

Government Engineering College Idukki
Recruitment of Assistant Professors on contract basis

Screening Test May 2017

Date of Exam: 21-05-2017

Discipline/Subject: Computer Science & Engineering

Duration: 60 minutes

Max. Marks: 4 x 40 = 160

*(Circle the choice numbers of the correct answers for multiple choice questions and write the answers (one line) just below the objective type questions for which choices are not given. Each wrong choice circled for multiple choice questions carries **minus one** mark.)*

1. Which among the following is not $O(n \log n)$? (Select all correct answers).

1. $n^{1.01}$
2. $n \log n^2$.
3. $2^{\log^2 n}$
4. $\sqrt{n \log n}$

Answer: Both $n^{1.01}$ and $2^{\log^2 n}$.

2. Suppose we know that a problem P is NP complete. Let Q be an problem of unknown complexity. Suppose you are able to find a polynomial time many one reduction from P to Q . Which among the following conclusions can be made? (Select all correct answers).

1. Q is in NP
2. Q is NP complete
3. Q is NP hard.
4. Q is not polynomial time solvable.

Answer: Q is NP hard

3. Suppose the merge procedure used in the merge sort algorithm takes $O(n^2)$ time instead of $O(n)$ time, what will be the complexity of the merge sort algorithm?

Answer: $O(n^2)$.

4. What is the complexity of the Floyd Warshall algorithm for computing all pairs of shortest distances in a weighted undirected graph?

Answer: $O(n^3)$.

5. Which among the following algorithms involve use of a priority queue? (Select all correct answers).

1. Kruskal's algorithm
2. Prim's algorithm
3. Dijkstra's algorithm
4. Floyd Warshall Algorithm.

Answer: Prim's algorithm and Dijkstra's algorithm

6. The C compiler does not allocate memory in the run time stack for variable declared locally within a function if

1. The variable is declared static.
2. The variable is an array.
3. The variable is a pointer variable.
4. The variable is of a user defined type.

Answer: The variable is declared static.

7. Which among the following parsers is not suitable for the context free grammar $A ::= Aa|b$? (Here A is a non-terminal, a, b are terminals).

1. SLR parser
2. LL(1) parser
3. LR(1) parser
4. LALR(1) parser.

Answer: LL(1) parser.

8. The C function `malloc()` allocates memory from the:

1. stack memory region at compile time.
2. The stack memory region at run time.
3. The heap memory region at compile time
4. The heap memory region at run time.

Answer: The heap memory region of at run time.

9. For the grammar with non-terminals $\{S, A, B\}$ and terminals $\{a, b, c\}$ given by: $S ::= ASB|BSB|c$, $A ::= Aa|a$, $B ::= Bb|b$, $Follow(S) = ?$

Answer: $\{b\}$.

10. Which among the following is most appropriate for an LALR(1) parser:

1. A bottom up parser supporting inherited attributes.
2. A top down parser supporting inherited attributes.
3. A bottom up parser supporting synthesised attributes
4. A top down parser supporting synthesised attributes

Answer: A bottom up parser supporting synthesised attributes.

11. Which among the following system calls require access to the Inode table? Select all correct answers.

1. Fork() system call.
2. Exec() system call
3. Exit() system call
4. Kill() system call.

Answer: Exec() system call.

12. Threads within in a process may share:

1. text, stack and static data regions.
2. text and stack regions but not static data region.
3. text and data regions but not stack region.

4. data and stack regions but not text region.

Answer: text and data regions but not stack region.

13. Each process requires a separate (answer all correct answers).

1. Process Table
2. Page Table
3. Inode Table
4. File descriptor table

Answer: Page Table and File descriptor table.

14. Which among the following operations (in a C program) need not involve a switch from unprivileged mode to privileged mode (choose all correct answers)?

1. A call to `exit()` to terminate a process.
2. A call to `ptrace()` to for single step execution of a process.
3. A call to `malloc()` to allocate memory dynamically.
4. A call to `open()` to open a file.

Answer: A call to `malloc()` to allocate memory dynamically.

15. Which among the following schemes divide the logical address space of a program into segments with each segment divided into pages (choose all correct answers)?

1. Segmented paging
2. Paged segmentation
3. Virtual memory with demand paging
4. Virtual memory without demand paging.

Answer: Segmented paging, Paged Segmentation.

16. How many numbers in the set $\{1, 2, \dots, n\}$ are multiples of either 4 or 6?

Answer: $\lfloor n/4 \rfloor + \lfloor n/6 \rfloor - \lfloor n/12 \rfloor$

17. How many different functions are there from A to A , where A is a set of n elements?

Answer: $|A|^{|A|}$ or n^n .

18. Which of the following are true in the domain of real numbers?

1. $\forall x \exists y (x = y^2)$
2. $\exists x \forall y (x = y^2)$
3. $\exists x \exists y (x = y^2)$
4. $\forall x \forall y (x = y^2)$

Answer: $\exists x \exists y (x = y^2)$

19. Negate the statement $\forall x \forall z \exists y (x < y < z)$

1. $\forall x \forall z \exists y \neg (x < y < z)$
2. $\exists x \exists z \forall y \neg (x < y < z)$
3. $\forall y \exists x \exists z \neg (x < y < z)$
4. $\exists y \forall x \forall z \neg (x < y < z)$

Answer: $\exists x \exists z \forall y \neg(x < y < z)$

20. G is a connected graph which is not a tree. If G has n vertices, what is the minimum number of edges that G can have?

Answer: n

21. G is a graph whose vertices can be properly coloured using 2 colours. If G has 20 vertices, what is the maximum number of edges that G can have?

Answer: 100

22. If G is a planar graph with n vertices, what is the maximum number of edges that G can have?

Answer: $3n - 6$

23. If three fair dice are rolled together, what is the probability that all of them show the same number?

Answer: $1/36$

24. If three fair dice are rolled together, what is the probability that at least two of them show the same number?

Answer: $16/36 = 4/9$

25. If 10 fair dice are rolled together, what is the probability that at least two of them show the same number?

Answer: 1

26. The language $\{a^n b^n c^n : n \geq 0\}$ is

1. Regular
2. Context-free but not regular
3. Turing decidable but not context-free
4. Not Turing decidable

Answer: Turing decidable but not context-free

27. Intersection of two context-free languages is always

1. Regular
2. Context-free but not necessarily regular
3. Turing decidable but not necessarily context-free
4. Not necessarily Turing decidable

Answer: Turing decidable but not context-free

28. The regular expression $(a + bb)^*$ generates the language of

1. All the strings over $\{a, b\}$ with an even number of b 's
2. All the strings over $\{a, b\}$ where number of b 's is twice the number of a 's
3. All the strings over $\{a, b\}$ in which all blocks of b 's have even length
4. All the strings over $\{a, b\}$ in which all blocks of b 's have even length and all blocks of a 's have odd length.

Answer: All the strings over $\{a, b\}$ in which all blocks of b 's have even length

29. The family of languages generated by context-free grammars is the same as the family of languages that can be recognised by

1. Deterministic Finite Automatons

2. Deterministic Pushdown Automaton
3. Non-deterministic Pushdown Automaton
4. Deterministic Turing Machines

Answer: Non-deterministic Pushdown Automaton

30. Which of the following sets is uncountable?

1. Set of all regular languages
2. Set of all finite-length strings over $\{a, b\}$
3. Set of all Turing Machines
4. Set of all subsets of $\{a, b\}^*$

Answer: Set of all subsets of $\{a, b\}^*$

31. Let \mathcal{T} be a binary tree with height (length (or number of edges) of the longest path from the root node) d . Then what is the maximum number of non-leaf nodes possible in \mathcal{T} .

Answer: $2^d - 1$

32. Let A be a two dimensional integer array with m rows and n columns. Assume that column-major representation is used for storing the elements of the array in memory. Let α be the base address of the array A and each integer is of size 2 bytes. Then what will be the address of the element $A[i][j]$?

Answer: $\alpha + (i \cdot m + j) \cdot 2$

33. Give the postfix representation of the following infix expression: $(A + (B - C)^(D + E))/2 * A$

Answer: $ABC - DE + ^ + 2A * /$

34. What linked list operation is implemented by the following function `foo`?

```

/* Assume head points to the head of a linear linked list */
/* Assume next is the field in the node to store the address of the next node */
foo( list * head) {
    list *Next, *Prev;
    if (head == NULL) return head;
    Next = NULL;
    Prev = head->next;
    while (Prev != NULL) {
        head->next=Next;
        Next=head;
        head=Prev;
        Prev=Prev->next;
    }
    return head;
}

```

Answer: Reversing a linked list

35. Let \mathcal{T} be a binary search tree of height h and n be a node in \mathcal{T} with depth (length of the path from root to n) d . Then what is the complexity of deleting the node n so that the resulting tree is a binary search tree. *Answer:* $h - d$

36. What is the output printed by the following program?

```
#include<stdio.h>
int main()
{
    int a,b[5],*ptr1,*ptr2;
    a=5;
    ptr1=&a;
    ptr2=&b[4];
    while(*ptr1)
    {
        *ptr2 = *ptr1;
        ptr2 = ptr2 -1;
        *ptr1 = *ptr1 - 1;
    }
    printf("a=%d b[0]=%d b[1]=%d b[2]=%d\n",a,b[0],b[1],b[2]);
    return 0;
}
```

Answer: a=0 b[0]=1 b[1]=2 b[2]=3

37. What is the output printed by the following program?

```
#include<stdio.h>
int main()
{
    int n=20, t=18, result=1,i;
    if(t > n / 2)
        t=n-t;
    for(i=1; i<=t; i++)
    {
        result=result*(n-i+1)/i;
    }
    printf("%d\n",result);
}
```

Answer: 190

38. What is the output of the following program?

```
#include<stdio.h>
int f(int, int);
int main()
{
    int n=4;
    f( n, 1 );
}
int f(int n, int a )
{
    printf("n=%d, a=%d\n", n,a);
    if(n<2)
        return a;
    else
        return (f(n-1, n*a));
}
```

Answer:

n=4, a=1
 n=3, a=4
 n=2, a=12
 n=1, a=24

39. What is the output printed by the following program?

```
#include<stdio.h>
void main()
{
    int x=24,y=34, z;
    while(x>0)
    {
        printf("x=%d, y=%d \n",x, y);
        z = y % x;
        y = x;
        x = z;
    }
}
```

Answer:

x=24, y=34
 x=10, y=24
 x=4, y=10
 x=2, y=4

40. What will be the value of `c` after executing the function `foo` ?

```
void foo() {
    unsigned a,b,c;
    a = 10; b = 20;
    bar( &a,&b );
    c = a;
}

void bar( unsigned *ptr1, unsigned *ptr2 ){
    unsigned *temp;
    temp = ptr1;
    ptr1 = ptr2;
    ptr2 = temp;
}
```

Answer: 10