

**6**

**WRITTEN TEST**  
**COMPUTER SCIENCE**

**Test Booklet No.**

Name of Applicant ..... Answer Sheet No. ....

Application ID : ..... Signature of Applicant : .....

Date of Examination: ..... Signature of the Invigilator(s)

1. ....

Time of Examination : ..... 2. ....

**Duration : 1 Hour]**

**[Maximum Marks : 50**

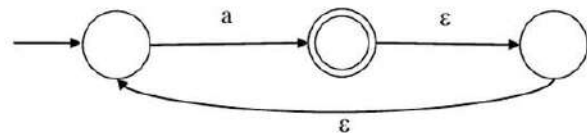
**IMPORTANT INSTRUCTIONS**

- (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.**



1. A program A reads in 500 integers in the range  $[0,100]$  representing the scores of 500 students. It then prints the frequency of each score above 50. What would be the best way for A to store the frequencies?
- (A) An array of 50 numbers  
 (B) An array of 100 numbers  
 (C) An array of 500 numbers  
 (D) A dynamically allocated array of 550 numbers
2. For what value of  $\lambda$ , do the following equations  $2x + 3y = 1$  and  $4x + 6y = \lambda$  has infinite solutions?
- (A)  $\lambda = 0$   
 (B)  $\lambda \neq 2$   
 (C)  $\lambda = 2$   
 (D)  $\lambda = 1$
3. A priority queue is implemented as a max-heap. Initially, it has 5 elements. The level order traversal of the heap is 10,8,5,3,2. Two new elements '1' and '7' are inserted into the heap in that order. The level order traversal of the heap after insertion of the elements is
- (A) 10,8,7,5,3,2,1  
 (B) 10,8,7,2,3,1,5  
 (C) 10,8,7,3,2,1,5  
 (D) 10,8,7,1,2,3,5
4. If each address space represents one byte of storage space, how many address lines are needed to access RAM chips arranged in  $4 \times 6$  array, where each chip is  $8K \times 4$  bits?
- (A) 13  
 (B) 14  
 (C) 16  
 (D) 17
5. Assume that the SLR parser for a grammar G has  $n_1$  states and the LALR parser for G has  $n_2$  states. The relationship between  $n_1$  and  $n_2$  is:
- (A)  $n_1$  is necessarily less than  $n_2$   
 (B)  $n_1$  is necessarily equal to  $n_2$   
 (C)  $n_1$  is necessarily greater than  $n_2$   
 (D) None of these
6. What is the complement of the language accepted by the NFA shown below? Assume  $\Sigma = \{a\}$



- (A)  $a^*$   
 (B)  $\phi$   
 (C)  $\{a, \epsilon\}$   
 (D)  $\epsilon$

7. Consider a 32-bit processor which supports 70 instructions. Each instruction is 32 bits 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. 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) BADE
- (D) CADD

9. 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	Q'
1	0	Q	Q
1	1	Q	0

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

- (A)  $(X' \wedge Q') \vee (Y' \wedge Q)$
- (B)  $(X' \wedge Q) \vee (Y' \wedge Q')$
- (C)  $(X \wedge Q') \vee (Y \wedge Q)$
- (D)  $(X \wedge Q) \vee (Y' \wedge Q)$

10. 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

11. If  $f(x) = |x+1| + |x+10|$ , then the minimum value of  $f(x)$  is

- (A) 9
- (B) 21
- (C) 1
- (D) 10

12. Which of the following is true?
- (A) Every subset of a regular set is regular
  - (B) Every finite subset of non-regular set is regular
  - (C) The union of two non-regular set is not regular
  - (D) Infinite union of finite set is regular
13. In a system using single processor, a new process arrives at the rate of six processes per minute and each such process requires seven seconds of service time. What is the CPU utilization?
- (A) 70%
  - (B) 30%
  - (C) 60%
  - (D) 64%
14. The hamming distance between the octets of 0xAA and 0x55 is
- (A) 7
  - (B) 5
  - (C) 8
  - (D) 6
15. If L and L' are recursively enumerable then L is
- (A) Regular
  - (B) Context-free
  - (C) Recursive
  - (D) Context-sensitive
16. Which of the following system calls results in the sending of SYN packets?
- (A) socket
  - (B) connect
  - (C) listen
  - (D) bind
17. Which of the following statements is true for every planar graph on n vertices?
- (A) The graph is connected
  - (B) The graph is Eulerian
  - (C) The graph has a vertex-cover of size at most  $3n/4$
  - (D) The graph has an independent set of size at least  $n/3$
18. Let X be a random variable following normal distribution with mean +1 and variance 4. Let Y be another normal variable with mean -1 and variance unknown. If  $P(X \leq -1) = P(Y \geq 2)$ , the standard deviation of Y is
- (A) 3
  - (B) 2
  - (C)  $\sqrt{2}$
  - (D) 1

19. For inclusion to hold between two cache levels L1 and L2 in a multi-level cache hierarchy, which of the following are necessary?
- L1 must be a write-through cache
  - L2 must be a write-through cache
  - The associativity of L2 must be greater than that of L1
  - The L2 cache must be at least as large as the L1 cache
- (A) IV only  
(B) I and IV only  
(C) I, II and IV only  
(D) I, II, III and IV
20. 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
21. If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?
- (A) 1022  
(B) 1023  
(C) 2046  
(D) 2047
22. A computer on a 10 Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2 Mbps. It is initially filled to capacity with 16 Megabits. What is the maximum duration for which the computer can transmit at the full 10 Mbps?
- (A) 1.6 seconds  
(B) 2 seconds  
(C) 5 seconds  
(D) 8 seconds
23. Let the page fault service time be 10 ms in a computer with average memory access time being 20 ns. If one page fault is generated for every  $10^6$  memory accesses, what is the effective access time for the memory?
- (A) 21 ns  
(B) 30 ns  
(C) 23 ns  
(D) 35 ns
24. Which of the following scenarios may lead to an irrecoverable error in a database system?
- (A) A transaction writes a data item after it is read by an uncommitted transaction  
(B) A transaction reads a data item after it is read by a committed transaction  
(C) A transaction reads a data item after it is written by an uncommitted transaction  
(D) A transaction reads a data item after it is written by a committed transaction

25. If two fair coins are flipped and at least one of the outcomes is known to be a head, what is the probability that both outcomes are heads?
- (A)  $1/4$   
 (B)  $1/3$   
 (C)  $1/2$   
 (D)  $2/3$
26. Which of the given options provides the increasing order of asymptotic complexity of functions  $f_1$ ,  $f_2$ ,  $f_3$  and  $f_4$ ?
- $f_1(n) = 2^n$ ;  $f_2(n) = n^{3/2}$ ;  $f_3(n) = n \log_2 n$ ;  
 $f_4(n) = (n)^{\log_2 n}$
- (A)  $f_3, f_2, f_1, f_4$   
 (B)  $f_3, f_2, f_4, f_1$   
 (C)  $f_2, f_3, f_1, f_4$   
 (D)  $f_2, f_3, f_4, f_1$
27. We are given a set of  $n$  distinct elements and an unlabelled binary tree with  $n$  nodes. In how many ways can we populate the tree with the given set so that it becomes a binary search tree?
- (A) 0  
 (B) 1  
 (C)  $n!$   
 (D)  $1/(n+1) \cdot {}^{2n}C_n$
28. A deck of 5 cards (each carrying a distinct number from 1 to 5) is shuffled thoroughly. Two cards are then removed one at a time from the deck. What is the probability that the two cards are selected with the number on the first card being one higher than the number on the second card?
- (A)  $4/25$   
 (B)  $1/5$   
 (C)  $1/4$   
 (D)  $2/5$
29. Let  $G$  be an arbitrary graph with  $n$  nodes and  $k$  components. If a vertex is removed from  $G$ , the number of components in the resultant graph must necessarily lie between
- (A)  $k$  and  $n$   
 (B)  $k - 1$  and  $k + 1$   
 (C)  $k - 1$  and  $n - 1$   
 (D)  $k + 1$  and  $n - k$
30. In a heap with  $n$  elements with the smallest element at the root, the 7th smallest element can be found in time
- (A)  $\Theta(n \log n)$   
 (B)  $\Theta(n)$   
 (C)  $\Theta(\log n)$   
 (D)  $\Theta(1)$

31. Consider the grammar shown below.

$S \rightarrow C C; C \rightarrow c C \mid d$

This grammar is

- (A) LL(1)
- (B) SLR(1) but not LL(1)
- (C) LALR(1) but not SLR(1)
- (D) LR(1) but not LALR(1)

32. 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 program?

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

33. Regular language is closed under

- (A) Union, intersection and inverse
- (B) Union, intersection and complement
- (C) Union, intersection and language difference
- (D) Above all

34. How many minimum numbers of states required to implement a DFA of even number of a's and even number of b's over the language of {a, b}.

- (A) 2
- (B) 6
- (C) 4
- (D) 3

35. Let the representation of a number in base 3 be 210. What is the hexadecimal representation of the number?

- (A) 15
- (B) 21
- (C) 528
- (D) 12



**36.** Consider the following statements about the functionality of an IP based router.

- I. A router does not modify the IP packets during forwarding.
- II. It is not necessary for a router to implement any routing protocol.
- III. A router should reassemble IP fragments if the MTU of the outgoing link is larger than the size of the incoming IP packet.

Which of the above statements is/are TRUE?

- (A) I and II only
- (B) I only
- (C) II only
- (D) II and III only

**37.** A table has fields, F1, F2, F3, F4, F5 with the following functional dependencies:  $F1 \rightarrow F3$ ;  $F2 \rightarrow F4$ ;  $(F1.F2) \rightarrow F5$ . In terms of normalization, this table is in

- (A) 2NF
- (B) 3NF
- (C) BCNF
- (D) 1NF

**38.** If an Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it : 245.248.128.0/20 and the ISP wants to give half of this chunk of address to Organization A, and a quarter to Organization B, while retaining the remaining with itself. Then, which among the following is a valid allocation of addresses to A and B?

- (A) 245.248.132.0/22 and 245.248.132.0/21
- (B) 245.248.136.0/21 and 245.248.128.0/22
- (C) 245.248.128.0/21 and 245.248.128.0/22
- (D) 245.248.136.0/22 and 245.248.132.0/21

**39.** If a CSMA/CD network that transmits data at a rate of 100 Mbps ( $10^8$  bits per second) over a 1 km(kilometre) cable with no repeaters and the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

- (A) 16000
- (B) 20000
- (C) 10000
- (D) 8000

40. The message 11001001 is to be transmitted using the CRC polynomial  $x^3 + 1$  to protect it from errors. The message that should be transmitted is \_\_\_\_\_
- (A) 11001001011  
 (B) 11001001000  
 (C) 110010010011  
 (D) 11001010
41. The maximum number of superkeys for the relation R(E, F, G, H) with E as the candidate key is
- (A) 6  
 (B) 8  
 (C) 7  
 (D) 16
42. The number of generators of a cyclic group of order 10 is
- (A) 2  
 (B) 4  
 (C) 3  
 (D) 5
43. The solution to the recurrence relation  $A_n = A_{n-1} + 2n$ , with initial term  $A_0 = 2$  is
- (A)  $4n+7$   
 (B)  $2(1+n)$   
 (C)  $3n^2$   
 (D)  $5*(n+1)/2$
44. If three coins are tossed simultaneously, the probability of getting at least one head is
- (A)  $7/8$   
 (B)  $1/8$   
 (C)  $3/8$   
 (D)  $4/8$
45.  $\lim_{x \rightarrow 0} (1 - \cos x) / x^2$  is
- (A)  $1/2$   
 (B)  $1/4$   
 (C) 1  
 (D) 2
46. What is the maximum height of any AVL-tree with 7 nodes? Assume that the height of a tree with a single node is 0.
- (A) 2  
 (B) 4  
 (C) 3  
 (D) 5

47. The number of J-K flip flops in modulo 16 binary up-counter are
- (A) 16
  - (B) 4
  - (C) 8
  - (D) 3
48. A given connected graph is a Euler graph if and only if all vertices are of
- (A) Odd degree
  - (B) Even degree
  - (C) Same degree
  - (D) Different degree
49. The correct matching for the following pairs is
- |                       |                       |
|-----------------------|-----------------------|
| A. Activation record  | 1. Linking loader     |
| B. Location counter   | 2. Garbage collection |
| C. Reference counts   | 3. Subroutine call    |
| D. Address relocation | 4. Assembler          |
- (A) A-4, B-3, C-1, D-2
  - (B) A-3, B-4, C-1, D-2
  - (C) A-4, B-3, C-2, D-1
  - (D) A-3, B-4, C-2, D-1
50. Consider an instruction of the type LW R1, 20(R2) which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by adding a constant 20 and contents of R2. Which one best reflects the source operand?
- (A) Immediate addressing
  - (B) Register addressing
  - (C) Indexed addressing
  - (D) Register Indirect addressing

## ROUGH WORK