Sample Question Paper for MSc Computer Science

- **Format of the Entrance Test Paper**
- The duration of the Entrance Test will be 2 hours and the question paper will consist of 80 multiple choice questions divided into two parts.

- **PART A:** It will have **20 multiple choice** questions of **two marks each** on the following areas of Mathematical Science:
- *Set Theory and Algebra*: Sets, Relations, Functions, Groups, Partial Orders, Lattice, Boolean Algebra.
- *Combinatorics*: Permutations, Combinations, Counting, Summation, Binomial Theorem, Exponential Series.
- *Matrix*: Basic Concepts, Types of Matrices, Determinants, Transpose, Inverse and Rank of a Matrix, Matrix Algebra, Systems of Linear Equations.
- *Calculus*: Limit, Continuity and Differentiability, Mean Value Theorems, Theorems of Integral Calculus, Evaluation of Definite and Improper Integrals, Partial Derivatives, Total Derivatives, Maxima and Minima.
- *Ordinary Differential Equations*: First Order First Degree Equations, Variable Separable Method, Homogeneous Equations, Exact Equations, Integrating Factors, Linear Equations.
- *Vector Analysis*: Addition, Subtraction, Dot Product and Cross Products of Vectors.
- **PART B:** It will have **60 multiple choice questions** of **one mark each** on the following areas of undergraduate level Computer Science:
- *Programming in C*: Elements of C, Identifiers, Data Types, Control Structures, Array, Structure, Union, Strings, Pointers, Functions, Parameter Passing to Functions, Recursion, File Handling.
- *Data Structures & Algorithms*: Elementary Concepts of List, Stack, Queue, Tree and Graph, Space and Time Complexity Analysis, Sorting Techniques: Bubble Sort, Insertion Sort, Selection Sort, Merge Sort, Quick Sort, etc., Searching Techniques: Linear and Binary Search.
- *Database Management System*: Basic Concepts, Attributes, Entity and Relationships, ER Diagram, Database Decomposition and Normalization, Database Constraints, Relational Algebra, SQL.
- *Digital Logic and Computer Architecture*: Number System, Data Representation, Compliments, Computer Arithmetic, Logic Gates, Combinational and Sequential Circuits, Computer Organization, Instruction Formats and Addressing Modes, Memory Organization and I/O Interfaces.
- **Negative Marks for Wrong Answers**
- If the answer given to any of the Multiple Choice Questions is wrong, ¼ of the marks assigned to that question will be deducted.

- This is only a sample paper and only meant to be indicative of the type of questions that will be asked.

(Twenty Questions. Each Question Carries 2 Marks)

1. Which one of the following in NOT necessarily a property of a Group?

    a. Commutativity

    b. Associativity

    c. Existence of inverse for every element

    d. Existence of identity

2. The cardinality of the power set of $\{0, 1, 2 \ldots, 11\}$ is .

    a. 2048

    b. 2043

    c. 4096

    d. 4098

3. If, $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$.

Which of the following is the Boolean product of A and B?

    a. $\begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$

    b. $\begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$

$$c. \begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

$$d. \begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$$

4. Let R denote the set of real numbers. If $f{:}R{\times}R{\to}R{\times}R$ is a bijective function defined by $f(x,y)=(x+y,x-y)$, then which of the following is the inverse function of f ?

a. $f^{-1}(x, y) = \left(\dfrac{1}{x+y}, \dfrac{1}{x-y} \right)$

b. $f^{-1}(x, y) = \left(x - y, x + y \right)$

c. $f^{-1}(x, y) = \left(\dfrac{x+y}{2}, \dfrac{x-y}{2} \right)$

d. $f^{-1}(x, y) = \left(2(x-y), 2(x+y) \right)$

5. For the matrix $\begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix}$, the eigenvalue corresponding to the eigenvector $\begin{bmatrix} 101 \\ 101 \end{bmatrix}$ is_____.

a. 2

b. 6

c. 4

d. 8

6. If $A = [a_{ij}], 1 \le i, j \le n$ with $n \ge 3$ and $a_{ij} = i.j$, then the rank of A is

a. 0

b. 1

c. n-1

d. n

7. The following systems of equations

$$x_1 + x_2 + 2x_3 = 1$$
$$x_1 + 2x_2 + 3x_3 = 2$$
$$x_1 + 4x_2 + ax_3 = 4$$

has a unique solution. The only possible value(s) is/are:

a. 0

b. Either 0 or 1

c. One of 0, 1 or -1

d. Any real number other than 5

8. The value of the determinant $\begin{vmatrix} 1 & 0 & 0 & 0 \\ 16 & 1 & 0 & 0 \\ 16 & 32 & 1 & 0 \\ 16 & 32 & 96 & 1 \end{vmatrix}$ is

a. 1
b. 0
c. 32
d. 96

9. In how many different ways can 4 letters be placed inside four differently addressed envelopes so that no letter gets into its correct envelope?

a. 9

b. 24

c. 6

d. 27

10. The coefficient of x^3 in $(1+x+x^2+x^3)^3$ is

a. 3

b. 12

c. 6

c. 10

11. If $S_1 = \sum n$, $S_2 = \sum n^2$, $S_3 = \sum n^3$, then the value of $\lim\limits_{n\to\infty} \dfrac{S_1\left(1+\frac{S_3}{8}\right)}{S_2^2}$ is equal to:

    a. $\dfrac{3}{32}$

    b. $\dfrac{3}{64}$

    c. $\dfrac{9}{32}$

    d. $\dfrac{9}{64}$

12. Let f be a differentiable function satisfying the condition $f\left(\dfrac{x}{y}\right) = \dfrac{f(x)}{f(y)}$ for all x, y ($\neq 0$) $\in \mathcal{R}$ and $f(y) \neq 0$. If $f'(1) = 2$, then $f'(x)$ is equal to:

    a. $2 f(x)$

    b. $\dfrac{2 f(x)}{x}$

    c. $2 x f(x)$

    d. $\dfrac{f(x)}{x}$

13. For which of the following, the minimum value of $a \tan^2 x + b \cot^2 x$ equals the maximum value of $a \sin^2 x + b \cos^2 x$, where $> b > 0$?

    a. $a = b$

    b. $a = 2b$

    c. $a = 3b$

    d. $a = 4b$

14. If $\dfrac{dy}{dx} = \sqrt{\tan x} + \sqrt{\cot x}$, then y is equal to:

    a. $\sin^{-1}(\sin x - \cos x) + C$

    b. $\sqrt{2} \sin^{-1}(\sin x - \cos x) + C$

    c. $\sqrt{2} \cos^{-1}(\sin x - \cos x) + C$

    d. $\cos^{-1}(\sin x - \cos x) + C$

15. The order of the differential equation whose solution is $y = a \cos x + b \sin x + Ce^{-x}$ is

    a. 3

    b.2

    c. 1

    d. none of these

16. Suppose, ABCD is a parallelogram with AC and BD as diagonals. Then, $\overrightarrow{AC} - \overrightarrow{BD}$ is equal to

    a. $2\overrightarrow{AC}$

    b. $\overrightarrow{AB}$

    c. $2\overrightarrow{AB}$

    d. $\overrightarrow{AC}$

17. If $\overrightarrow{e_1} = (1, 1, 1)$, $\overrightarrow{e_2} = (1, 1, -1)$ and $\vec{a}, \vec{b}$ are two vectors such that $\overrightarrow{e_1} = 2\vec{a} + \vec{b}$ and $\overrightarrow{e_2} = \vec{a} + 2\vec{b}$, then the angle between $\vec{a}$ and $\vec{b}$ is

    a. $\cos^{-1}\left(\frac{-7}{11}\right)$

    b. $\cos^{-1}\left(\frac{7}{11}\right)$

    c. $\cos^{-1}\left(\frac{7}{9}\right)$

    d. $\cos^{-1}\left(\frac{6\sqrt{2}}{11}\right)$

18. Given that $|\vec{a}| = 2\sqrt{2}$, $|\vec{b}| = 3$ and $\vec{a}.\vec{b} = \frac{\pi}{4}$ the length of the longer diagonal of the parallelogram constructed on $5\vec{a} + 2\vec{b}$ and $\vec{a} - 3\vec{b}$ is

    a. 15

    b. $\sqrt{113}$

    c. $\sqrt{593}$

    d. $\sqrt{369}$

19. Given **x** $= 3i - j + 2k$, **y** $= 2i + 2j - k$. then $x \times y$ is equal to

     a. $-3i + 7j + 8k$
     b. $5i + j + k$
     c. $i - j + 3k$
     d. $6i - 2j - 2k$

20. If vector **u** $= (3, -12, 4)$, then $||\mathbf{u}||$ is equal to

     a. 13
     b. 12
     c. 19
     d. 5

PART B

Each Question Carries 1 Mark)

21. What is the size of () in C?

     a. Macro
     b. Function
     c. None of these
     d. Operator

22. What is the output of the following program?

```
#include<stdio.h>
int main()
{
    extern int i;
    i = 20;
    printf("%d", sizeof(i));
    return 0;
}
```

     a. 2

b. Undefined reference to i

c. 20

d. 0

23. What is the output of the following program?

```
#include<stdio.h>
int main()
{
    int x = 10;
      {
            int x = 100;
            printf("%d",x);
      }
    return 0;
}
```

a. Compilation Error

b. 100

c. 10

d. None of the above

24. Which of the following is executed by preprocess?

a. return 0

b. #include<stdio.h>

c. void main(int argc , char ** argv)

d. None of above

25. What is the output of the following program?

```
#include<stdio.h>
int main()
{
    int a = 320;
    char *ptr;
```

```
        ptr =( char *)&a;

        printf("%d",*ptr);

        return 0;

    }
```

a. 64

b. 320

c. 160

d. 60

26. What is the output of the following program?

```
#include<stdio.h>

int main()

{

    int x;

    x=10,20,30;

    printf("%d",x);

    return 0;

}
```

a. Compilation Error

b. 10

c. 30

d. 20

27. In the following program, how many times is South Asian University printed?

```
#include<stdio.h>

void main()

{

    int a = 0;

    while(++a++);

        {
```

```
            printf("South Asian University");
        }
    }
```

a. Only once
b. Infinite times
c. Error: Lvalue Required
d. Only Twice

28. What is the output of the following program?

```
#include<stdio.h>
void main()
{
    int i;
    for(i=0; i<5; i++);
    printf("%d", i);
}
```

a. 5
b. Compilation Error
c. 1 2 3 4
d. Nothing is printed

29. What is the output of the following program?

```
#include<stdio.h>
void main()
{
    for(; ;)
    printf("Hello World");
}
```

a. Hello is printed infinite times
b. Compilation Error
c. Runtime Error
d. Hello Word is printed only one time

30. What is the storage class for variable A in the following code?

```
#include<stdio.h>
void main()
{
    int A;
    A = 10;
    printf("%d", A);
}
```

a. register
b. extern
c. static
d. auto

31. What is the output of the following program?

```
#include<stdio.h>
int main()
{
    int a = 10, b = 20;
    if(a=b)
    {
        printf("Easy");
    }
    else
        printf("Hard");
    }
    return 0;
}
```

a. Hard
b. Easy
c. Syntax error
d. EasyHard

32. What is the output of the following program?

```
#include <stdio.h>
```

```
int main (int argc, char *argv[])
{
char str1 [] = "Welcome to SAU";
int a = 10;
char str2[12];
sprintf (str2, "%s-%d", str1, a);
printf ("%s", str2);
return 0;
}
```

a. Welcome to SAU-10

b. Compilation Error

c. Welcome to SAU

d. none of the above

33. What is the output of the following program?

```
#include <stdio.h>
void main()
{
   int i,j,k,count;
   count=0;
   for(i=0;i<5;i++)
    {
       for(j=0;j<5;j++)
        {
            count++;
        }
     }
   printf("%d",count);
}
```

a. 25

b. 24

c. 23

d. none of the above

34. What is the output of the following program?

```c
#include <stdio.h>
#include <stdlib.h>
int main(int argc, char *argv[])
{
        int a = atoi("100");
        printf("%d",a);
        return 0;
}
```

a. 100

b. 1

c. 0

d. 3

35. What is the output of the following program?

```c
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
int main()
{
   char* string = (char*)malloc(64);
   strcpy(string, "hello_World");
   printf("%s\n", string);
   return 0;
}
```

a. hello_World

b. ello_World

c. llo_World

d. lo_World

36. What is the important difference between structure & union?

    a. There is no difference

    b. Union takes less memory

    c. Union is faster

    d. Structure is faster

37. What gets printed by the code below? (Assume 1 byte characters)

        char array[] = "foo";

        printf("%lu\n", sizeof(array[1]));

    a. 1

    b. 3

    c. 2

    d. 4

38. Which of the following is an invalid header file in C?

    a. math.h

    b. mathio.h

    c. string.h

    c. ctype.h

39. A complete binary tree with height h can have _____ nodes.

    a. Less than 2^{h-1}
    b. Less than $2^h - 1$
    c. Exactly $2^h - 1$
    d. Between 2^{h-1} and $2^h - 1$

40. For deleting a node other than the head node from a circular doubly linked list, we need to update _____ links.

    a. 2
    b. 3
    c. 4
    d. 5

41. The run-time complexity of the following pseudo code

is

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

a. $O(n^2)$
b. $O(n^3)$
c. $O(n^4)$
d. $O(n^5)$

42. Consider the functions given below:

(i) $nlogn$ (ii) $nloglogn$ (iii) $nlog^2n$ (iv) $nlogn^2$

If you arrange these functions by growth rate from slowest to fastest, which of the following is the correct answer?

        a. (i), (ii), (iii), (iv)
        b. (ii), (i), (iii), (iv)
        c. (ii), (i), (iv), (iii)
        d. (i), (ii), (iv), (iii)

43. Consider the two functions given below:

$$f(n) = n^{1.5} \quad \text{and} \quad g(n) = nlog^4(n)$$

Which of the following statements is true?

        a. $f(n) = o\big(g(n)\big)$
        b. $f(n) = \theta\big(g(n)\big)$
        c. $g(n) = o\big(f(n)\big)$
        d. $g(n) = \theta\big(f(n)\big)$

44. In a Quicksort implementation, the first call to the partition function returns the following array:

$$3, 9, 1, 14, 17, 24, 22, 20$$

Which of the following statements is correct about the partition step?

        a. The pivot can be either 14 or 17
        b. The pivot can be 14, but not 17
        c. The pivot can be 17, but not 14
        d. Neither 14 nor 17 can be the pivot

45. What will be the complexity of the *Merge Sort* algorithm, if the complexity of the merge operation is $O(n^2)$?

        a. $O(nlogn)$
        b. $O(n^2logn)$
        c. $O(n^2)$
        d. $O(nlog^2n)$

46. How many comparisons are needed in the worst case to search a sorted array containing 64 elements using binary search?

    a. 6
    b. 12
    c. 14
    d. None of the above

47. Which of the following is not a stable sorting algorithm in its typical implementation?

    a. Insertion Sort
    b. Bubble Sort
    c. Merge Sort
    d. Quick Sort

48. You have to sort 1 GB of data with only 100 MB of available main memory. Which sorting technique will be most appropriate?

    a. Merge Sort
    b. Quick Sort
    c. Bubble Sort
    d. Insertion Sort

49. Which of the following is the correct recurrence for worst case of Binary Search?

    a. $T(n) = 2T(n/2) + O(1), T(1) = T(0) = O(1).$
    b. $T(n) = T(n-1) + O(1), T(1) = T(0) = O(1).$
    c. $T(n) = T(n/2) + O(1), T(1) = T(0) = O(1).$
    d. $T(n) = T(n-2) + O(1), T(1) = T(0) = O(1).$

50. Consider a sorted array of n numbers. What would be the time complexity of the best known algorithm to find a pair a and b such that $|a - b| = k$, k being a positive integer.

    a. $O(n)$
    b. $O(nlogn)$
    c. $O(n^2)$
    d. $O(logn)$

51. If W(n) and A(n) denote respectively, the worst case and average case running time of an algorithm executed on an input of size n, which of the following will be ALWAYS TRUE?

    a. $A(n) = \Omega(W(n))$
    b. $A(n) = \Theta(W(n))$
    c. $A(n) = O(W(n))$
    d. $A(n) = o(W(n))$

52. The result evaluating the following postfix expression

$$10\ 5\ +\ 60\ 6\ /\ *\ 8\ -$$

is

        a. 284
        b. 213
        c. 142
        d. 71

53. The seven elements A, B, C, D, E, F and G are pushed onto a stack in reverse order, i.e., starting from G. The stack is popped five times and each element is inserted into a queue. Two elements are deleted from the queue and pushed back onto the stack. Now, one element is popped from the stack. The popped item is

        a. A
        b. B
        c. F
        d. G

54. What is the degree of the following relation schema?

Student(enrollment, name, programme, year, dob)

    a. 5

    b. 2

    c. 4

    d. 1

55. Which of the following relation schema is definitely in BCNF?

    a. R(A, B, C)

    b. R(A, B)

    c. R(A, B, C, D)

    d. R(A, B, C, D, E)

56. Consider a relation schema R(A, B, C, D) and the set of functional dependencies F={A→B, B→CD}. What is the candidate key of R?

    a. A

    b. B

c. C

d. CD

57. Which of the following can be considered as a multivalued and composite attribute for student relation (table)?

    a. Date-of-birth

    b. Telephone-number

    c. Age

    d. Grade

58. Consider the Relations R1(A, B, C) and R2(C, D, E), where the domain of C is the same in both relations. What will be the degree of the resultant relation when natural join is applied between R1 and R2?

    a. 3

    b. 2

    c. 5

    d. 6

59. Which of the following statements is FALSE?

    a. A relation schema can have two or more candidate keys.

    b. If a relation schema has two candidate keys then they must have the same number of attributes.

    c. A relation schema which is in BCNF is always in 3NF.

    d. Duplicate tuples are not allowed in database relations.

60. Which of the following is the optional component of an SQL query?

    a. SELECT
    b. FROM
    c. WHERE
    d. Both SELECT and FROM

61. Derived attributes are shown using _____ in ER diagrams.

    a. Solid-line ellipse
    b. Rectangle
    c. Diamond

d. Dashed-line ellipse

62. Consider the following relation schema R along with four instances:

A	B	C	D
1	1	3	4
2	4	5	5
3	1	3	4
4	2	4	3

Which of the following can be considered as a candidate key of R?
    a. BC
    b. BD
    c. CD
    d. none of these

63. Consider the entities Employee and Department. If an employee can be the chairperson of at most one department and each department is managed by only one chairperson, then what will be the cardinality of the "Manages" relationship relating Employee and Department entities?

    a. 1:1
    b. 1:N
    c. N:1
    d. M:N

64. Which of the following is NOT a Data Manipulation Language (DML) statement in SQL?

    a. INSERT
    b. UPDATE
    c. DROP
    d. DELETE

65. Which of the following is NOT a Data Definition Language (DDL) statement in SQL?

    (A) CREATE
    (B) ALTER
    (C) DROP
    (D) DELETE

66. Consider the following relation schema R along with four instances:

A	B	C	D
1	1	3	4
2	4	5	5
3	1	3	4
4	2	4	3

How many tuples will there be in the resultant relation of R×R, where × represents the Cartesian product operation of the Relational Algebra?

    a. 4

    b. 8

    c. 16

    d. 0

67. The _____ constraint states that the value of the primary key cannot be NULL.

    a. Key

    b. Referential integrity

    c. Entity integrity

    d. Domain

68. Which of the following is an unary operator in Relational Algebra?

    a.Selection

    b.Division

    c. Natural Join

    d.Theta Join

69. In the instruction given below,
addi $s3, $s7, 4
'addi' stands for which of the following?

    a. addition

    b. additional

    c. add immediate

    d. none of the above

70. Choose the correct answer from the following options

    a. $(630)_8 = (408)_{10}$

b. $(603)_8 = (409)_{10}$

c. $(630)_8 = (470)_{10}$

d. None of the above

71. Which of the following is correct?

    a. $(33.375)_{10} = (100001.101)_2$

    b. $(33.375)_{10} = (100001.011)_2$

    c. $(33.375)_{10} = (100010.011)_2$

    d. $(33.375)_{10} = (100010.110)_2$

72. If the clock rate of a computer is 3.3 GHZ, then how many clock cycles are produced in two milliseconds?

    a. 1.65×10^9

    b. 1.65×10^6

    c. 3.30×10^6

    d. 6.60×10^6

73. Total number of tasks completed per unit time is called the

    a. execution time

    b. throughput

    c. makespan

    d. all of the above

74. If $F\ (X, Y, Z) = \sum m(1, 2, 3, 4, 5, 7)$, which of the following is true?

    a. $F = X\bar{Y} + \bar{X}Y + Z$

    b. $F = X\bar{Y} + \bar{X}Y + \bar{Z}$

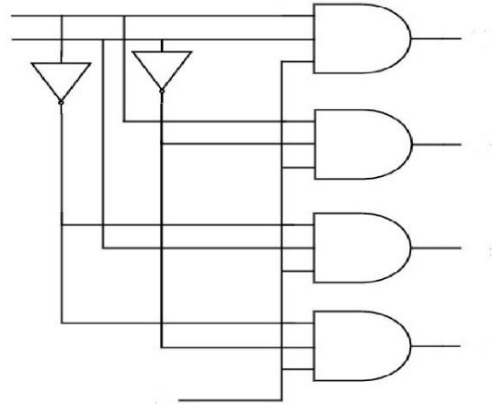   c. $F = X\bar{Z} + \bar{X}Y + \bar{Y}Z$

    d. none of the above

75. In a D Flip-flop, the minimum time for which the D input must be maintained at a constant value prior to the occurrence of clock transition is called:

    a. hold time

b. propagation delay

c. setup time

d. all of the above

76. The following circuit

represents :

   a. 3 to 4 line decoder

   b.2 to 4 line decoder

   c. 3 to 4 line encoder

   d. 2 to 4 line encoder

77. If a memory unit has a capacity of 2^{10} words of 32 bits, how many bytes can it accommodate?

   a. 32

   b.4096

   c. 2048

   d.1024

78. EPROM stands for which one of the following?

   a. erasable programmable read-only memory

   b. extendable programmable read-only memory

   c. electrically-erasable programmable read-only memory

   d. all of the above

79. If a magnetic disc has 100 cylinders, each containing 10 tracks of 10 sectors, and

each sector can contain 128 bytes, what is the maximum capacity of the disk in bytes?

      a. 128,000

      b. 12,800,000

      c. 12,800

      d. 1,280,000

80. A computer's memory is composed of 8K words of 32 bits each, and the smallest addressable memory unit is an 8 bit byte. How many bits will be required for the memory address?

      a. 12

      b. 15

      c. 13

      d. 10