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**GATE SOLVED PAPER**  
**Computer Science Engineering**  
**2001**

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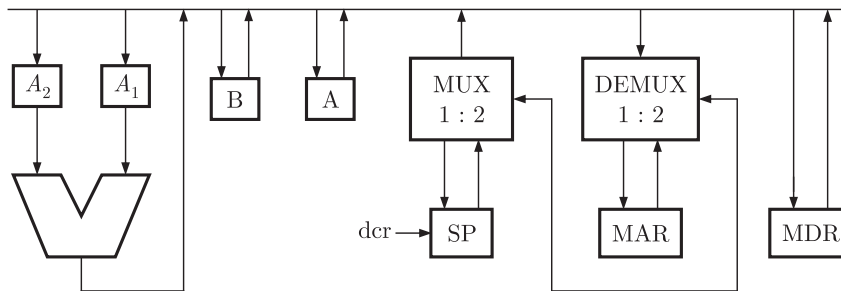
# GATE SOLVED PAPER - CS

2001

- Q. 1 Randomized quicksort is an extension of quicksort where the pivot is chosen randomly. What is the worst case complexity of sorting  $n$  numbers using randomized quicksort ?
- (A)  $O(n)$  (B)  $O(n \log n)$   
(C)  $O(n^2)$  (D)  $O(n!)$
- Q. 2 Consider any array representation of an  $n$  element binary heap where the elements are stored from index 1 to index  $n$  of the array. For the element stored at index  $i$  of the array ( $i \leq n$ ), the index of the parent is
- (A)  $i - 1$  (B)  $\lfloor \frac{i}{2} \rfloor$   
(C)  $\lceil \frac{i}{2} \rceil$  (D)  $\frac{(i+1)}{2}$
- Q. 3 Let  $f(n) = n^2 \log n$  and  $g(n) = n(\log n)^{10}$  be two positive functions of  $n$ . Which of the following statements is correct ?
- (A)  $f(n) = O(g(n))$  and  $g(n) \neq O(f(n))$   
(B)  $g(n) = O(f(n))$  and  $f(n) \neq O(g(n))$   
(C)  $f(n) \neq O(g(n))$  and  $g(n) \neq O(f(n))$   
(D)  $f(n) = O(g(n))$  and  $g(n) = O(f(n))$
- Q. 4 Consider the undirected unweighted graph  $G$ . Let a breadth-first traversal of  $G$  be done starting from a node  $r$ . Let  $d(r, u)$  and  $d(r, v)$  be the lengths of the shortest paths from  $r$  to  $u$  and  $v$  respectively in  $G$ . If  $u$  is visited before  $v$  during the breadth-first traversal, which of the following statements is correct ?
- (A)  $d(r, u) < d(r, v)$  (B)  $d(r, u) > d(r, v)$   
(C)  $d(r, u) \leq d(r, v)$  (D) None of the above
- Q. 5 How many undirected graphs (not necessarily connected) can be constructed out of a given set  $V = \{V_1, V_2, \dots, V_n\}$  of  $n$  vertices ?
- (A)  $\frac{n(n-1)}{2}$  (B)  $2^n$   
(C)  $n!$  (D)  $2^{\frac{n(n-1)}{2}}$
- Q. 6 What is the minimum number of stacks of size  $n$  required to implement a queue to size  $n$  ?
- (A) One (B) Two  
(C) Three (D) Four
- Q. 7 Which of the following statements is false ?
- (A) An unambiguous grammar has same left most and right most derivation  
(B) An  $LL(1)$  parser is a top-down parser  
(C)  $LALR$  is more powerful than  $SLR$   
(D) An ambiguous grammar can never be  $LR(K)$  for any  $k$

- Q. 8 More than one word are put in one cache block to
- (A) Exploit the temporal locality of reference in a program
  - (B) Exploit the spatial locality of reference in a program
  - (C) Reduce the miss penalty
  - (D) None of the above
- Q. 9 A low memory can be connected to 8085 by using
- (A) INTER
  - (B)  $\overline{\text{RESET IN}}$
  - (C) HOLD
  - (D) READY
- Q. 10 Suppose a processor does not have any stack pointer register. Which of the following statements is true ?
- (A) It cannot have subroutine call instruction
  - (B) It can have subroutine call instruction, but no nested subroutine calls.
  - (C) Nested subroutine calls are possible, but interrupts are not.
  - (D) All sequences of subroutine calls and also interrupts are possible
- Q. 11 A processor needs software interrupt to
- (A) Test the interrupt system of the processor.
  - (B) Implement co-routines.
  - (C) Obtain system services which need execution of privileged instructions.
  - (D) Return from subroutine.
- Q. 12 A CPU has two modes-privileged and non-privileged. In order to change the mode from privileged to non-privileged.
- (A) A hardware interrupt is needed.
  - (B) A software interrupt is needed.
  - (C) A privileged instruction (which does not generate an interrupt) is needed.
  - (D) A non-privileged instruction (Which does not generate an interrupt) is needed.
- Q. 13 The process of assigning load addresses to the various parts of the program and adjusting the code and data in the program to reflect the assigned addresses is called
- (A) Assembly
  - (B) Parsing
  - (C) Relocation
  - (D) Symbol resolution
- Q. 14 Which of the following requires a device driver ?
- (A) Register
  - (B) Cache
  - (C) Main memory
  - (D) Disk
- Q. 15 Which is the most appropriate match for the items in the first column with the items in the second column
- |                               |                                   |
|-------------------------------|-----------------------------------|
| (X.) Indirect Addressing      | (I.) Array implementation         |
| (Y.) Indexed Addressing       | (II.) Writing re-locatable code   |
| (Z.) Base Register Addressing | (III.) Passing array as parameter |
| (A) (X, III) (Y, I) (Z, II)   | (B) (X, II) (Y, III) (Z, I)       |
| (C) (X, III) (Y, II) (Z, I)   | (D) (X, I) (Y, III) (Z, II)       |

- Q. 16 Consider the following data path of a simple non-pipeline CPU. The registers A, B,  $A_1$ ,  $A_2$ , MDR the bus and the ALU are 8-bit wide. SP and MAR are 16-bit registers. The MUX is of size  $8 \times (2:1)$  and the DEMUX is of size  $8 \times (1:2)$ . Each memory operation takes 2 CPU clock cycles and uses MAR (Memory Address Register) and MDR (Memory Date Register). SP can be decremented locally.



The CPU instruction “push r”, where  $r = A$  or  $B$ , has the specification

$$M[SP] \leftarrow r$$

$$SP \leftarrow SP - 1$$

How many CPU clock cycles are needed to execute the “push r” instruction ?

- (A) 2 (B) 3  
(C) 4 (D) 5
- Q. 17 Which of the following does not interrupt a running process ?  
(A) A device (B) Timer  
(C) Scheduler process (D) Power failure
- Q. 18 Consider a schema  $R(A,B,C,D)$  and functional dependencies  $A \rightarrow B$  and  $C \rightarrow D$ . Then the decomposition of  $R$  into  $R_1(AB)$  and  $R_2(CD)$  is :  
(A) Dependency preserving and lossless join  
(B) Lossless join but not dependency preserving  
(C) Dependency preserving but not lossless join  
(D) Not dependency preserving and not lossless join
- Q. 19 Suppose the adjacency relation of vertices in a graph is represented in a table Adj  $(X, Y)$ . Which of the following queries cannot be expressed by a relational algebra expression of constant length ?  
(A) List all vertices adjacent to a given vertex.  
(B) List all vertices which have self loops  
(C) List all vertices which belong to cycles of less than three vertices  
(D) List all vertices reachable from a given vertex
- Q. 20 Let  $r$  and  $s$  be two relations over the relation schemes  $R$  and  $S$  respectively, and let  $A$  be an attribute in  $R$ . Then the relational algebra expression  $\sigma_{A=a}(r \bowtie s)$  is always equal to :  
(A)  $\sigma_{A=a}(r)$   
(B)  $r$   
(C)  $\sigma_{A=a}(r \bowtie s)$   
(D) None of the above

Q. 21 R, (A,B,C,D) is a relation. Which of the following does not have a lossless join, dependency preserving BCNF decomposition ?  
 (A)  $A \rightarrow B, B \rightarrow CD$  (B)  $A \rightarrow B, B \rightarrow C, C \rightarrow D$   
 (C)  $AB \rightarrow C, C \rightarrow AD$  (D)  $A \rightarrow BCD$

Q. 22 Which of the following relational calculus expressions is not safe ?  
 (A)  $\{r \mid \exists u \in R_1 (t[A] = u[A] \wedge \neg \exists s \in R_2 (t[A] = s[A]))\}$   
 (B)  $\{r \mid \forall u \in R_1 (u[A] = "x" \Rightarrow \exists s \in R_2 (t[A] = s[A] \wedge s[A] = u[A]))\}$   
 (C)  $\{t \mid \neg (t \in R_1)\}$   
 (D)  $\{t \mid \exists u \in R_1 (t[A] = u[A]) \wedge \exists s \in R_2 (t[A] = s[A])\}$

Q. 23 Consider a relation geq which represents "greater than or equal to", that is,  $(x, y) \in \text{geq}$  only if  $y \leq x$ .

Create table gaq

( Ib integer not null  
 ub integer not null

primary key Ib

foreign key (ub) references geq on delete cascade):

Which of the following is possible if a tuple  $(x, y)$  is deleted ?

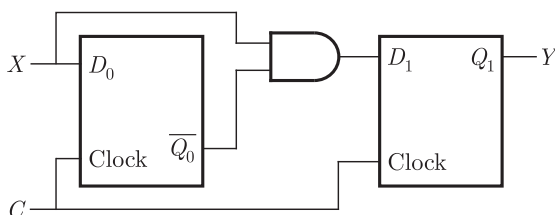
- (A) A tuple  $(z, w)$  with  $z > y$  is deleted
- (B) A tuple  $(z, w)$  with  $z > x$  is deleted
- (C) A tuple  $(z, w)$  with  $w < x$  is deleted
- (D) The deletion of  $(x, y)$  is prohibited

Q. 24 Given the following Karnaugh map, which one of the following represents the minimal sum-of-Products of the map ?

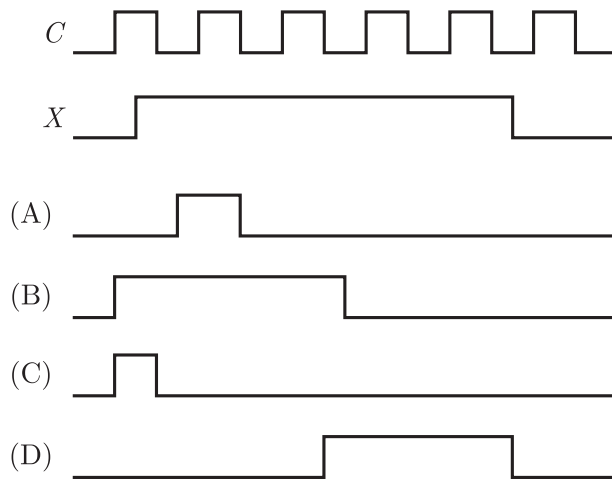
	$wx$	00	01	11	10
$yz$	00	0	×	0	×
01	×	1	×	1	
11	0	×	1	0	
10	0	1	1	×	

- (A)  $xy + y'z$  (B)  $wx'y' + xy + xz$
- (C)  $w'x + y'z + xy$  (D)  $xz + y$

Q. 25 Consider the following circuit with initial state  $Q_0 = Q_1 = 0$ . The D flip-flops are positive edged triggered and have set up times 20 nanosecond and hold times 0.

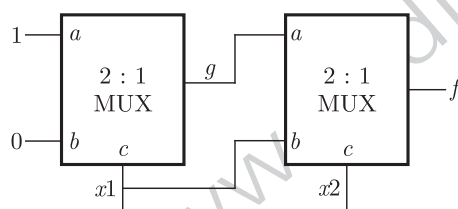


Consider the following timing diagrams of  $X$  and  $C$ ; the clock of  $C \geq 40$  nanosecond. Which one is the correct plot of  $Y$



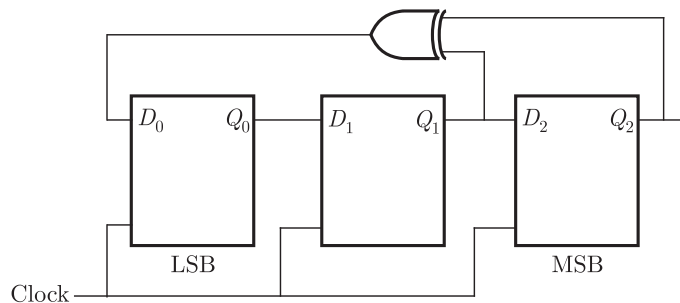
- Q. 26 The 2's complement representation of  $(-539)_{10}$  is hexadecimal is  
 (A) ABE (B) DBC  
 (C) DE5 (D) 9E7

Q. 27 Consider the circuit shown below. The output of a 2:1 Mux is given by the function  $(ac' + bc)$ .



- Which of the following is true ?  
 (A)  $f = x1' + x2$  (B)  $f = x1'x2 + x1x2'$   
 (C)  $f = x1x2 + x1'x2'$  (D)  $f = x1 + x2$

Q. 28 Consider the circuit given below the initial state  $Q_0 = 1, Q_1 = Q_2 = 0$ . The state of the circuit is given by the value  $4Q_2 + 2Q_1 + Q_0$



- Which one of the following is the correct state sequence of the circuit ?  
 (A) 1, 3, 4, 6, 7, 5, 2 (B) 1, 2, 5, 3, 7, 6, 4  
 (C) 1, 2, 7, 3, 5, 6, 4 (D) 1, 6, 5, 7, 2, 3, 5

- Q. 29 Which of the following statements is false ?  
(A) Virtual memory implements the translation of a program's address space into physical memory address space.  
(B) Virtual memory allows each program to exceed the size of the primary memory.  
(C) Virtual memory increases the degree of multi-programming  
(D) Virtual memory reduces the context switching overhead.
- Q. 30 Consider a set of  $n$  tasks with known runtimes  $r_1, r_2, \dots, r_n$  to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput ?  
(A) Round-Robin (B) Shortest-Job-First  
(C) Highest-Response-Ratio-Next (D) First-come-First-Served
- Q. 31 Where does the swap space reside ?  
(A) RAM (B) Disk  
(C) ROM (D) On-chip cache
- Q. 32 Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will.  
(A) Always decrease the number of page faults  
(B) Always increase the number of page faults  
(C) Sometimes increase the number of page faults  
(D) Never affect the number of page faults
- Q. 33 Consider a machine with 64 MB physical memory and a 32-bit virtual address space. If the page size is 4 KB, what is the approximate size of the page table ?  
(A) 16 MB (B) 8 MB  
(C) 2 MB (D) 24 MB
- Q. 34 Consider Peterson's algorithm for mutual exclusion between two concurrent processes  $i$  and  $j$ . The program executed by process  $i$  is shown below.
- ```
repeat
    flag[i]=true;
    turn=j;
    while(p)do no-op;
    Enter critical section, perform actions, then
    exit critical section
    Flag[i]=false;
    Perform other non-critical section actions.
Until false;
```
- For the program to guarantee mutual exclusion, the predicate P in the while loop should be  
(A) flag [ j ] = true and turn = j  
(B) flag [ j ] = true and turn = j  
(C) flag [ i ] = true and turn = j  
(D) flag [ i ] = true and turn = i

Q. 35 What is printed by the print statements in the program P1 assuming call by reference parameter passing ?

```

Program P1( )
{
    x=10;
    y=3;
    funcl(y,x,x);
    print x;
    print y;
}
funcl(x,y,z)
{
    y=y+4
    z=x+y+z;
}

```

- (A) 10, 3 (B) 31, 3  
(C) 27, 7 (D) None of the above

Q. 36 Consider the following three functions :

```

[P1]      int *g(void)
          {
            int x=10;
            return (& x);
          }
[P2]      int *g(void)
          {
            int *px;
            *px=10;
            return px;
          }
[P3]      int *g(void)
          {
            int *px
            px=(int*)malloc (size of (int));
            *px=10;
            return px;
          }

```

Which of the above three functions are likely to cause problems with pointers ?

- (A) Only P3 (B) Only P1 and P3  
(C) Only P1 and P2 (D) P1, P2 and P3

Q. 37 Consider the following program

```

Program P2
Var n:int:
procedure W (var x:int)
begin
    X=X+1
    Print x;
end
Procedure D

```



```

Begin
    var n:int;
    n=3;
    W(n);
End
Begin    \\begin P2
    n=10;
    D;
end

```

If the language has dynamic scoping and parameters are passed by reference, what will be printed by the program ?

- (A) 10 (B) 11  
(C) 3 (D) None of the above

Q. 38

Consider the following two statements :

$S1 : \{0^{2n} | n \geq 1\}$  is a regular language

$S2 : \{0^m 1^n 0^{m+n} | m \geq 1 \text{ and } n \geq 1\}$  is a regular language

Which of the following statements is incorrect ?

- (A) Only  $S1$  is correct  
(B) Only  $S2$  is correct  
(C) Both  $S1$  and  $S2$  are correct  
(D) None of  $S1$  and  $S2$  is correct

Q. 39

Which of the following statements true ?

- (A) If a language is context free it can be always be accepted by a deterministic push-down automaton.  
(B) The union of two context free language is context free.  
(C) The intersection of two context free language is context free  
(D) The complement of a context free language is context free

Q. 40

Given an arbitrary non-deterministic finite automaton (NFA) with  $N$  states, the maximum number of states in an equivalent minimized DFA is at least.

- (A)  $N^2$  (B)  $2^N$   
(C)  $2N$  (D)  $N!$

Q. 41

Consider a DFA over  $\Sigma = \{a, b\}$  accepting all strings which have number of  $a$ 's divisible by 6 and number of  $b$ 's divisible by 8. What is the minimum number of states that the DFA will have ?

- (A) 8 (B) 14  
(C) 15 (D) 48

Q. 42

Consider the following languages :

$L1 = \{ww | w \in \{a, b\}^*\}$

$L2 = \{ww^R | w \in \{a, b\}^* \text{ and } w^R \text{ is the reverse of } w\}$

$L3 = \{0^{2i} | i \text{ is an integer}\}$

$L4 = \{0^i | i \text{ is an integer}\}$

Which of the languages are regular ?

- (A) Only  $L1$  and  $L2$  (B) Only  $L2, L3$  and  $L4$   
(C) Only  $L3$  and  $L4$  (D) Only  $L3$

Q. 43

Consider the following problem  $x$ .

Given a Turing machine  $M$  over the input alphabet  $\Sigma$ , any state  $q$  of  $M$ .

And a word  $w \in \Sigma^*$  does the computation of  $M$  on  $w$  visit the state  $q$  ?

Which of the following statements about  $x$  is correct ?

- (A)  $x$  is decidable
- (B)  $x$  is undecidable but partially decidable
- (C)  $x$  is undecidable and not even partially decidable
- (D)  $x$  is not a decision problem

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## ANSWER KEY

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|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1    | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |
| (B)  | (B) | (A) | (C) | (D) | (B) | (A) | (A) | (D) | (A) |
| 11   | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  |
| (C)  | (B) | (C) | (B) | (A) | (B) | (C) | (C) | (C) | (C) |
| 21   | 22  | 23  | 24  | 25  | 26  | 27  | 28  | 29  | 30  |
| (C)  | (C) | (C) | (A) | (C) | (C) | (C) | (B) | (A) | (B) |
| 31   | 32  | 33  | 34  | 35  | 36  | 37  | 38  | 39  | 40  |
| (B)  | (C) | (C) | (B) | (C) | (C) | (D) | (A) | (B) | (C) |
| 41   | 42  | 43  |     |     |     |     |     |     |     |
| (C)  | (D) | (B) |     |     |     |     |     |     |     |

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