If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Q. No. 1 to Q. No. 10 carry 1 mark each

Q.1 Consider the Two sets of FD's for the relation $R(ABCDE)$:

$F_1 = \{A \rightarrow B, AB \rightarrow C, D \rightarrow AC, D \rightarrow E\}$
$F_2 = \{A \rightarrow BC, D \rightarrow AE\}$

Which of the following statement true about FD set?

(a) $F_1 \subset F_2$ (b) $F_1 \supset F_2$
(c) $F_1 \equiv F_2$ (d) None of these

Q.2 Suppose relation $R(ABC)$ has the tuples:

R	A	B	C
	1	2	3
	1	2	3
	3	2	1

How many tuples resulted by given Relational Algebra expression?

$\pi_{A,B}(R) \bowtie_{R.B<S.B} \rho_{S(A,B)}(\pi_{B,C}(R))$

(a) 6 (b) 2
(c) 3 (d) 4

Q.3 Which of the following statements about ER models is/are correct?

I. Many-many relationships cannot be represented in ERD.
II. Relationship sets can have attributes of their own.
III. All many to one relationships are represented by the relationships between a weak && a non weak entity set.

(a) II only (b) III only
(c) II, III only (d) I and II only

Q.4 Which of the following statement true about B tree and B$^+$ tree index? Assume order of B tree node same as order of B$^+$ tree node.

(a) B tree index has more levels than B$^+$ tree index for large number of keys.
(b) B$^+$ tree index has more levels than B tree index for large number of keys.
(c) Both B tree B$^+$ tree best for sequential access of records.
(d) B tree index nodes more than B$^+$ tree for large number of keys.

Q.5 The number of concurrent schedules can be formed with 3 transactions having 3, 2 and 1 operations respectively

(a) 15 (b) 65
(c) 60 (d) 40

Q.6 Which of the following statements is/are true?

S_1 : In relational algebra σ (selection) operation is NOT commutative.
S_2 : In relational algebra Π (projection) operation is commutative.

(a) Only S_1 (b) Only S_2
(c) Both S_1 and S_2 (d) Neither S_1 nor S_2

Q.7 Consider the following modified **2 phase locking protocol:** Before a transaction T writes a data object A, T has to obtain an exclusive lock on A. Before a transaction T reads a data object A, T has to obtain a shared lock on A. If exclusive locks are held until the end of transaction and shared locks can be released at any time then which of the following properties are guaranteed?

(a) Conflict serializability
(b) Recoverability
(c) Avoids cascading rollbacks
(d) All of the above

Q.8 Given relation $R(P, Q, R, S, T)$ and set of functional dependencies

$F = \{PQ \rightarrow R, PQ \rightarrow S, S \rightarrow P, QR \rightarrow S, QR \rightarrow T\}$

The highest normal form satisfied by R is _____.

(a) 1 NF (b) 2 NF
(c) 3 NF (d) BCNF

Q.9 Consider the following schedule S on 4 transactions i.e. T_1, T_2, T_3 and T_4 which are working on two data items namely A and B:

S : R_4 (A), R_2 (A), R_3 (A), W_1 (B), W_2 (A), R_3 (B), W_2 (B)

Which of the following is correct?

(a) The schedule cannot be serialized
(b) The schedule is equivalent to T_3, T_4, T_1, T_2
(c) The schedule is equivalent to T_1, T_4, T_3, T_2
(d) The schedule is equivalent to T_2, T_3, T_1, T_4

Q.10 A database relation has 5000 records block can hold either 10 records or 15 keys and pointer pairs. If sparse index is used at 1st level and multilevel indexing is used in system, then the number of disk block required to store relation and index is

(a) 256 (b) 369
(c) 499 (d) 538

Q. No. 11 to Q. No. 30 carry 2 marks each

Q.11 Consider the following schedule:

$S: R_2(A)\ W_1(B)\ W_1(C)\ R_3(B)\ R_2(B)\ R_1(A) C_1\ R_2(C) C_2\ W_3(A) C_3$

Which of the following is correct about above schedule?

(a) Schedule(S) is not conflict serializable schedule.
(b) Schedule(S) is allowed by 2PL.
(c) Schedule(S) is strict recoverable schedule.
(d) Schedule(S) is allowed by strict 2PL.

Q.12 Which of the following statement false of relation R is in 3NF but not BCNF?

(a) Relation *R* must consist atleast two over-lapped candidate keys.
(b) Relation *R* must consist proper subset of candidate key determines proper subset of some other candidate key.
(c) Relation *R* must consist atmost one compound candidate key and other candidate keys simple candidate key.
(d) Relation *R* must consist atleast two compound candidate keys.

Q.13 Consider the following Relational Schema *R*(*ABCDEF*) and functional dependency set:

$\{AB \to C, C \to A, BC \to D, ACD \to B, BE \to C, EC \to AF, CF \to BD, D \to E\}$

What is highest normal form satisfied by relation *R*?

(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

Q.14 Consider the following FD set:

$\{AB \to C, C \to A, BC \to D, ACD \to B, BE \to C, EC \to FA, CF \to BD, D \to E\}$

Which of the following FD set is minimal cover of given FD set?

(a) $\{AB \to C, C \to A, BC \to D, BE \to C, EC \to F, CF \to D, D \to E\}$
(b) $\{AB \to C, C \to A, BC \to D, BE \to C, EC \to F, CF \to B, D \to E\}$
(c) $\{AB \to C, C \to A, CD \to B, EC \to F, CF \to B, D \to E\}$

Q.15 Edges of the directed graph stored in database relation Adj(*X*, *Y*) [i.e. if there exists edge from vertex *A* to *B* then (*A*, *B*) is one record in Adj relation]. Which of relational algebra query retrieves vertices whose out degree atleast two?

(a) $\pi_X(\text{Adj} \bowtie_{X = X1 \wedge Y \neq Y1} \rho_{X1,\ Y1}(\text{Adj}))$
(b) $\pi_X(\text{Adj} \bowtie_{X = X1 \wedge Y = Y1} \rho_{X1,\ Y1}(\text{Adj}))$
(c) $\pi_X(\text{Adj} \bowtie_{X = X1} \rho_{X1,\ Y1}(\text{Adj}))$
(b) $\pi_X(\text{Adj} \bowtie_{X \neq X1 \wedge Y = Y1} \rho_{X1,\ Y1}(\text{Adj}))$

Q.16 Consider the following relational schema $R(\underline{AB})$ and $S(\underline{CD})$:

Query 1:

Select *A*
From *R*
Where EXISTS (Select *
From *S*
Where *R. A* > *S.C*

Query 2: $\pi_A(R \bowtie_{R.A > S.C} S)$

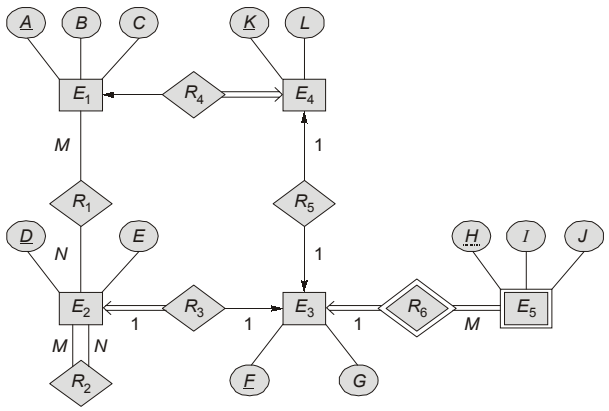
Query 3:

Select *A*
From *R*
Where *A* > ALL (Select *C*
From *S*)

Which of the following statement is true?

(a) Query 1 and Query 2 results same but not Query 3.
(b) Query 1 and Query 3 results same but not Query 2.
(c) Query 2 and Query 3 results same but not Query 1.
(d) All Query 1, Query 2, Query 3 results same.

Q.17 Consider the following ER-diagram:



How many minimum relations required for the above ER diagram?

(a) 4 (b) 5
(c) 6 (d) 7

Q.18 Suppose size of disk block 1000 bytes and search key of 12 bytes, pointer size 8 bytes. How many minimum number of records in data file which leads 3 level dense B^+ tree index? (Assume minimum node fill factor $\lceil P/2 \rceil$ pointers where P is the maximum pointer per node).

(a) 1200 (b) 1250
(c) 15000 (d) 15625

Q.19 Consider the following schedule:

S: $r_1(A)\ r_3(D)\ w_1(B)\ r_2(B)\ r_4(B)\ w_2(C)\ r_5(C)\ w_4(E)\ r_5(E)\ w_5(B)$

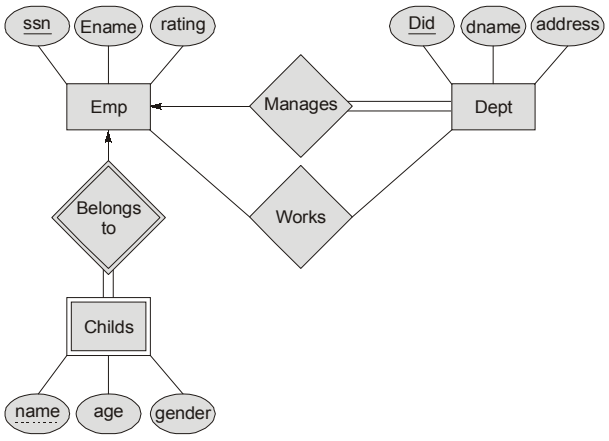
How many serial schedules conflict equal to schedules (S)?

(a) 10 (b) 15
(c) 8 (d) 12

Q.20 Database file consist 50000 records with record size 100 bytes, block size 512 bytes. If sparse B^+ tree index build over given database file with search key size 20 bytes both block pointer and record pointer sizes 12 bytes each. How many maximum index blocks required if node order P is defined as between $\lceil P/2 \rceil$ to P pointers per node?

(a) 1635 (b) 1631
(c) 716 (d) 713

Q.21 Consider the given ER-diagram:



The number of relational tables for given ERD

(a) 1 (b) 2
(c) 3 (d) 4

Q.22 How many concurrent schedules are conflict serializable of given transactions T_1 and T_2:

T_1: $r_1(A)\ w_1(A)\ r_1(B)\ w_1(B)$ T_2 : $r_2(B)\ \ w_2(B)\ r_2(A)\ w_2(A)$

(a) 2 (b) 3
(c) 4 (d) 8

Q.23 Consider the following relational schema $R(ABCDE)$. The number of super keys in relation R if every two attributes of relation R is candidate keys are

(a) 12 (b) 26
(c) 36 (d) 28

Q.24 There is a database of the dealers of a Products_deal. Following is the snapshot.

Product_deal

Dealer-no	Part-no	Color-id
D_6	P_2	C_1
D_2	P_1	C_2
D_7	P_4	C_3
D_5	P_3	C_4
D_2	P_3	C_5
D_7	P_2	C_6

Consider the following query:
SELECT A.Color-id, *A*.Dealer-no
FROM Product_deal *A*, Product_deal *B*
WHERE A.Dealer-no = *B*.Dealer-no
and *A*.Part-no < > *B*.Part-no;
The number of tupples contained in the output will be _____.

(a) 2 (b) 4
(c) 6 (d) 9

Q.25 Consider a file of 8192 records. Each record is 16 bytes long and its key field is of size 6 bytes. The file is ordered on a key field, and the file organization is unspanned. The file is stored in a file system with block size 512 bytes, and the size of a block pointer is 10 bytes. If the primary index is built on the key field of the file, and a multilevel index scheme is used to store the primary index, the number of first-level and second-level blocks in the multilevel index are respectively

(a) 8 and 1 (b) 16 and 1
(c) 8 and 2 (d) None of these

Q.26 Consider the following relations:
R ($\underline{A}$ B) $\underline{A}$ primary key
S ($\underline{C}$ $\underline{D}$ E) $\underline{C}$ primary key and $\underline{D}$ alternative key.
An attribute "B" of relation R is foreign key references to alternative key D of relation S. Which of the following statement is true?
(a) Every record of R must references to some record of S.
(b) Each record of R can references to at most one record of S.
(c) Each record of R can references zero or more record of S.
(d) Each record of R must references one or more record of S.

Q.27 Consider a database that has the relation schemas;
student(ID, name, dept_name, tot_cred)
course(coures_id, dept_name)
takes(ID, coures_id, sec_id, semester, year, grade)
"Find all students who have taken all courses offered in the CS department". Which of the following will represents above queries?
(a) $\{t \mid \exists r \in \text{student } (r[\text{ID}] = t[\text{ID}]) \wedge (\forall u \in \text{course } (u[\text{dept\_name}] = \text{"CS"} \Rightarrow \exists s \in \text{takes } (t[\text{ID}] = s[\text{ID}] \wedge s[\text{course\_id}] = u[\text{course\_id}]))\}$
(b) $\{t \mid \exists r \in \text{student } (r[\text{ID}] = t[\text{ID}]) \wedge (\forall u \in \text{course } (u[\text{dept\_name}] \neq \text{"CS"} \vee \exists s \in \text{takes } (t[\text{ID}] = s[\text{ID}] \wedge s[\text{course\_id}] = u[\text{course\_id}]))\}$
(c) Both (a) and (b)
(d) None of these

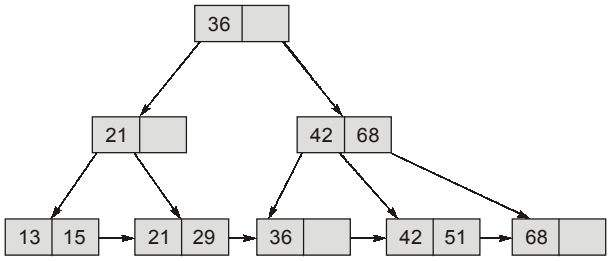
Q.28 Suppose the process P has been running for several days when a new process Q starts up and begins contending with P for resources. Which of the following is true?
(a) In a wait-die system, if P needs a resource held by Q, then P waits.
(b) In a wait-die system, if Q needs a resource held by P, then Q waits.
(c) In a wound-wait system, if P needs a resource held by Q, then Q yields and waits.
(d) In a wound-wait system, if Q needs a resource held by P, then Q dies.

Q.29 Consider the following schedules:

T_1	T_2	T_3
$R(a)$		
	$R(a)$	
	$W(a)$	
		$W(b)$
		$W(a)$
$R(c)$		
$W(a)$		

Which of the following is correct about above schedule?
(a) Only view serializable
(b) Only conflict serializable
(c) Both conflict and view serializable
(d) Neither view serializable nor conflict serializable

Q.30 Consider the following B^+ tree with the order of internal and leaf nodes as 3 and 2 respectively:



The minimum number of key insertions that causes a new level to be introduced in the above B^+ tree _____. (Assume key redistribution is not allowed)
(a) 2 (b) 3
(c) 6 (d) 8

■■■■

S.No. : 01JPCS_29062024

MADE EASY
India's Best Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune | Kolkata

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

DBMS

COMPUTER SCIENCE & IT

Date of Test : 29/06/2024

ANSWER KEY ➤

1.	(c)	7.	(d)	13.	(c)	19.	(a)	25.	(a)
2.	(b)	8.	(c)	14.	(b)	20.	(b)	26.	(b)
3.	(a)	9.	(c)	15.	(a)	21.	(d)	27.	(c)
4.	(b)	10.	(d)	16.	(a)	22.	(a)	28.	(a)
5.	(c)	11.	(b)	17.	(b)	23.	(b)	29.	(d)
6.	(d)	12.	(c)	18.	(a)	24.	(b)	30.	(b)

DETAILED EXPLANATIONS

1. (c)

F_1 covers F_2 : True

F_2 covers F_1 : True

2. (b)

$$\pi_{A,B}(R) \bowtie_{R.B<S.B} \rho_{S(A,B)}(\pi_{B.C}(R))$$

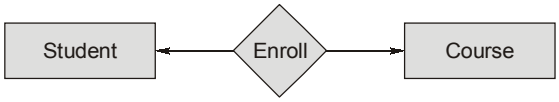
A	B
1	2
3	2

A	B
2	3
2	1

$\Rightarrow$

A	B	A	B
1	2	2	3
3	2	2	3

3. (a)



So, ER-diagram represents many student can enroll many courses.

- In ER-diagram Relationship set can have own attribute.
- Many to one relation can be represented the relation between non-weak entity set.

4. (b)

B^+ tree index has more levels than B-tree index for large number of keys. Since in B-tree every key appears at only single level but which is not the case for B^+ tree.

5. (c)

$$\frac{(3+2+1)!}{3! \cdot 2!} = \frac{6!}{3! \cdot 2!} = 60$$

6. (d)

Both the statements are incorrect.

The select operation is commutative i.e. $\sigma_{C_1}(\sigma_{C_2}(R)) \Leftrightarrow \sigma_{C_2}(\sigma_{C_1}(R))$.

Ultimately only those tupples will be selected which satisfy both C_1 and C_2. Hence order does not matter.

But Π (projection) operation is not commutative.

$\Pi_{a_1}(\Pi_{a_2}(R)) = \Pi_{a_1}(R)$ if and only if a_1 is substring (or subset) of a_2, otherwise operation would be incorrect.

7. (d)

The given locking protocol follows the properties of strict 2 PL which is conflict serializable, recoverable and avoid cascading rollbacks.

8. (c)

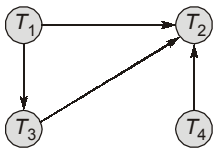
Candidate keys for the relation are: *PQ*, *QS* and *QR*

$S \rightarrow P$, prime attribute $\rightarrow$ prime attribute (not allowed in BCNF but allowed in 3NF).

$\Rightarrow$ Relation *R* is in 3NF but not in BCNF since $S \rightarrow P$ does have a superkey on the left hand side.

9. (c)

The precedence graph of the given schedule is



Therefore schedule is equivalent to $(T_1, T_4, T_3, T_2), (T_1, T_3, T_4, T_2)$ and (T_4, T_3, T_1, T_2).

10. (d)

Disk block size = 5000 records

Block size = 10 records or 15 (keys + Pointers)

Sparse index at 1st level. So number of disk block at 1st level is number of block in database.

$$\text{Data base} = \frac{5000}{10} = 500 \text{ blocks}$$

$$1^{st} \text{ level} = \left\lceil \frac{500}{15} \right\rceil = \lceil 33.33 \rceil = 34 \text{ blocks}$$

$$2^{nd} \text{ level} = \left\lceil \frac{34}{15} \right\rceil = \lceil 2.26 \rceil = 3 \text{ blocks}$$

3^{rd} level = 1 block

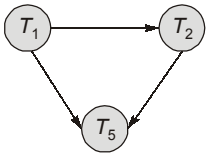
Total = [500 + 34 + 3 +1] blocks

= 538 blocks

11. (b)

T_1	T_2	T_3
	$S(A)$ $R_2(A)$	
$X(B)$ $W_1(B)$ $X(C)$ $W(C)$ $S(A)$ $U(A)$		
		$S(B)$ $R_3(B)$
	$S(B)$ $R_2(B)$	
$S(B)$ $R(A)$ $U(B)$ C_1		
	$R_2(C)$ $U(A)U(B)$ C_2	
		$X(A)$ $W_3(A)$ $U(B)U(A)$ C_3

(*i*) Conflict serializable



(*ii*) Allowed by 2PL.
(*iii*) Not strict recoverable.
(*iv*) No allowed by strict 2PL.

12. (c)

If relation *R* in 3NF but not BCNF then atleast two compound keys must exists where non-trivial FD with determinant not superkey.

13. (c)

The given relation with functional dependencies is in 3NF i.e., no transitive and partial function dependency exist but $C \rightarrow A$, violets BCNF i.e., super key $\rightarrow$ any attributes. So, relation R in 3NF but not BCNF.

(d) $\{AB \rightarrow C, C \rightarrow A, BC \rightarrow D, BE \rightarrow C, EC \rightarrow A, CF \rightarrow B, D \rightarrow E\}$

14. (b)

$[AB \rightarrow C$
$C \rightarrow A$
$BC \rightarrow D$
$ACD \rightarrow B$
$BE \rightarrow C$
$EC \rightarrow F$
$EC \rightarrow A$
$CF \rightarrow B$
$CF \rightarrow D$
$D \rightarrow E]$

$\xrightarrow{\text{After removal of extraneous attributes}}$

$[AB \rightarrow C$
$C \rightarrow A$
$BC \rightarrow D$
$CD \rightarrow B$
$BE \rightarrow C$
$EC \rightarrow F$
$EC \rightarrow A$
$CF \rightarrow B$
$CF \rightarrow D$
$D \rightarrow E]$

$\xrightarrow{\text{After removal of redundant FD's}}$

$[AB \rightarrow C$
$C \rightarrow A$
$BC \rightarrow D$
$BE \rightarrow C$
$EC \rightarrow F$
$CF \rightarrow B$
$D \rightarrow E]$
Minimal cover

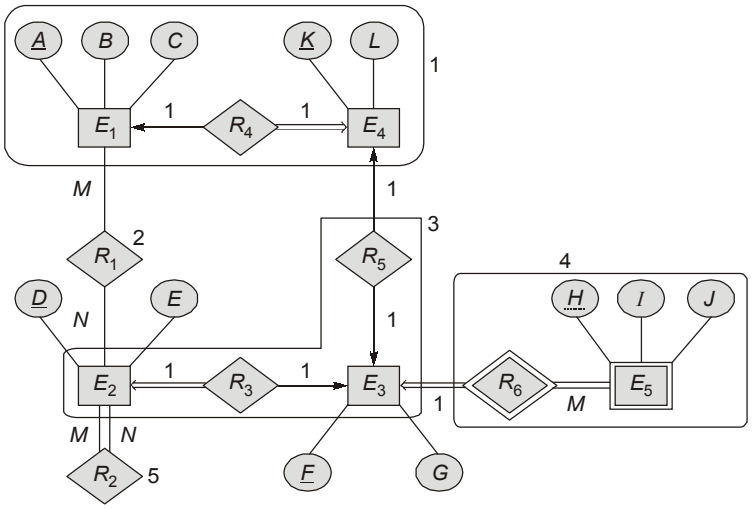
15. (a)

Condition $X = X_1$ and $Y \neq Y_1$ says that vertices whose starting vertex is same but end vertices is different, which returns vertices whose out degree is atleast 2.

16. (a)

Q_1 :Retrieves A which are more than some C.
Q_2 :Retrieves A which are more than some C.
Q_3 :Retrieves A which are more than every C.

17. (b)



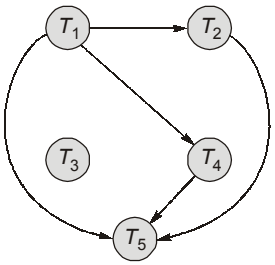
18. (a)

Order P:

$$P \times \text{Pointer} + (P-1) \times \text{Key} \leq \text{Block}$$
$$P \times 8 + (P-1)\,12 \leq 1000$$
$$20\,P \leq 1012$$
$$P = \left\lfloor \frac{1012}{20} \right\rfloor = 50$$

Level	Min nodes	Min B_P	Min keys
1	1	2	1
2	2	2 × 25	24
3	50	–	50 × 24
			1200

19. (a)



# of serial schedules conflict equal to schedule (S) is # of topological orders

$$T_1 \begin{cases} T_2 - T_4 - T_5 \\ T_4 - T_2 - T_5 \end{cases}$$ 2 sequences for $T_1\ T_2\ T_4\ T_5$

T_3 can be any where in both sequences. Total 10 topological order.

20. (b)

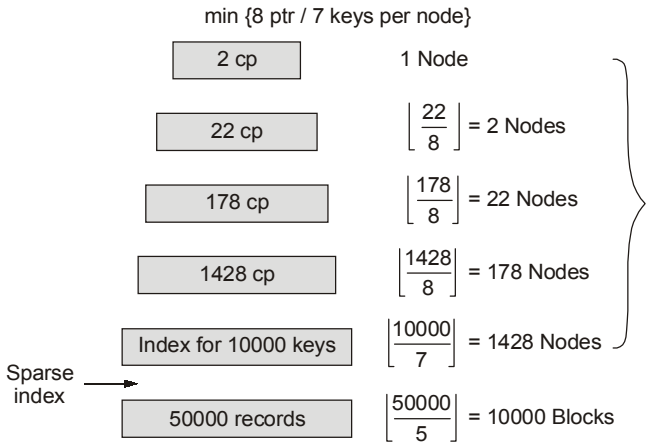
Order $P \Rightarrow P \times B_P + (P-1)\ \text{Key} \leq \text{Block}$

$$P \times 12 + (P-1)\ 20 \leq 512$$

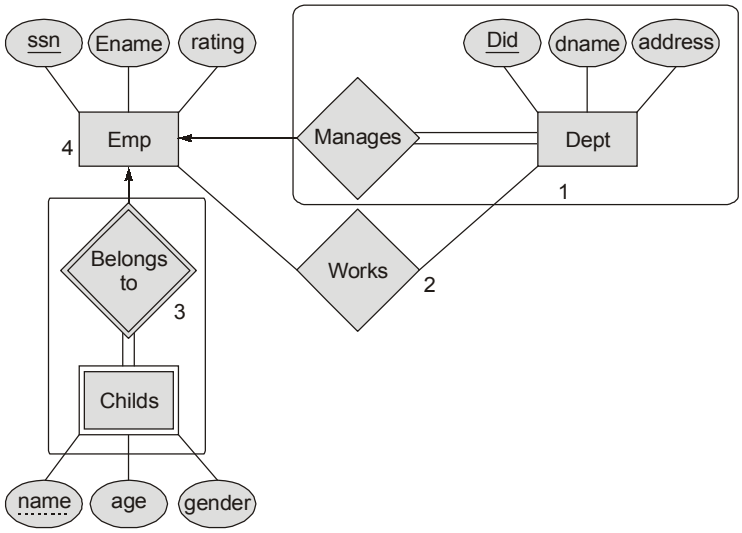
$$32\,P \leq 532$$

$$P = \left\lfloor \frac{532}{32} \right\rfloor = 16$$

Maximum index nodes in index mean min fill factor



21. (d)



Emp (ssn, Ename, rating)
Dept_manages (did, dname, address, ssn)
Works (ssn did)
Childs belongs to (ssn name, age, gender)

22. (a)

- Only serial schedules $T_1 \rightarrow T_2$, $T_2 \rightarrow T_1$ are conflict serializable.
- None of non serial schedules are conflict serializable.

23. (b)

$${}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5 = 26$$

24. (b)

The output Table will be

Dealer-No.	Color-id
D_2	C_2
D_7	C_3
D_2	C_5
D_7	C_6

25. (a)

$$\text{Content of index <key, BP>} = 6 + 10 = 16$$

$$\text{Block factor of database} = \frac{512}{16} = 32$$

$$\text{Number of block in database} = \frac{8192}{32} = 256$$

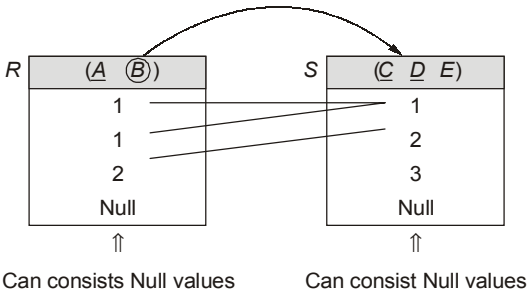
In first level entry for each record,

$$\text{Number of blocks in first level} = \frac{\text{Number of Database Block}}{\text{Entry size of 1st level}} = \left\lceil \frac{256}{32} \right\rceil = 8$$

In second level

$$\text{Number of blocks in second level} = \frac{\text{Number of 1st level Block}}{\text{Entry size of 2nd level}} = \left\lceil \frac{8}{32} \right\rceil = 1$$

26. (b)



Null value of B column record not references to any record of S. Remaining records of R references to atmost one record of S.

27. (c)

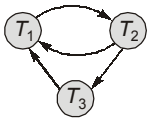
$\{t \mid \exists r \in$ student $(r[\text{ID}] = t[\text{ID}]) \wedge (\forall u \in$ course $(u[\text{dept\_name}] = \text{“CS”} \Rightarrow \exists\ s \in$ takes $(t[\text{ID}] = s[\text{ID}] \wedge s[\text{course\_id}] = u[\text{course\_id}]))\}$ will results all students who have taken all courses offered in the CS department. Since we know that $P \Rightarrow Q \equiv$ not $P \vee Q$, so option (b) is also true.

28. (a)

In wait-die scheme, when transaction T_i request a data items currently held by T_j, T_i is allowed to wait only if it has a time stamp smaller then that of T_j otherwise T_i is rolled back (die). Here process P is running so it has time stamp less than process Q now if process P need a resource held by process Q then process P has to wait.

29. (d)

Checking for conflict serializable:



Cycle is present
So not conflict serialiazable

Since their is blind write between W_2(a) to W_3(a), so it may be view serializable.
Checking for view serializability:

1. Final write: $a = T_1,\ b = T_3$ (1)
2. Initial read: $a = T_1,\ T_2\ b = T_3,\ c = T_1$ (2)
3. Write read: No write read

$(T_2, T_3) \rightarrow T_1$ from (1)
$T_1 \rightarrow T_2, T_3$ from (2)

Both at a time not possible, so not view serializable.

30. (b)

If we insert keys 45,48,55 in same order, then on insertion of key 55, root will be overflow and new level will be created.

■■■■