Written Test Paper, 2021

Test Booklet No.

SENIOR SKILL INSTRUCTOR
(CSE / IT)

Name of Applicant ....

Answer Sheet No. ....

Application No. : SVSU/2020/Estt/NT/ ....

Signature of Applicant : ....

Date of Examination: **25 / 12 / 2021**

Signature of the Invigilator(s)

1. ....

Time of Examination : ....

2. ....

Duration : 60 Minutes]

[Maximum Marks : 50

IMPORTANT INSTRUCTIONS

(i) The question paper is in the form of Test-Booklet containing **50 (Fifty)** questions. All questions are compulsory. Each question carries four answers marked (A), (B), (C) and (D), out of which only one is correct.

(ii) On receipt of the Test-Booklet (Question Paper), the candidate should immediately check it and ensure that it contains all the pages, i.e., **50** questions. Discrepancy, if any, should be reported by the candidate to the invigilator immediately after receiving the Test-Booklet.

(iii) A separate Answer-Sheet is provided with the Test-Booklet/Question Paper. On this sheet there are **50** rows containing four circles each. One row pertains to one question.

(iv) The candidate should write his/her Application number at the places provided on the cover page of the Test-Booklet/Question Paper and on the Answer-Sheet and NOWHERE ELSE.

(v) No second Test-Booklet/Question Paper and Answer-Sheet will be given to a candidate. The candidates are advised to be careful in handling it and writing the answer on the Answer-Sheet.

(vi) For every correct answer of the question **One (1) mark will be awarded.** For every unattempted question, Zero (0) mark shall be awarded. **There is no Negative Marking.**

(vii) Marking shall be done only on the basis of answers responded on the Answer-Sheet.

(viii) To mark the answer on the Answer-Sheet, candidate should **darken** the appropriate circle in the row of each question with Blue or Black pen.

(ix) For each question only **one** circle should be **darkened** as a mark of the answer adopted by the candidate. If more than one circle for the question are found darkened or with one black circle any other circle carries any mark, the question will be treated as cancelled.

(x) The candidates should not remove any paper from the Test-Booklet/Question Paper. Attempting to remove any paper shall be liable to be punished for use of unfair means.

(xi) Rough work may be done on the blank space provided in the Test-Booklet/Question Paper only.

(xii) *Mobile phones (even in Switch-off mode) and such other communication/programmable devices are not allowed inside the examination hall.*

(xiii) No candidate shall be permitted to leave the examination hall before the expiry of the time.

DO NOT OPEN THIS QUESTION BOOKLET UNTIL ASKED TO DO SO.

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1. If 73_x (in base-x number system) is equal to 54_y (in base-y number system), the possible values of x and y are
   (A) 8, 16
   (B) 10, 12
   (C) 9, 13
   (D) 8, 11

2. P is a 16 bit signed integer. The 2's complement representation of P is $(F87B)_{16}$. The 2's complement representation of 8*P is
   (A) $(C3D8)_{16}$
   (B) $(187B)_{16}$
   (C) $(F878)_{16}$
   (D) $(987B)_{16}$

3. Let f (x, y, z) = x' + y'x + xz be a switching function. Which one of the following is valid?
   (A) y'x is a prime implicant of f
   (B) xz is a minterm of f
   (C) xz is an implicant of f
   (D) y' is a prime implicant of f

4. Let f (w, x, y, z) = $\Sigma(0,4,5,7,8,9,13,15)$. Which of the following expressions are NOT equivalent to f ?
   (P) x'y'z' + w'xy' + wy'z + xz
   (Q) w'y'z' + wx'y' + xz
   (R) w'y'z' + wx'y' + xyz + xy'z
   (S) x'y'z' + wx'y' + w'y
   (A) P only
   (B) Q and S
   (C) R and S
   (D) S only

5. Suppose only one multiplexer and one inverter are allowed to be used to implement any Boolean function of n variables. What is the minimum size of the multiplexer needed?
   (A) 2^n line to 1 line
   (B) 2^{n+1} line to 1 line
   (C) 2^{n-1} line to 1 line
   (D) 2^{n-2} line to 1 line

6. In a two-level cache system, the access times of L1 and L2 caches are 1 and 8 clock cycles, respectively. The miss penalty from the L2 cache to main memory is 18 clock cycles. The miss rate of L1 cache is twice that of L2. The average memory access time (AMAT) of this cache system is 2 cycles. The miss rate of L1 and L2 respectively are:
   (A) 0.111 and 0.056
   (B) 0.056 and 0.111
   (C) 0.0892 and 0.1784
   (D) 0.1784 and 0.0892

7. Consider a processor with 64 registers and an instruction set of size twelve. Each instruction has five distinct fields, namely, opcode, two source register identifiers, one destination register identifier, and a twelve-bit immediate value. Each instruction must be stored in memory in a byte-aligned fashion. If a program has 100 instructions, the amount of memory (in bytes) consumed by the program text is _____ .
   (A) 400
   (B) 450
   (C) 300
   (D) 500

8. Consider the following code sequence having five instructions I1 to I5. Each of these instructions has the following format.

OP Ri, Rj, Rk

Where operation OP is performed on contents of registers Rj and Rk and the result is stored in register Ri.

I1: ADD R1, R2, R3

I2: MUL R7, R1, R3

I3: SUB R4, R1, R5

I4: ADD R3, R2, R4

I5: MUL R7, R8, R9

Consider the following three statements.

S1: There is an anti-dependence between instruction I2 and I5

S2: There is an anti-dependence between instructions I2 and I4

S3: Within an instruction pipeline an anti-dependence always creates one or more stalls

Which one of above statement/s is/are correct?

(A) Only S1 is true

(B) Only S2 is true

(C) Only S1 and S3 are true

(D) Only S2 and S3 are true

9. In designing a computer's cache system, the cache block (or cache line) size is an important parameter. Which one of the following statements is correct in this context?

(A) A smaller block size implies better spatial locality

(B) A smaller block size implies a smaller cache tag and hence lower cache tag overhead

(C) A smaller block size implies a larger cache tag and hence lower cache hit time

(D) A smaller block size incurs a lower cache miss penalty

10. Consider an instruction pipeline with five stages without any branch prediction: Fetch Instruction (FI), Decode Instruction (DI), Fetch Operand (FO), Execute Instruction (EI) and Write Operand (WO). The stage delays for FI, DI, FO, EI and WO are 5 ns, 7 ns, 10 ns, 8 ns and 6 ns, respectively. There are intermediate storage buffers after each stage and the delay of each buffer is 1 ns. A program consisting of 12 instructions I1, I2, I3, …, I12 is executed in this pipelined processor. Instruction I4 is the only branch instruction and its branch target is I9. If the branch is taken during the execution of this program, the time (in ns) needed to complete the program is

(A) 132

(B) 165

(C) 176

(D) 328

11. Consider the following C program:

```
#include <stdio.h>
int r(){
static int num=7;
return num--;
}
int main(){
for (r();r();r())
printf("%d",r());
return 0;
}
```

Which one of the following values will be displayed on execution of the programs?

(A) 41
(B) 52
(C) 63
(D) 630

12. Consider the following C program.

```
void f(int, short);
void main()
{
    int i = 100;
    short s = 12;
    short *p = &s;
    _____ ; // call to f()
}
```

Which one of the following expressions, when placed in the blank above, will NOT result in a type checking error?

(A) f(s,*s)
(B) i = f(i,s)
(C) f(i,*s)
(D) f(i,*p)

13. What will be the output of the following C program?

```
void count(int n){
    static int d=1;
        printf("%d ", n);
        printf("%d ", d);
        d++;
        if(n>1) count(n-1);
        printf("%d ", d);
}

void main(){
    count(3);
}
```

(A) 3 1 2 2 1 3 4 4 4
(B) 3 1 2 1 1 1 2 2 2
(C) 3 1 2 2 1 3 4
(D) 3 1 2 1 1 1 2

14. What is the output of the following C code? Assume that the address of x is 2000 (in decimal) and an integer requires four bytes of memory?

```
int main( )
{
    unsigned int x[4][3] =
{(1, 2, 3), {4, 5, 6}, {7, 8, 9}, {10, 11, 12}};
        printf("%u, %u, %u", x+3, *(x+3),
*(x+2)+3);
}
```

(A) 2012, 4, 2204
(B) 2036, 2036, 2036
(C) 2036, 10, 10
(D) 2012, 4, 6

15. Abstraction and encapsulation are fundamental principles that underlie the object oriented approach to software development. What can you say about the following two statements ?

I. Abstraction allows us to focus on what something does without considering the complexities of how it works?

II. Encapsulation allows us to consider complex ideas while ignoring irrelevant detail that would confuse us.

(A) Neither I nor II is correct.

(B) Both I and II are correct.

(C) Only II is correct.

(D) Only I is correct.

16. Which of the following differentiates between overloaded functions and overridden functions?

(A) Overloading is a dynamic or runtime binding and overridden is a static or compile time binding.

(B) Overloading is a static or compile time binding and overriding is dynamic or runtime binding.

(C) Redefining a function in a friend class is called overloading, while redefining a function in a derived class is called as overridden function.

(D) Redefining a function in a derived class is called function overloading, while redefining a function in a friend class is called function overriding.

17. In case of inheritance where both base and derived class are having constructor and destructor, then which if the following are true ?

1. Constructors are executed in their order of derivation

2. Constructors are executed in reverse order of derivation

3. Destructors are executed in their order of derivation

4. Destructors are executed in reverse order of derivation

(A) Only 2, 4

(B) Only 1, 3

(C) Only 1, 4

(D) Only 2, 3

18. Using friend operator function, following perfect set of operators may not be overloaded.

(A) ( ) , [ ] , ->,=

(B) <<, = = , [ ] , >>

(C) ?, = , ( ) , ++

(D) None of the above

19. Predict the output of following program.

```
#include<iostream>
using namespace std;
class Base
{
public:
    virtual void show() = 0;
};
```

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```
class Derived : public Base { };
int main(void)
{
    Derived q;
    return 0;
}
```

(A) Compiler Error: there cannot be an empty derived class

(B) Compiler Error: Derived is abstract

(C) No compiler Error

(D) None of the above

20. How can we restrict a function to throw certain exceptions?

(A) Defining multiple try and catch block inside a function

(B) Defining generic function within try block

(C) Defining function with throw clause

(D) It is not possible in CPP to restrict a function

21. The following C function takes a singly-linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```
typedef struct node {
    int value;
    struct node *next;
}   Node;
Node *move_to_front(Node *head) {
    Node *p, *q;
```

```
if ((head = = NULL || (head->next
= = NULL)) return head;
q = NULL; p = head;
while (p-> next !=NULL) {
        q=p;
        p=p->next;
}
_____

    return head;
}
```

Choose the correct alternative to replace the blank line.

(A) q = NULL; p->next = head; head = p;

(B) q->next = NULL; head = p; p->next = head;

(C) head = p; p->next = q; q->next = NULL;

(D) q->next = NULL; p->next = head; head = p;

22. A circular queue has been implemented using a singly linked list where each node consist of a value and a single pointer pointing to the next node. We maintain exactly two external pointers FRONT and REAR pointing to the front node and rear node of the queue, respectively. Which of the following statement is/ are CORRECT for such a circular queue, so that insertion and deletion operations can be performed in O(1) time?

I.   Next pointer of front node point to the rear node.

II.   Next pointer of rear node points to the front node.

(A)   I only

(B)   II only

(C)   Both I and II

(D)   Neither I nor II

23.   Suppose a stack implementation supports an instruction REVERSE, which reverses the order of elements on the stack, in addition to the PUSH and POP instructions. Which one of the following statements is TRUE with respect to this modified stack?

(A)   A queue cannot be implemented using this stack.

(B)   A queue can be implemented where ENQUEUE takes a single instruction and DEQUEUE takes a sequence of two instructions.

(C)   A queue can be implemented where ENQUEUE takes a sequence of three instructions and DEQUEUE takes a single instruction.

(D)   A queue can be implemented where both ENQUEUE and DEQUEUE take a single instruction each.

24.   Consider the following operation along with Enqueue and Dequeue operations on queues, where k is a global parameter.

```
MultiDequeue(Q){
    m = k
    while (Q is not empty) and (m > 0) {
        Dequeue(Q)
        m = m - 1
    }
}
```

What is the worst case time complexity of a sequence of n queue operations on an initially empty queue?

(A) $\Theta(n)$

(B) $\Theta(n + k)$

(C) $\Theta(nk)$

(D) $\Theta(n^2)$

25.   The preorder traversal sequence of a binary search tree is 30, 20, 10, 15, 25, 23, 39, 35, 42. Which one of the following is the postorder traversal sequence of the same tree?

(A)   10, 20, 15, 23, 25, 35, 42, 39, 30

(B)   15, 10, 25, 23, 20, 42, 35, 39, 30

(C)   15, 20, 10, 23, 25, 42, 35, 39, 30

(D)   15, 10, 23, 25, 20, 35, 42, 39, 30

26.   A B-tree of order 4 is built from scratch by 10 successive insertions. What is the maximum number of node splitting operations that may take place?

(A)   3

(B)   4

(C)   5

(D)   6

27.   Assume that a mergesort algorithm in the worst case takes 30 seconds for an input of size 64. Which of the following most closely approximates the maximum input size of a problem that can be solved in 6 minutes?

(A)   256

(B)   512

(C)   1024

(D)   2048

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28. An array n numbers is given, where n is an even number. The maximum as well as the minimum of these n numbers needs to be determined. Which of the following is TRUE about the number of comparisons needed?

(A) At least 2n - c comparisons, for some constant, c are needed.

(B) At most 1.5n - 2 comparisons are needed.

(C) At least $nlog_2n$ comparisons are needed.

(D) None of the above.

29. Consider the tree arcs of a BFS traversal from a source node W in an unweighted, connected, undirected graph. The tree T formed by the tree arcs is a data structure for computing

(A) the shortest path between every pair of vertices

(B) the shortest path from W to every vertex in the graph

(C) the shortest paths from W to only those nodes that are leaves of T

(D) the longest path in the graph

30. Consider a situation where swap operation is very costly. Which of the following sorting algorithms should be preferred so that the number of swap operations are minimized in general?

(A) Heap Sort

(B) Selection Sort

(C) Merge Sort

(D) Heap Sort

31. Which of the following is true about inheritance in Java?

1) Private methods are final.

2) Protected members are accessible within a package and inherited classes outside the package.

3) Protected methods are final.

4) We cannot override private methods.

(A) 1, 2 and 4

(B) Only 1 and 2

(C) 1, 2 and 3

(D) 2, 3 and 4

32. What will be the output of the program?

```
class Super
    {
public int i = 0;

public Super(String text) /* Line 4 */
    {
        i = 1;
    }
}

class Sub extends Super
{
    public Sub(String text)
    {
        i = 2;
    }

    public static void main(String args[])
```

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```
        {
            Sub sub = new Sub("Hello");
            System.out.println(sub.i);
        }
    }
```

(A)   0

(B)   1

(C)   2

(D)   Compilation Fails

33.   Which statement is true?

(A)   Programs will not run out of memory.

(B)   Objects that will never again be used are eligible for garbage collection.

(C)   Objects that are referred to by other objects will never be garbage collected.

(D)   Objects that can be reached from a live thread will never be garbage collected.

34.   public class ExceptionTest

```
{
        class TestException extends Exception
        {}
        public void runTest() throws
        TestException {}
    public void test() /* Point X */
    {
        runTest();
    }
}
```

At Point X on line 5, which code is necessary to make the code compile?

(A)   No code is necessary.

(B)   throws Exception

(C)   catch (Exception e)

(D)   throws RuntimeException

35.   The following block of code creates a Thread using a Runnable target:

Runnable target = new MyRunnable();

Thread myThread = new Thread(target);

Which of the following classes can be used to create the target, so that the preceding code compiles correctly?

(A)   public class MyRunnable extends Runnable{public void run(){}}

(B)   public class MyRunnable extends Object{public void run(){}}

(C)   public class MyRunnable implements Runnable{public void run(){}}

(D)   public class MyRunnable implements Runnable{void run(){}}

36.   Recall that Belady's anomaly is that the page-fault rate may increase as the number of allocated frames increases. Now, consider the following statements:

S1: Random page replacement algorithm (where a page chosen at random is replaced) suffers from Belady's anomaly

S2: LRU page replacement algorithm suffers from Belady's anomaly

Which of the following is CORRECT?

(A) S1 is true, S2 is true

(B) S1 is true, S2 is false

(C) S1 is false, S2 is true

(D) S1 is false, S2 is false

37. A system shares 9 tape drives. The current allocation and maximum requirement of tape drives for three processes are shown below:

Process	Current Allocation	Maximum Requirement
P1	3	7
P2	1	6
P3	3	5

Which of the following best describes current state of the system?

(A) Safe, Deadlocked

(B) Safe, Not Deadlocked

(C) Not Safe, Deadlocked

(D) Not safe, Not Deadlocked

38. Which of the following is NOT true of deadlock prevention and deadlock avoidance schemes?

(A) In Deadlock prevention, the request for resources is always granted, if the resulting state is safe

(B) In deadlock Avoidance, the request for resources is always granted, if the resulting state is safe

(C) Deadlock avoidance is less restrictive than deadlock prevention

(D) Deadlock avoidance requires knowledge of resource requirements a priori

39. Consider a non-negative counting semaphore S. The operation P(S) decrements S, and V(S) increments S. During an execution, 20 P(S) operations and 12 V(S) operations are issued in some order. The largest initial value of S for which at least one P(S) operation will remain blocked is _____.

(A) 4

(B) 5

(C) 6

(D) 7

40. Consider six memory partitions of sizes 200 KB, 400 KB, 600 KB, 500 KB, 300 KB and 250 KB, where KB refers to kilobyte. These partitions need to be allotted to four processes of sizes 357 KB, 210 KB, 468 KB and 491 KB in that order. If the best fit algorithm is used, which partitions are NOT allotted to any process?

(A) 200 KB and 300 KB

(B) 200 KB and 250 KB

(C) 250 KB and 300 KB

(D) 300 KB and 400 KB

41. Let the set of functional dependencies

F = {QR → S, R → P, S → Q}

hold on a relation schema X = (PQRS). X is not in BCNF. Suppose X is decomposed into two schemas Y and Z, where Y = (PR) and Z = (QRS).

Consider the two statements given below.

I.   Both Y and Z are in BCNF

II. Decomposition of X into Y and Z is dependency preserving and lossless

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Which of the above statement/s is/are correct?

(A) I only

(B) Neither I nor II

(C) II Only

(D) Both I and II

42. Which of the following relational query languages have the same expressive power?

I. Relational algebra

II. Tuple relational calculus restricted to safe expressions

III. Domain relational calculus restricted to safe expressions

(A) II and III only

(B) I and II only

(C) I and III only

(D) I, II and III

43. Consider a database implemented using B+ tree for file indexing and installed on a disk drive with block size of 4 KB. The size of search key is 12 bytes and the size of tree/disk pointer is 8 bytes. Assume that the database has one million records. Also assume that no node of the B+ tree and no records are present initially in main memory. Consider that each record fits into one disk block. The minimum number of disk accesses required to retrieve any record in the database is _____.

(A) 6

(B) 5

(C) 4

(D) 3

44. A database of research articles in a journal uses the following schema.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, YEAR, PRICE)

The primary key is (VOLUME, NUMBER, STARTPAGE, ENDPAGE) and the following functional dependencies exist in the schema.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE) $\rightarrow$ TITLE

(VOLUME, NUMBER) $\rightarrow$ YEAR

(VOLUME, NUMBER, STARTPAGE, ENDPAGE) $\rightarrow$ PRICE

The database is redesigned to use the following schemas.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, PRICE)

(VOLUME, NUMBER, YEAR)

Which is the weakest normal form that the new database satisfies, but the old one does not?

(A) INF

(B) 2NF

(C) 3NF

(D) BCNF

45. Consider the following database schedule with two transactions, T_1 and T_2

$S = r_2(X); r_1(X); r_2(Y); w_1(X); r_1(Y); w_2(X); a_1; a_2$

where $r_i(Z)$ denotes a read operation by transaction T_i on a variable Z, $w_i(Z)$ denotes a write operation by T_i on a variable Z and a_i denotes an abort by transaction T_i.

Which one of the following statements about the above schedule is TRUE?

(A) S is non-recoverable

(B) S is recoverable, but has a cascading abort

(C) S does not have a cascading abort

(D) S is strict

46. A prime attribute of a relation scheme R is an attribute that appears

(A) In all candidate keys of R

(B) In some candidate key of R

(C) In a foreign key of R

(D) Only in the Primary Key of R

47. A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames. Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps (1Kbps = 1000 bits/second). Size of an acknowledgment is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds. Assuming no frame is lost, the sender throughput is _____ bytes/second.

(A) 2000

(B) 2500

(C) 3000

(D) 3500

48. An organization requires a range of IP addresses to assign one to each of its 1500 computers. The organization has approached an Internet Service Provider (ISP) for this task. The ISP uses CIDR and serves the requests from the available IP address space 202.61.0.0/17. The ISP wants to assign an address space to the organization which will minimize the number of routing entries in the ISP's router using route aggregation. Which of the following address spaces are potential candidates from which the ISP can allot any one to the organization?

I.   202.61.84.0/21

II.   202.61.104.0/21

III. 202.61.64.0/21

IV.   202.61.144.0/21

(A) I and II Only

(B) II and III only

(C) III and IV only

(D) I and IV only

49. Identify the correct order in which a server process must invoke the function calls accept, bind, listen, and recv according to UNIX socket APL

(A) listen, accept, bind, recv

(B) bind, listen, accept, recv

(C) bind, accept, listen, recv

(D) accept, listen, bind, recv

50. Which of the following is/are example(s) of stateful application layer protocols?

(i)   HTTP

(ii)   FTP

(iii)   TCP

(iv)   POP3

(A)   (i) and (ii) only

(B)   (ii) and (iii) only

(C)   (ii) and (iv) only

(D)   (iv) only

ROUGH WORK

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ANSWER KEY Senior Skill Instructor CSE IT

1. D	26. C
2. A	27. B
3. C	28. B
4. B	29. B
5. C	30. B
6. A	31. A
7. D	32. D
8. B	33. D
9. D	34. B
10. B	35. C
11. B	36. B
12. D	37. B
13. A	38. A
14. B	39. D
15. A	40. A
16. B	41. C
17. C	42. D
18. A	43. C
19. B	44. B
20. C	45. C
21. D	46. B
22. B	47. B
23. C	48. B
24. A	49. B
25. D	50. C