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GOVERNMENT OF INDIA :: DEPARTMENT OF SPACE
INDIAN SPACE RESEARCH ORGANISATION

ISRO Centralised Recruitment Board

Recruitment for Scientist/Engineer 'SC'

Test Booklet		COMPUTER SCIENCE	C
Date	:	January 12, 2020 (Sunday)	
Time	:	1200 hrs to 1330 hrs	
Test Duration (Minutes)	:	90	
No. of Questions	:	80	
No. of Pages (Other than cover sheet)	:	20	

Instructions to the candidates

1. The question paper is in the form of test booklet. All candidates will be assessed on identical questions.
2. A separate OMR answer sheet is provided to all candidates for answering.
3. Each objective question is provided with a text and/or figures wherever applicable with **multiple answer choices (a), (b), (c) and (d)**. Choose the most appropriate answer.
4. Read the instructions on the OMR sheet carefully. Use only **Black or Blue Ball Point Pen** for writing on OMR sheet and marking/bubbling your answers.
5. All objective type questions carry equal marks of **THREE** for a correct answer, **ZERO** for no answer and minus **ONE** for a wrong answer.
6. **Multiple answers** for a question will be regarded as a wrong answer.
7. Although the test stresses on accuracy more than speed, it is important to use time as effectively as possible.
8. Do not spend time on questions, which are difficult for you. Go on to other questions and come back to the difficult ones later.
9. Question booklets have been marked with **A** or **B** or **C** or **D** or **E** on the right hand top corner, which is mandatory to be written on the OMR sheet in the box and bubbled appropriately, failing which, the answer sheet will not be evaluated.
10. Space available in the booklet could be used for rough work, if required. No separate sheet will be provided.
11. Attempt of any malpractice in the exam hall shall entail disqualification of candidature, debar from future exams and legal action against the candidate.

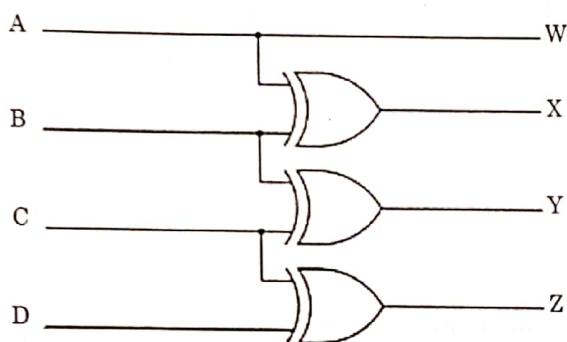
BE 003



1. Minimum number of NAND gates required to implement the following binary equation

$$Y = (\overline{A} + \overline{B})(C + D)$$

2. IF ABCD is a 4-bit binary number, then what is code generated by the following circuit?



- | | |
|---------------|-------------------|
| (a) BCD code | (b) Gray code |
| (c) 8421 code | (d) Excess-3 code |

3. The number of tokens in the following C code segment is

switch(inputvalue)

{

```
case 1 : b = c * d; break;
```

```
default : b = b++; break;
```

3

- (a) 27 (b) 29
 (c) 26 (d) 24

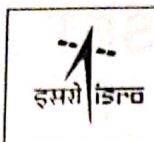
4. In a two-pass assembler, resolution of subroutine calls and inclusion of labels in the symbol table is done during

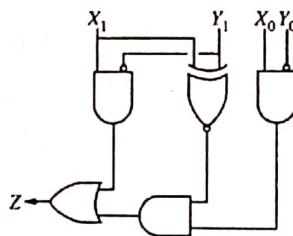
- (a) second pass
 - (b) first pass and second pass respectively
 - (c) second pass and first pass respectively
 - (d) first pass



5. Which of the following algorithms defines time quantum?
- (a) shortest job scheduling algorithm
 - (b) round robin scheduling algorithm
 - (c) priority scheduling algorithm
 - (d) multilevel queue scheduling algorithm
6. Dispatch latency is defined as
- (a) the speed of dispatching a process from running to the ready state
 - (b) the time of dispatching a process from running to ready state and keeping the CPU idle
 - (c) the time to stop one process and start running another one
 - (d) none of these
7. An aid to determine the deadlock occurrence is
- (a) resource allocation graph
 - (b) starvation graph
 - (c) inversion graph
 - (d) none of the above
8. Consider the following page reference string.
- 1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6
- What are the minimum number of frames required to get a single page fault for the above sequence assuming LRU replacement strategy?
- (a) 7
 - (b) 4
 - (c) 6
 - (d) 5
9. Three CPU-bound tasks, with execution times of 15, 12 and 5 time units respectively arrive at times 0, t and 8, respectively. If the operating system implements a shortest remaining time first scheduling algorithm, what should be the value of t to have 4 context switches?
- Ignore the context switches at time 0 and at the end.
- (a) $0 < t < 3$
 - (b) $t = 0$
 - (c) $t \leq 3$
 - (d) $3 < t < 8$







Under what condition Z will be 1?

18. What is the availability of the software with following reliability figures
Mean Time Between Failures (MTBF) is 20 days
Mean Time To Repair (MTTR) is 20 hours

(a) 90% (b) 96%
(c) 24% (d) 50%

19. What is the defect rate for Six sigma?

(a) 1.0 defect per million lines of code
(b) 1.4 defects per million lines of code
(c) 3.0 defects per million lines of code
(d) 3.4 defects per million lines of code

20. In the following procedure

Integer procedure P(X,Y);

Integer X,Y;

value x;

begin

K = 5;

L = 8;

P = x + y;

end

X is called by value and Y is called by name. If the procedure were invoked by the following program fragment

K = 0;

L = 0;

Z = P(K,L);

then the value Z would be set equal to

- | | |
|--------|-------|
| (a) 5 | (b) 8 |
| (c) 13 | (d) 0 |

21. Consider product of three matrices M_1, M_2 and M_3 having w rows and x columns, x rows and y columns, and y rows and z columns. Under what condition will it take less time to compute the product as $(M_1 M_2) M_3$ than to compute $M_1 (M_2 M_3)$?

- | | |
|-------------------------------|---------------------------------|
| (a) Always take the same time | (b) $(1/x + 1/z) < (1/w + 1/y)$ |
| (c) $x > y$ | (d) $(w + x) > (y + z)$ |

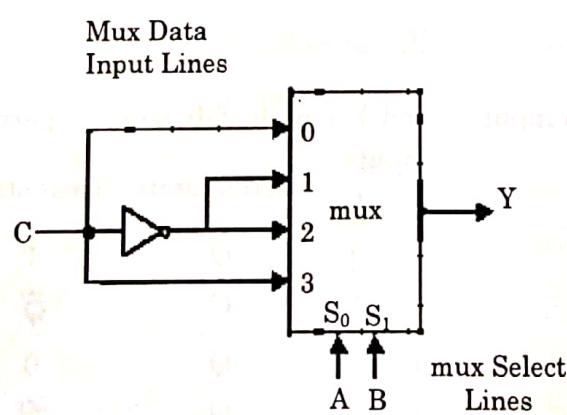
22. A new flipflop with inputs X and Y , has the following property

Inputs		Current state	Next state
X	Y		
0	0	Q	1
0	1	Q	\bar{Q}
1	1	Q	0
1	0	Q	Q

Which of the following expresses the next state in terms of X, Y , current state?

- | | |
|--|--|
| (a) $(\bar{X} \wedge \bar{Q}) \vee (\bar{Y} \wedge Q)$ | (b) $(\bar{X} \wedge Q) \vee (\bar{Y} \wedge \bar{Q})$ |
| (c) $(X \wedge \bar{Q}) \vee (Y \wedge Q)$ | (d) $(X \wedge \bar{Q}) \vee (\bar{Y} \wedge Q)$ |





- (a) Sum equation of full adder
 - (b) Carry equation of full adder
 - (c) Borrow equation for full subtractor
 - (d) Difference equation of a full subtractor





33. The post-order traversal of a binary tree is ACEDBHIGF. The pre-order traversal is
- (a) ABCDEFGHI
 - (b) FBADCEGIH
 - (c) FABCDEGHI
 - (d) ABDCEFGIH
34. In linear hashing, if blocking factor bfr, loading factor i and file buckets N are known, the number of records will be
- (a) $cr = i + bfr + N$
 - (b) $r = i - bfr - N$
 - (c) $r = i + bfr - N$
 - (d) $r = i * bfr * N$
35. What is compaction refers to
- (a) a technique for overcoming internal fragmentation
 - (b) a paging technique
 - (c) a technique for overcoming external fragmentation
 - (d) a technique for compressing the data
36. The operating system and the other processes are protected from being modified by an already running process because
- (a) they run at different time instants and not in parallel
 - (b) they are in different logical addresses
 - (c) they use a protection algorithm in the scheduler
 - (d) every address generated by the CPU is being checked against the relocation and limit parameters



37. What is the output of the following 'c' code assuming it runs on a byte addressed little endian machine?

```
#include <stdio.h>
int main( )
{
    int x ; char *ptr;
    x = 622,100,101;
    printf("%d", (*( char *)&x) * (x % 3));
    return 0;
}
```


38. What is the output in a 32 bit machine with 32 bit compiler?

```

#include<stdio.h>
rer(int **ptr2,int **ptr1)
{
    int* ii;
    ii=*ptr2;
    *ptr2=*&ptr1;
    *&ptr1=ii;
    **ptr1 *= **ptr2;
    **ptr2 += **ptr1;
}
void main()
{
    int var1=5,var2=10;
    int *ptr1=&var1,*ptr2=&var2;
    rer(&ptr1,&ptr2);
    printf("%d %d ",var2,va
}

```

- (a) 60 70
 (c) 50 60

- (b) 50 50
 (d) 60 50

39. A grammar is defined as

- A \rightarrow BC
- B \rightarrow x | Bx
- C \rightarrow B | D
- D \rightarrow y | Ey
- E \rightarrow z

The non-terminal alphabet of the grammar is

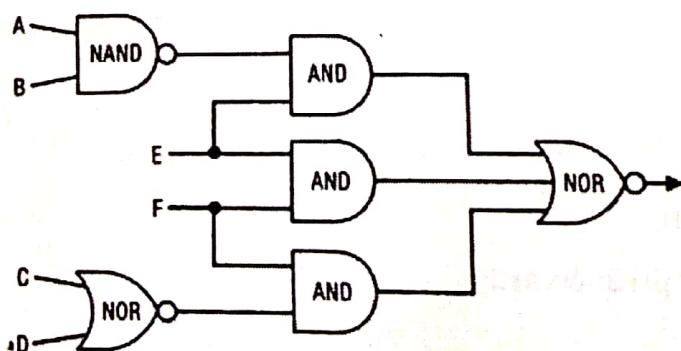
- | | |
|------------------------------|------------------|
| (a) {A, B, C, D, E} | (b) {B, C, D, E} |
| (c) {A, B, C, D, E, x, y, z} | (d) {x, y, z} |

40. If $A = \{x, y, z\}$ and $B = \{u, v, w, x\}$, and the universe is $\{s, t, u, v, w, x, y, z\}$

Then $(A \cup \bar{B}) \cap (A \cap B)$ is equal to

- | | |
|------------------------|---------------|
| (a) {u, v, w, x} | (b) {} |
| (c) {u, v, w, x, y, z} | (d) {u, v, w} |

41. Consider the following circuit



The function by the network above is

- | | |
|--|---|
| (a) $\overline{ABE} + EF + \overline{CDF}$ | (b) $(\overline{E} + AB\overline{F})(C + D + \overline{F})$ |
| (c) $(\overline{AB} + E)(\overline{E} + \overline{F})(C + D + \overline{F})$ | (d) $(A + B)\overline{E} + \overline{EF} + CDF$ |



42. An array of 2 two byte integers is stored in big endian machine in byte addresses as shown below. What will be its storage pattern in little endian machine?

Address	Data
0 × 104	78
0 × 103	56
0 × 102	34
0 × 101	12

(a) 0 × 104 12
0 × 103 56
0 × 102 34
0 × 101 78

(b) 0 × 104 12
0 × 103 34
0 × 102 56
0 × 101 78

(c) 0 × 104 56
0 × 103 78
0 × 102 12
0 × 101 34

(d) 0 × 104 56
0 × 103 12
0 × 102 78
0 × 101 34

43. A non-pipelined CPU has 12 general purpose registers (R0, R1, R2,...,R12). Following operations are supported

ADD Ra, Rb, Rr Add Ra to Rb and store the result in Rr

MUL Ra, Rb, Rr Multiply Ra to Rb and store the result in Rr

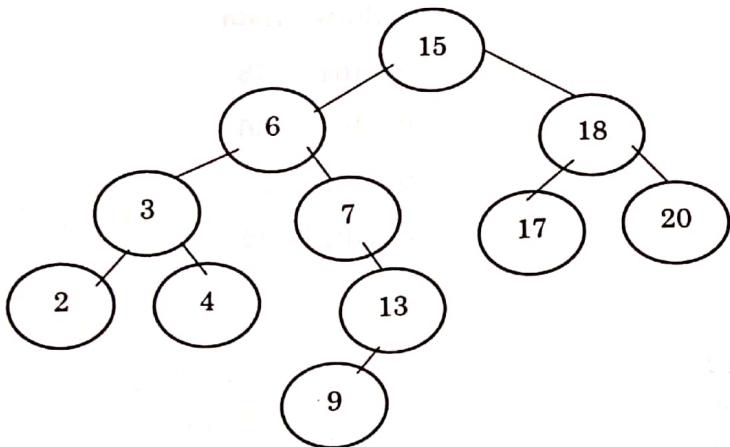
MUL operations takes two clock cycles, ADD takes one clock cycle.

Calculate minimum number of clock cycles required to compute the value of the expression XY + XYZ + YZ. The variables X, Y, Z are initially available in registers R0, R1 and R2 and contents of these registers must not be modified.

- (a) 5
(c) 7

- (b) 6
(d) 8

44. What is the in-order successor of 15 in the given binary search tree?



- (a) 18
(c) 17

- (b) 6
(d) 20

45. The minimum height of an AVL tree with n nodes is

- | | |
|---|--|
| (a) Ceil $(\log_2(n+1))$
(c) Floor $(\log_2(n+1))$ | (b) $1.44 \log_2 n$
(d) $1.64 \log_2 n$ |
|---|--|

46. The master theorem

- (a) assumes the subproblems are unequal sizes
- (b) can be used if the subproblems are of equal size
- (c) cannot be used for divide and conquer algorithms
- (d) cannot be used for asymptotic complexity analysis

47. Raymonds tree based algorithm ensures

- (a) no starvation, but deadlock may occur in rare cases
- (b) no deadlock, but starvation may occur
- (c) neither deadlock nor starvation can occur
- (d) deadlock may occur in cases where the process is already starved





54. A stack is implemented with an array of ' $A[0..N-1]$ ' and a variable 'pos'. The push and pop operations are defined by the following code.

```
push (x)
    A[pos] ← x
    pos ← pos + 1
end push
pop ()
    pos ← pos - 1
    return A[pos]
end pop
```

Which of the following will initialize an empty stack with capacity N for the above implementation?

- (a) pos ← -1 (b) pos ← 0 (c) pos ← 1 (d) pos ← $N-1$

55. Given that

$B(a)$ means " a is a bear"

$F(a)$ means " a is a fish" and

$E(a, b)$ means " a eats b "

Then what is the best meaning of

$$\forall x [F(x) \rightarrow \forall y (E(y, x) \rightarrow b(y))]$$

- (a) Every fish is eaten by some bear (b) Bears eat only fish
(c) Every bear eats fish (d) Only bears eat fish

56. Following declaration of an array of struct, assumes size of byte, short, int and long are 1, 2, 3 and 4 respectively. Alignment rule stipulates that n -byte field must be located at an address divisible by n . the fields in a struct are not rearranged, padding is used to ensure alignment. All elements of array should be of same size.

Struct complx

Short s

Byte b

Long l

Int i

End complx

Complx C[10]

Assuming C is located at an address divisible by 8, what is the total size of C , in bytes?

- (a) 150 (b) 160 (c) 200 (d) 240



57. Remote Procedure Calls are used for
- (a) communication between two processes remotely different from each other on the same system
 - (b) communication between two processes on the same system
 - (c) communication between two processes on separate systems
 - (d) none of the above
58. Consider the following recursive C function that takes two arguments
- ```
unsigned int rer (unsigned int n, unsigned int r) {
 if (n > 0) return (n%r + rer (n/r, r));
 else return 0;
}
```
- What is the return value of the function rer when it is called as rer (513, 2)?
- (a) 9
  - (b) 8
  - (c) 5
  - (d) 2
59. A given grammar is called ambiguous if
- (a) two or more productions have the same non-terminal on the left hand side
  - (b) a derivation tree has more than one associated sentence
  - (c) there is a sentence with more than one derivation tree corresponding to it
  - (d) brackets are not present in the grammar
60. What is the output of the code given below?
- ```
#include <stdio.h>  
int main()  
{  
    char name[ ]="satellites";  
    int len;  
    int size;  
    len = strlen(name);  
    size = sizeof(name);  
    printf("%d", len * size);  
    return 0;  
}
```
- (a) 100
 - (b) 110
 - (c) 40
 - (d) 44





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SET
C

65. A stack organised computer is characterised by instructions with
- (a) indirect addressing
 - (b) direct addressing
 - (c) zero addressing
 - (d) index addressing
66. A computer which issues instructions in order, has only 2 registers and 3 opcodes ADD, SUB and MOV. Consider 2 different implementations of the following basic block :

Case 1 Case 2

$$t1 = a + b; \quad t2 = c + d;$$

$$t2 = c + d; \quad t3 = e - t2;$$

$$t3 = e - t2; \quad t1 = a + b;$$

$$t4 = t1 - t2; \quad t4 = t1 - t2;$$

Assume that all operands are initially in memory. Final value of computation also has to reside in memory. Which one is better in terms of memory accesses and by how many MOV instructions?

- (a) Case 2, 2
 - (b) Case 2, 3
 - (c) Case 1, 2
 - (d) Case 1, 3
67. Which one indicates a technique of building cross compilers?
- (a) Beta cross
 - (b) Canadian cross
 - (c) Mexican cross
 - (d) X-cross
68. Consider a 2-dimensional array x with 10 rows and 4 columns, with each element storing a value equivalent to the product of row number and column number. The array is stored in row-major format. If the first element $x[0][0]$ occupies the memory location with address 1000 and each element occupies only one memory location, which all locations (in decimal) will be holding a value of 10?
- (a) 1018, 1019
 - (b) 1022, 1041
 - (c) 1013, 1014
 - (d) 1000, 1399



69. G is an undirected graph with vertex set {v1, v2, v3, v4, v5, v6, v7} and edge set {v1v2, v1v3, v1v4, v2v4, v2v5, v3v4, v4v5, v4v6, v5v6, v6v7}. A breadth first search of the graph is performed with v1 as the root node. Which of the following is a tree edge?
(a) v2v4 (b) v1v4 (c) v4v5 (d) v3v4
70. If the array A contains the items 10, 4, 7, 23, 67, 12 and 5 in that order, what will be the resultant array A after third pass of insertion sort?
(a) 67, 12, 10, 5, 4, 7, 23 (b) 4, 7, 10, 23, 67, 12, 5
(c) 4, 5, 7, 67, 10, 12, 23 (d) 10, 7, 4, 67, 23, 12, 5
71. Huffman tree is constructed for the following data : {A, B, C, D, E} with frequency {0.17, 0.11, 0.24, 0.33 and 0.15} respectively. 100 00 01101 is decoded as
(a) BACE (b) CADE (c) BAD (d) CADD
72. Given the grammar
 $s \rightarrow T^* S \mid T$
 $T \rightarrow U + T \mid U$
 $U \rightarrow a \mid b$
Which of the following statements is wrong?
(a) Grammar is not ambiguous
(b) Priority of + over * is ensured
(c) Right to left evaluation of * and + happens
(d) None of these
73. What is the complexity of the following code?

```
sum=0;
for (i=1; i <= n; i*=2)
    for(j=1; j<=n;j++)
        sum++;
```

Which of the following is not a valid string?
(a) $O(n^2)$ (b) $O(n \log n)$
(c) $O(n)$ (d) $O(n \log n \log n)$

74. Checksum field in TCP header is

- (a) ones complement of sum of header and data in bytes
- (b) ones complement of sum of header, data and pseudo header in 16 bit words
- (c) dropped from IPv6 header format
- (d) better than md5 or sh1 methods

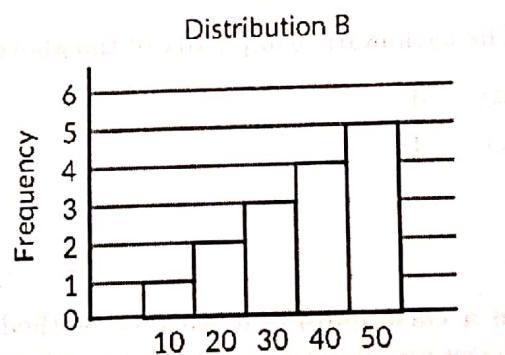
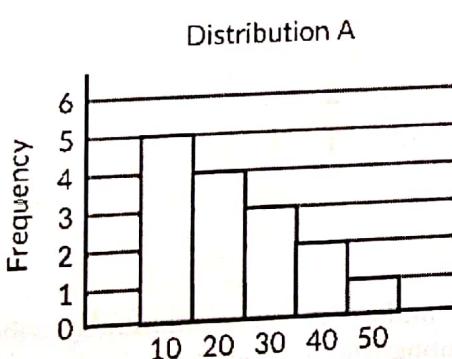
75. If $x + 2y = 30$, then

$$\left(\frac{2y}{5} + \frac{x}{3}\right) + \left(\frac{x}{5} + \frac{2y}{3}\right)$$

will be equal to

- | | |
|--------|--------|
| (a) 8 | (b) 16 |
| (c) 18 | (d) 20 |

76. For the distributions given below :



Which of the following is correct for the above distributions?

- (a) Standard deviation of A is significantly lower than standard deviation of B
- (b) Standard deviation of A is slightly lower than standard deviation of B
- (c) Standard deviation of A is same as standard deviation of B
- (d) Standard deviation of A is significantly higher than standard deviation of B

77. The hardware implementation which provides mutual exclusion is

- (a) Semaphores
- (b) Test and set instruction
- (c) Both options
- (d) None of the options

78. Consider the following pseudo-code

```
I=0; J=0; K=8;  
while (I < K-1) // while-1  
{  
    J=J+1;  
    while (J < K) // while-2  
    {  
        if (x[I] < x[J])  
        {  
            temp = x[I];  
            x[I] = x[J];  
            x[J] = temp;  
        }  
    } // end of while-2  
    I=I+1;  
} // end of while-1
```

The cyclomatic complexity of the above is

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

79. In a class definition with 10 methods, to make the class maximally cohesive, number of direct and indirect connections required among the methods are

- | | |
|------------|------------|
| (a) 90, 0 | (b) 45, 0 |
| (c) 10, 10 | (d) 45, 45 |

80. Of the following, which best approximates the ratio of the number of nonterminal nodes in the total number of nodes in a complete K -ary tree of depth N ?

- | | |
|-----------|-------------|
| (a) $1/N$ | (b) $N-1/N$ |
| (c) $1/K$ | (d) $K-1/K$ |