



GOVERNMENT OF INDIA :: DEPARTMENT OF SPACE
INDIAN SPACE RESEARCH ORGANISATION
ISRO Centralised Recruitment Board
Recruitment for Scientist/Engineer 'SC'

Test Booklet		COMPUTER SCIENCE	E
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	

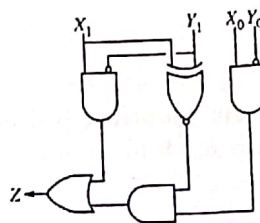
Instructions to the candidates

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

SEAL

1. Regression testing is primarily related to
 - ☒ (a) Functional testing
 - (b) Development testing
 - (c) Data flow testing
 - (d) Maintenance testing
2. Of the following sort algorithms, which has execution time that is least dependant on initial ordering of the input?
 - (a) Insertion sort
 - ☒ (b) Quick sort
 - (c) Merge sort
 - (d) Selection sort
3. The following circuit compares two 2-bit binary numbers, X and Y represented by X_1X_0 and Y_1Y_0 respectively. (X_0 and Y_0 represent Least Significant Bits)



Under what condition Z will be 1?

- (a) $X > Y$
 - (b) $X < Y$
 - (c) $X = Y$
 - (d) $X \neq Y$
4. 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%
 5. 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

6. Consider a 5-segment pipeline with a clock cycle time 20ns in each sub operation. Find out the approximate speed-up ratio between pipelined and non-pipelined system to execute 100 instructions. (if an average, every five cycles, a bubble due to data hazard has to be introduced in the pipeline)

- (a) 5 (b) 4.03
(c) 4.81 (d) 4.17

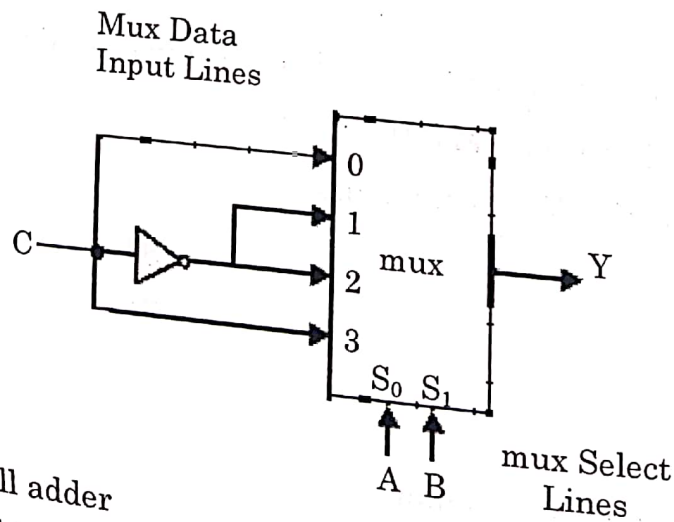
7. Consider a 32-bit processor which supports 70 instructions. Each instruction is 32 bit long and has 4 fields namely opcode, two register identifiers and an immediate operand of unsigned integer type. Maximum value of the immediate operand that can be supported by the processor is 8191. How many registers the processor has?

- (a) 32 (b) 64
(c) 128 (d) 16

8. In a 8-bit ripple carry adder using identical full adders, each full adder takes 34 ns for computing sum. If the time taken for 8-bit addition is 90 ns, find time taken by each full adder to find carry.

- (a) 6 ns (b) 7 ns
(c) 10 ns (d) 8 ns

9. Following Multiplexer circuit is equivalent to



- (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

10. 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) $pos \leftarrow -1$ (b) $pos \leftarrow 0$ (c) $pos \leftarrow 1$ (d) $pos \leftarrow N-1$

11. 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

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

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

12. 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

13. The immediate addressing mode can be used for

1. Loading internal registers with initial values
2. Perform arithmetic or logical operation on data contained in instructions

Which of the following is true?

- (a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) Immediate mode refers to data in cache

14. Statements associated with registers of a CPU are given. Identify the false statement.

- (a) The program counter holds the memory address of the instruction in execution.
(b) Only opcode is transferred to the control unit
(c) An instruction in the instruction register consists of the opcode and the operand
(d) The value of the program counter is incremented by 1 once its value has been read to the memory address register

15. Which of the following affects the processing power assuming they do not influence each other.

1. Data bus capability
2. Addressing scheme
3. Clock speed

- (a) 3 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

16. Convert the pre-fix expression to in-fix

$- * + ABC * - DE + FG$

- (a) $(A-B)*C+(D*E)-(F+G)$
(b) $(A+B)*C-(D-E)*(F-G)$
(c) $(A+B-C)*(D-E)*(F+G)$
(d) $(A+B)*C-(D*E)-(F+G)$

January 2020

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17. G is an undirected graph with vertex set $\{v_1, v_2, v_3, v_4, v_5, v_6, v_7\}$ and edge set $\{v_1v_2, v_1v_3, v_1v_4, v_2v_4, v_2v_5, v_3v_4, v_4v_5, v_4v_6, v_5v_6, v_6v_7\}$. A breadth first search of the graph is performed with v_1 as the root node. Which of the following is a tree edge?
 (a) v_2v_4 (b) v_1v_4 (c) v_4v_5 (d) v_3v_4
18. 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
19. 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
20. 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
21. 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) $O(n \log n \log n)$



22. 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
23. 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) $(w + x) > (y + z)$

24. 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	$\overline{Q}$
1	1	Q	0
1	0	Q	Q

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

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

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25. 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;
}
```

- (a) 622 (b) 311 (c) 22 (d) 110

26. 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,var1);
}
```

- (a) 60 70 (b) 50 50
(c) 50 60 (d) 60 50

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27. Which of the following is an efficient method of cache updating?
 (a) Snoopy writes (b) Write through
 (c) Write within (d) Buffered write
28. In a columnar transposition cipher, the plain text is "the tomato is a plant in the night shade family", keyword is "TOMATO". The cipher text is
 (a) "TINESAX / EOAHTFX / HTLTHEY / MAIIAIX / TAPNGDL / OSTNHMX"
 (b) "TINESAX / EOAHTFX / MAIIAIX / HTLTHEY / TAPNGDL / OSTNHMX"
 (c) "TINESAX / EOAHTFX / HTLTHEY / MAIIAIX / OSTNHMX / TAPNGDL"
 (d) "EOAHTFX / TINESAX / HTLTHEY / MAIIAIX / TAPNGDL / OSTNHMX"
29. Avalanche effect in cryptography refers
 (a) Large changes in cipher text when the keyword is changed minimally
 (b) Large changes in cipher text when the plain text is changed
 (c) Large Impact of keyword change to length of the cipher text
 (d) None of the above
30. A magnetic disk has 100 cylinders, each with 10 tracks of 10 sectors. If each sector contains 128 bytes, what is the maximum capacity of the disk in kilobytes?
 (a) 1,280,000 (b) 1280
 (c) 1250 (d) 128,000
31. How many total bits are required for a direct-mapped cache with 128 KB of data and 1 word block size, assuming a 32-bit address and 1 word size of 4 bytes?
 (a) 2 Mbits (b) 1.7 Mbits (c) 2.5 Mbits (d) 1.5 Mbits
32. Properties of 'DELETE' and 'TRUNCATE' commands indicate that
 (a) After the execution of 'TRUNCATE' operation, COMMIT, and ROLLBACK statements cannot be performed to retrieve the lost data, while 'DELETE' allow it
 (b) After the execution of 'DELETE' and 'TRUNCATE' operation retrieval is easily possible for the lost data
 (c) After the execution of 'DELETE' operation, COMMIT and ROLLBACK statements can be performed to retrieve the lost data., while TRUNCATE do not allow it
 (d) After the execution of 'DELETE' and 'TRUNCATE' operation no retrieval is possible for the lost data

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33. 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

34. 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

35. 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

36. 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

37. 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

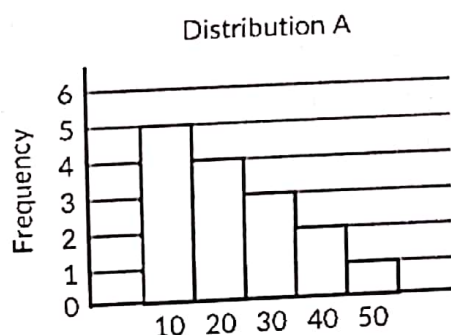
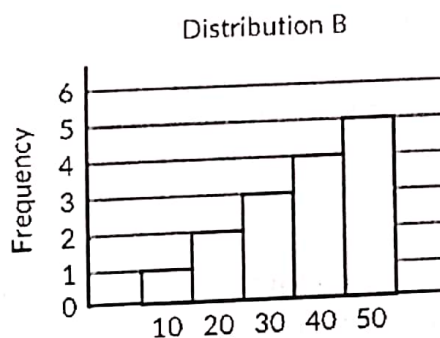
38. If  $x + 2y = 30$ , then

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

will be equal to

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

39. 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
40. The hardware implementation which provides mutual exclusion is
- (a) Semaphores
  - (b) Test and set instruction
  - (c) Both options
  - (d) None of the options

41. Which of the following algorithms defines time quantum?
- shortest job scheduling algorithm
  - round robin scheduling algorithm
  - priority scheduling algorithm
  - ☒ multilevel queue scheduling algorithm
42. Dispatch latency is defined as
- the speed of dispatching a process from running to the ready state
  - the time of dispatching a process from running to ready state and keeping the CPU idle
  - ☒ the time to stop one process and start running another one
  - none of these
43. An aid to determine the deadlock occurrence is
- resource allocation graph
  - ☒ starvation graph
  - inversion graph
  - none of the above
44. 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 |
45. 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) $3 < t < 8$ |

46. The post-order traversal of a binary tree is ACEDBHIGF. The pre-order traversal is
- (a) ✓ ABCDEFGHI
  - (b) FBADCEGIH
  - (c) FABCDEGHI
  - (d) ABDCEFGIH
47. 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)  $r = i * bfr * N$
48. 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
49. 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

50. A grammar is defined as

$$A \rightarrow BC$$

$$B \rightarrow x \mid Bx$$

$$C \rightarrow B \mid D$$

$$D \rightarrow y \mid Ey$$

$$E \rightarrow z$$

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)  $\{x, y, z\}$

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

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

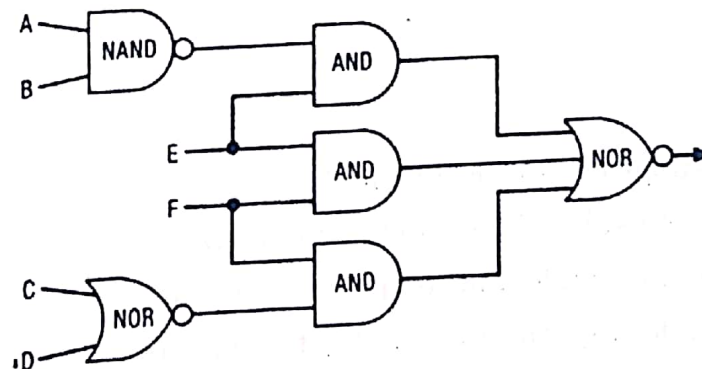
(a)  $\{u, v, w, x\}$

(b)  $\{\}$

(c)  $\{u, v, w, x, y, z\}$

(d)  $\{u, v, w\}$

52. Consider the following circuit



The function by the network above is

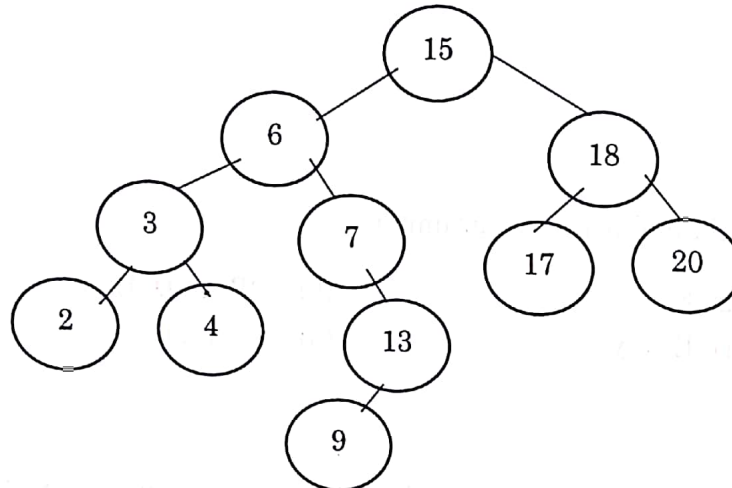
(a)  $\overline{A}BE + EF + \overline{C}DF$

(b)  $(\overline{E} + AB\overline{F})(C + D + \overline{F})$

(c)  $(\overline{AB} + E)(\overline{E} + \overline{F})(C + D + \overline{F})$

(d)  $(A + B)\overline{E} + \overline{E}F + CDF$

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



(a) 18

(b) 6

☒ (c) 17

(d) 20

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

(a)  $\text{Ceil}(\log_2(n+1))$

(b)  $1.44 \log_2 n$

(c)  $\text{Floor}(\log_2(n+1))$

(d)  $1.64 \log_2 n$

55. 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

56. 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

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- $\{$

 $\{$  $\{$ 

}

```
} // end of while-1
```

(c) 4

✓(b) 2

(d) 1

- (b) 45, 0

(c) 10, 10

(d) 45, 45

- ~~(b)~~
- $N-1/N$

(c)  $1/K$ 

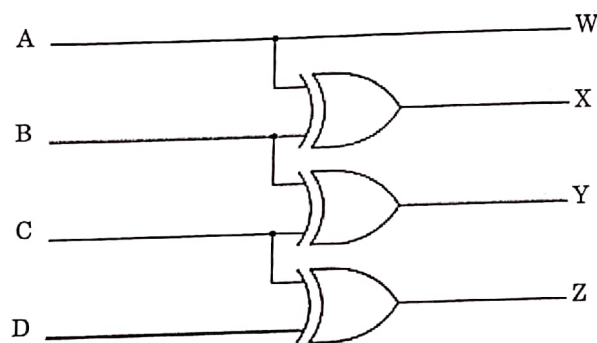
(d)  $K-1/K$

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

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

- |       |       |
|-------|-------|
| (a) 4 | (b) 5 |
| (c) 3 | (d) 6 |

61. 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 |

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

```

switch(inputvalue)
{
case 1 : b = c * d; break;
default : b = b++; break;
}

```

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

63. 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

64. One instruction tries to write an operand before it is written by previous instruction. This may lead to a dependency called
- (a) True dependency (b) Anti-dependency  
(c) Output Dependency (d) Control hazard
65. If every non-key attribute functionally dependant on the primary key, then the relation will be in
- (a) First normal form (b) Second normal form  
(c) Third normal form (d) Fourth normal form
66. The SQL query
- ```

SELECT columns
FROM TableA
RIGHT OUTER JOIN TableB
ON A.columnName = B.columnName
WHERE A.columnName IS NULL

```
- returns the following :
- (a) All rows in TableB, which meets equality condition above and, none from Table A which meets the condition
(b) All rows in TableA, which meets equality condition above and none from Table B, which meets the condition
(c) All rows in TableB, which meets equality condition
(d) All rows in TableA, which meets equality condition
67. To send same bit sequence, NRZ encoding require
- (a) Same clock frequency as Manchester encoding
(b) Half the clock frequency as Manchester encoding
(c) Twice the clock frequency as Manchester encoding
(d) A clock frequency which depend on number of zeros and ones in the bit sequence
68. The persist timer is used in TCP to
- (a) To detect crashes from the other end of the connection
(b) To enable retransmission
(c) To avoid deadlock condition
(d) To timeout FIN_Wait1 condition

69. 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

- | | | | | | | | | | | | | | | | | | |
|---|---------|----|---------|----|---------|----|---------|----|---|---------|----|---------|----|---------|----|---------|----|
| <p>(a)</p> <table> <tr><td>0 × 104</td><td>12</td></tr> <tr><td>0 × 103</td><td>56</td></tr> <tr><td>0 × 102</td><td>34</td></tr> <tr><td>0 × 101</td><td>78</td></tr> </table> | 0 × 104 | 12 | 0 × 103 | 56 | 0 × 102 | 34 | 0 × 101 | 78 | <p>(b)</p> <table> <tr><td>0 × 104</td><td>12</td></tr> <tr><td>0 × 103</td><td>34</td></tr> <tr><td>0 × 102</td><td>56</td></tr> <tr><td>0 × 101</td><td>78</td></tr> </table> | 0 × 104 | 12 | 0 × 103 | 34 | 0 × 102 | 56 | 0 × 101 | 78 |
| 0 × 104 | 12 | | | | | | | | | | | | | | | | |
| 0 × 103 | 56 | | | | | | | | | | | | | | | | |
| 0 × 102 | 34 | | | | | | | | | | | | | | | | |
| 0 × 101 | 78 | | | | | | | | | | | | | | | | |
| 0 × 104 | 12 | | | | | | | | | | | | | | | | |
| 0 × 103 | 34 | | | | | | | | | | | | | | | | |
| 0 × 102 | 56 | | | | | | | | | | | | | | | | |
| 0 × 101 | 78 | | | | | | | | | | | | | | | | |
| <p>(c)</p> <table> <tr><td>0 × 104</td><td>56</td></tr> <tr><td>0 × 103</td><td>78</td></tr> <tr><td>0 × 102</td><td>12</td></tr> <tr><td>0 × 101</td><td>34</td></tr> </table> | 0 × 104 | 56 | 0 × 103 | 78 | 0 × 102 | 12 | 0 × 101 | 34 | <p>(d)</p> <table> <tr><td>0 × 104</td><td>56</td></tr> <tr><td>0 × 103</td><td>12</td></tr> <tr><td>0 × 102</td><td>78</td></tr> <tr><td>0 × 101</td><td>34</td></tr> </table> | 0 × 104 | 56 | 0 × 103 | 12 | 0 × 102 | 78 | 0 × 101 | 34 |
| 0 × 104 | 56 | | | | | | | | | | | | | | | | |
| 0 × 103 | 78 | | | | | | | | | | | | | | | | |
| 0 × 102 | 12 | | | | | | | | | | | | | | | | |
| 0 × 101 | 34 | | | | | | | | | | | | | | | | |
| 0 × 104 | 56 | | | | | | | | | | | | | | | | |
| 0 × 103 | 12 | | | | | | | | | | | | | | | | |
| 0 × 102 | 78 | | | | | | | | | | | | | | | | |
| 0 × 101 | 34 | | | | | | | | | | | | | | | | |

70. 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

71. Context free languages are closed under
- union, intersection
 - union, kleene closure
 - intersection, complement
 - complement, kleene closure
72. Which of the following is true?
- Every subset of a regular set is regular
 - Every finite subset of non-regular set is regular
 - The union of two non regular set is not regular
 - Infinite union of finite set is regular
73. The language which is generated by the grammar $S \rightarrow aSa \mid bSb \mid a \mid b$ over the alphabet $\{a, b\}$ is the set of
- Strings that begin and end with the same symbol
 - All odd and even length palindromes
 - All odd length palindromes
 - All even length palindromes
74. Which of the following classes of languages can validate an IPv4 address in dotted decimal format? It is to be ensured that the decimal values lie between 0 and 255.
- RE and higher
 - CFG and higher
 - CSG and higher
 - Recursively enumerable language
75. Minimum number of states required in DFA accepting binary strings not ending in "101" is
- 3
 - 4
 - 5
 - 6
76. Which of the following is a type of a out-of-order execution, with the reordering done by a compiler
- loop unrolling
 - dead code elimination
 - strength reduction
 - software pipelining

77. A stack organised computer is characterised by instructions with
- | | |
|-------------------------|-----------------------|
| (a) indirect addressing | (b) direct addressing |
| (c) zero addressing | (d) index addressing |

78. 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
$t1 = a + b;$	$t2 = c + d;$
$t2 = c + d;$	$t3 = e - t2;$
$t3 = e - t2;$	$t1 = a + b;$
$t4 = t1 - t2;$	$t4 = t1 - t2;$

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 |
79. Which one indicates a technique of building cross compilers?
- | | |
|-------------------|--------------------|
| (a) Beta cross | (b) Canadian cross |
| (c) Mexican cross | (d) X-cross |

80. 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 |