Sample Question Paper for PhD 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 70 multiple choice questions in two parts, Part A and Part B.

PART A:
It will have **25 multiple choice questions of one mark each** and will test the knowledge of the candidate in Mathematics. All questions will be compulsory. The areas from which questions may be asked are.

Discrete Mathematics: Sets, Relations, Functions, Boolean Algebra, Propositional logic, First Order Predicate Logic, Lattice.

Combinatorics: Permutations, Combinations, Counting, Summation, Recurrence Relations, Binomial Theorem, Exponential Series, Pigeonhole Principle.

Probability and Statistics: Conditional Probability, Mean, Median, Mode, Standard Deviation, Variance, Covariance, Random Variable, Distributions (Uniform, Normal, Exponential, Poisson, Binomial).

Vector Analysis: Rectangular Cartesian Co-ordinates, Equations of a Line, Mid-point, Intersections etc., Equations of a Circle, Distance Formulae, Pair of Straight Lines, Addition and Subtraction of Vectors, Scalar and Vector, Product of Two Vectors, Scalar Triple Product, Vector Triple Product.

Matrices: Basic Concepts, Types of Matrices, Determinants, Transpose, Inverse and Rank of a Matrix, Matrix Algebra, Systems of Linear Equations, Eigen Values and Eigen Vectors.

Part B:
It will have **45 multiple choice questions of one mark each** and will test the knowledge of the candidate in Computer Science. The areas from which questions may be asked are.

Programming in C: Data Types & Qualifiers, Identifiers, Control Structures, Array and Pointers, Array of Pointers, Pointers to Array, Ragged Array, Strings, Structure, Union, Functions, Recursion, File Handling, Macros, Enumeration.

Data & File Structures: Arrays, Sparse Matrix, Linked Lists, Doubly Linked Lists, Circular Linked Lists, Stack, Queue, Priority Queue, Postfix and Prefix Representation and Evaluation, Tree, Binary Search Tree, Heap Tree, AVL Trees, B Tree, B+ Tree, Graph Representation, Properties and Traversals, Inverted List, Multi-List, Hashing and Tables.

Design & Analysis of Algorithms: Asymptotic Notations, Asymptotic Analysis (best, worst, average cases) of Time and Space, Sorting, Searching, Recursion, Graph (Spanning tree, connected component, shortest path), Divide-and-Conquer Approach, Greedy Approach, Dynamic Programming, Complexity Classes - P, NP, NP-hard and NP-Complete.

Operating Systems: Processes, Threads, Inter-Process Communication, Concurrency, Synchronization (Semaphores, Critical Regions, Mutual Exclusion), Deadlock Handling (Bankers Algorithm), CPU Scheduling, Memory Management and Virtual Memory (Paging and Segmentation), File Systems, I/O systems, Protection and Security, UNIX and Windows, Basic UNIX Commands, Shell Programming.

Computer Networks: Local Area Networks (LAN), Metropolitan Area Networks (MAN), Wide Area Networks (WAN), OSI Model, TCP/IP Model, Encoding and Modulation, Multiplexing, Switching, Transmission Media, Flow Control, Error Detection and Correction, Multiple Access Protocols, IP Addresses, Routing Algorithms, Multicasting, Congestion Control, QoS, TCP/UDP, Application Layer Protocols.

Database Management System: ER Model, Relational Model (Relational Algebra, Tuple and Domain Calculus), Database Design (Integrity Constraints, Normal Forms), SQL/PL-SQL, Transactions and Concurrency Control, Distributed Databases, File Organization and Indexing.

Computer Architecture and Organization: Subsystems of a Computer, Instruction Formats, Addressing Modes, Processor Datapath Design, Control Unit Design, Pipelining, Memory Organization, I/O Organization, Interrupts and DMA, Parallelism.

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.

PART A

(*Each Question Carries 1 Mark*)

1. Which of the following is not true?
    a. The set of negative integers is countable.
    b. The set of negative integers is not countable.
    c. The set of even integers is countable.
    d. The set of integers that are multiples of 7 is countable.

2. If G is a forest with n vertices and k connected components, how many edges does G have?
    a. floor(n/k)
    b. ceil(n/k)

c. n-k

d. n-k+1

3. In how many ways can 4 red and 5 white balls be drawn from a bag containing 10 red and 8 white balls?

a. ${}^{10}C_4 \times {}^{8}C_5$

b. ${}^{10}C_5 \times {}^{8}C_4$

c. ${}^{10}C_8 \times {}^{5}C_4$

d. ${}^{18}C_9$

4. A survey shows that 81% of Indians speaks Hindi,whereas 66% prefer other Indian languages. If x% of Indians speak both Hindi and other language, then which of the following is true?

a. $47 \leq x \leq 81$

b. $47 \leq x \leq 66$

c. $66 \leq x \leq 81$

d. $66 \leq x \leq 100$

5. The coefficient of x^{12} in $\left(x^3 + x^4 + x^5 + x^6 + \ldots\right)^3$ is:

a. 1

b. 2

c. 4

d. 10

6. Let A and$B$ be $n \times n$ real matrices, Then, which of the following statements is correct?

a. rank $(A + B)$ = rank (A)+rank (B)

b. rank $(A + B) \leq$ rank (A)+rank (B)

c. rank $(A + B)$ = min{rank (A),rank (B)}

d. rank $(A + B)$ = max{rank (A),rank(B)}

7. If A and B are $n \times n$ matrices such that $BA + B^2 = I - BA^2$, where I is the $n \times n$ identity matrix. then, which ofthe following is always true?

   a. A is nonsingular

   b. B is nonsingular

   c. $A + B$ is nonsingular

   d. AB is nonsingular

8. Suppose the matrix $\begin{bmatrix} 40 & -29 & -11 \\ -18 & 30 & -12 \\ 26 & 24 & -50 \end{bmatrix}$ has a certain complex number $\lambda \neq 0$ as an eigenvalue, then, which of the following numbers must also be an eigenvalue of A?

   a. $\lambda + 20$

   b. $\lambda - 20$

   c. $20 - \lambda$

   d. $-20 - \lambda$

9. The following system of equations

$$x + y + z = 1$$
$$2x + 3y - z = 5$$
$$x + 2y - kz = 4$$

where $k \in ¡$ has an infinite number of solutions for

   a. $k = 0$

   b. $k = 1$

   c. $k = 2$

   d. $k = 3$

10. The row space of a 20×50 matrix A has dimension 13. What is the dimension of the space of solutions of $Ax = 0$?

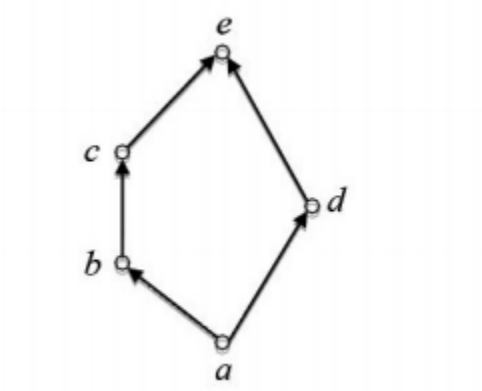
   a. 7

b. 13

c. 33

d. 37

11. Consider the set $X = \{a, b, c, d, e\}$ under the partial ordering $R = \{(a,a),(a,b),(a,c),(a,d),(a,e),(b,b),(b,c),(b,e),(c,c),(c,e),(d,d),(d,e),(e,e)\}$
The Hasse diagram of the partial order (X,R) is shown below:



What is the minimum number of ordered pairs that requires to be added to R to make (X, R) a lattice?

a. 3

b. 2

c. 0

d. 1

12. What is the logical translation of the following statement?
"None of my friends are perfect."

a. $\exists x(F(x) \wedge \neg P(x))$

b. $\exists x(\neg F(x) \wedge P(x))$

c. $\exists x(\neg F(x) \wedge \neg P(x))$

d. $\neg \exists x(F(x) \wedge P(x))$

13. Which one of the following options is CORRECT given three positive integers x, y and z, and a predicate

$P(x) = \neg(x = 1) \wedge \forall y(\exists z(x = y * z)) \Rightarrow (y = x) \vee (y = 1))$

a. P(x) being true means that x is a prime number

b. P(x) being true means that x is a number other than 1

c. P(x) is always true irrespective of the value of x

d. P(x) being true means that x has exactly two factors other than 1 and x

14. If w, x, y, z are Boolean variables, then which one of the following is incorrect?

a. $wx + w(x + y) + x(x + y) = x + wy$

b. $(w\bar{x}(y + x\bar{z}) + \bar{w}\bar{x})y = x\bar{y}$

c. $(w + y)(wxy + wyz) = wxy + wyz$

d. $w\bar{x}(y + \bar{z}) + \bar{w}x = \bar{w} + x + \bar{y}z$

15. Let S be a set of n elements. The number of ordered pairs in the largest and the smallest equivalence relations on S are:

a. n^2 and n

b. n and n

c. n^2 and 0

d. n and 0

16. For $k = 1,2,3$ the box B_k contains k black balls and $k + 1$ white balls. Let $P(B_1) = \frac{1}{2}$, $P(B_2) = \frac{1}{3}$ and $P(B_3) = \frac{1}{6}$. A box is selected at random and a ball is drawn from it. If a black ball is drawn, then the probability that it has come from B_2 is:

a. $\frac{35}{78}$

b. $\frac{14}{39}$

c. $\frac{10}{13}$

d. $\frac{12}{13}$

17. If the ratio of the mode and the median of a distribution is $6 : 5$, then the ratio of its mean and median is:

a. $8 : 9$

b. $9:10$

c. $9:7$

d. $8:11$

18. The mean age of a combined group of men and women is 25 years. If the mean age of the group of men is 26 and that of the group of women is 21, then the percentage of men and women in the group is:

    a. $60, 40$

    b. $80, 20$

    c. $20, 80$

    d. $40, 60$

19. A family has six children. What is the probability that there are fewer boys than girls?

    a. 0.32

    b. 0.37

    c. 0.34

    d.0.46

20. Two numbers from 1 to 3 are chosen at random with repetition allowed. Let X denote the sum of the numbers. Then the mean of X will be

    a. 6

    b. 2

    c. 7

    d. 4

21. Given that the vectors $\vec{a}$ and $\vec{b}$ are non-collinear, the values of x and y for which the vector equality $\overrightarrow{2u} - \vec{v} = \vec{w}$ holds true if$\vec{u} = x\vec{a} + 2y\vec{b}$, $\vec{v} = -2y\vec{a} + 3x\vec{b}, \vec{w} = 4\vec{a} - 2\vec{b}$ are:

    a. $x = {}^{4}/_{7}, y = {}^{3}/_{7}$

    b. $x = {}^{10}/_{7}, y = {}^{4}/_{7}$

    c. $x = {}^{8}/_{7}, y = {}^{2}/_{7}$

d. $x = 2, y = 3$

22. Let $\vec{a}, \vec{b}, \vec{c}$ be three unit vectors such that $|\vec{a} + \vec{b} + \vec{c}| = 1$ and $\vec{a}$ is perpendicular to $\vec{b}$. If $\vec{c}$ makes angles α, β with $\vec{a}, \vec{b}$ respectively, then $\cos\alpha + \cos\beta$ is equal to:

    a. -1

    b. 1

    c. $\frac{3}{2}$

    d. 0

23. For three vectors $\boldsymbol{a}$, **b**and **c,**if $\mathbf{a}.(\mathbf{b} \times \mathbf{c}) = 4$, then $(\mathbf{a} \times \mathbf{b}).\mathbf{c}$is equal to:

    a. 0
    b. 1
    c. 4
    d. -4

24. Two vectors **u** and **v** are parallel if:

    a. $\mathbf{u}.\mathbf{v} = 0$
    b. $\mathbf{u}.(\mathbf{v} \times \mathbf{v}) = 0$
    c. $\mathbf{u} \times \mathbf{v} = 0$
    d. $\mathbf{v}.(\mathbf{u} \times \mathbf{u}) = 0$

25. For what value of k, the points $(8, 1)$, $(k, -4)$ and $(2, -5)$ are collinear?

    a. 1
    b. 0
    c. 3
    d. 5

PART B

(*Each Question Carries 1 Mark*)

26. Which predefined function is used to write whole structure into a file?

    a. swrite()

b. sscanf()
c. fwrite()
d. None of the above

27. What is the output of the following program?

```
#include<stdio.h>
intmain()
{
    structxyz{
    char a,b,c;
        }s;
    printf("%d", sizeof(s));
    }return 0;
}
```

a. 1
b. 3
c. 2
d. None of these

28. What is the output of the following program?

```
#include<stdio.h>
void main()
    {
        char name[]="South Asian University";
        intlen;
        long int size;
        len = strlen(name);
        size = sizeof(len);
          printf("%d,%d",len,size);
    }
```

a. 5, 2

b. 22, 4
c. 22, 10
d. None of the above

29. What is the output of the following program?

```
#include<stdio.h>
void decrement();
void main()
        {
                decrement();
                decrement();
                decrement();
        }
 void decrement()
        {
                 static inti = 10;
                printf("%d",i);
                 i--;
        }
```

a. 10 9 8
b. 10 10 8
c. 10 10 10
d. 0 0 0

30. What is the output of the following program?

```
#include<stdio.h>
intmain()
{
printf("%d", printf("HELLO Welcome to SAU"));
    return 0;
}
```

a. HELLO

b. HELLO Welcome to SAU20

c. HELLO Welcome to SAU

d. None of the above

31. What is the output of the following program?

```
#include<stdio.h>
#include<string.h>
intmain()
{
        char arr[] = "SAU";
        printf("%d %d", arr[0]++, arr[1]++);
        return 0;
}
```

a. S A

b. S U

c. 83 65

d. 1 2

32. What is the output of the following program?

```
#include<stdio.h>
intmain()
{
int a = 10;
   switch(a)
{
        case 10: printf("Ten");
        case 20: printf("Twenty");break;
        case 30: printf("Thirty");break;
        default: printf("nothing");
}
```

```
return 0;
}
```

a. TenTwenty
b. Ten
c. Twenty
d. nothing

33. The postfix equivalent of which of the following prefix expression is * + a b - c d?

a. a b + c d - *
b. a b c d + - *
c. a b + c d * -
d. a b + - c d *

34. Which of the following traversals is sufficient to construct BST from given traversals?

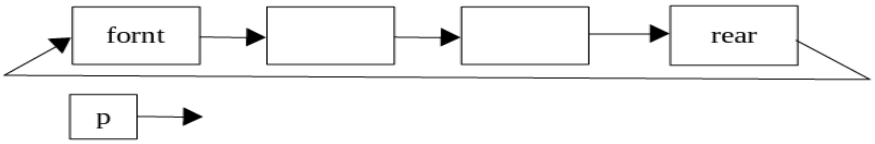
1) Inorder 2) Preorder 3) Postorder.

a. Any one of the given three traversals is sufficient
b. Either 2 or 3 is sufficient
c. 2 and 3
d. 1 and 3

35. A 3-ary max heap is like a binary max heap; but instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array as follows: The root is stored in the first location, a[0], nodes in the next level, from left to right, is stored from a[1] to a[3]. The nodes from the second level of the tree from left to right are stored from a[4] location onward. An item x can be inserted into a 3-ary heap containing n items by placing x in the location a[n] and pushing it up the tree to satisfy the heap property. For example, A = {9, 5, 6, 8, 3, 1} is an array representing 3-ary max heap. Now, if we insert 7, 2, 10 and 4 in array A, then which of the following is the correct sequence of items in the resultant heap?

a. 10, 7, 9, 8, 3, 1, 5, 2, 6, 4
b. 10, 9, 8, 7, 6, 5, 4, 3, 2, 1
c. 10, 9, 4, 5, 7, 6, 8, 2, 1, 3
d. 10, 8, 6, 9, 7, 2, 3, 4, 1, 5

36. A circularly linked list is used to represent a Queue, where a single pointer p is used to access the Queue. Then to which node should the pointer p point such that both the operations *enQueue* and *deQueue* can be performed in constant time?



a. front node
b. rear node
c. not possible with a single pointer
d. node next to front

37. 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

38. A single array A[1..MAXSIZE] is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables *top1* and *top2(topl< top 2)* point to the location of the topmost element in each of the stacks. If the space is to be used efficiently, then which of the following is the condition for "stack full" ?

a. (top1 = MAXSIZE/2) and (top2 = MAXSIZE/2+1)
b. top1 + top2 = MAXSIZE
c. (top1 = MAXSIZE/2) or (top2 = MAXSIZE)
d. top1 = top2 -1

39. Which of the following paradigms can be used to find the solution to the following problem in minimum time?

Given a set of non-negative integer, and a value K, determine if there is a subset of the given set with sum equal to K.

a. Divide and Conquer
b. Dynamic Programming
c. Greedy Algorithms
d. Distributed Algorithms

40. Which one of the following in place sorting algorithms needs the minimum number of swaps?

a. Quick sort
b. Insertion sort
c. Selection sort
d. Heap sort

41. Consider the functions given below:

$$f(n) = 2^n$$
$$g(n) = n!$$
$$h(n) = n^{logn}$$

Which of the following statements about the asymptotic behavior of f(n), g(n), and h(n) is true?

$$(i) f(n) = O\big(g(n)\big); g(n) = O\big(h(n)\big)$$
$$(ii) f(n) = \Omega\big(g(n)\big); g(n) = O\big(h(n)\big)$$
$$(iii) g(n) = O\big(f(n)\big); h(n) = O\big(f(n)\big)$$
$$(iv) h(n) = O\big(f(n)\big); g(n) = \Omega\big(f(n)\big)$$

42. Consider the recurrence equation given below:

$$T(n) = 1, \qquad \text{for } n = 1$$
$$T(n) = 2T(n-1) + n, \quad n \geq 2$$

To which of the following does it equate?

a. $2^{n+1} - n - 2$
b. $2^n - n$
c. $2^{n+1} - 2n - 2$
d. $2^n + n$

43. Four matrices $\mathrm{M1}, \mathrm{M2}, \mathrm{M3}$ and $\mathrm{M4}$ of dimensions $\mathrm{p} \times \mathrm{q}$, $\mathrm{q} \times \mathrm{r}$, $\mathrm{r} \times \mathrm{s}$ and $\mathrm{s} \times \mathrm{t}$ respectively can be multiplied in several ways with different numbers of total scalar multiplications. For example, when multiplied as $((\mathrm{M1} \times \mathrm{M2}) \times (\mathrm{M3} \times \mathrm{M4}))$, the total number of multiplications is $\mathrm{pqr} + \mathrm{rst} + \mathrm{prt}$. However, if we multiply $(((\mathrm{M1} \times \mathrm{M2}) \times \mathrm{M3}) \times \mathrm{M4})$, the total number of scalar multiplications is $\mathrm{pqr} + \mathrm{prs} + \mathrm{pst}$. Now, for $\mathrm{p} = 10, \mathrm{q} = 100, \mathrm{r} = 20, \mathrm{s} = 5$ and $\mathrm{t} = 80$, what is the number of scalar multiplications needed?

a. 248000
b. 44000
c. 19000
d. 25000

44. Two students, say S1 and S2, are asked to show that a certain problem X is NP-complete. The first student S1, shows a polynomial time reduction from the 3-SAT problem to X, and the second student S2 shows a polynomial time reduction from X to 3-SAT. Which of the following can be inferred from these reductions?

a. X is NP-hard but not NP-complete
b. X is in NP but is not NP-complete
c. X is NP-complete

d. X is neither NP-hard, nor in NP.

45. Assume that a text is made up of characters a, b, c, d, e, f, each occurring with the probability 1/2, 1/4, 1/8, 1/16, 1/32, 1/32 respectively, If the text is compressed using Huffman encoding, before processing it further. What will be the average length of Huffman codes?

    a. 3
    b. 2.1875
    c. 2.25
    d. 1.9375

46. A multi-programmed operating system has degree of 5. Assume that each process spends 25% of its time waiting for I/O. The CPU utilization in this case will be

    a. 95 %

    b. 99 %

    c. 99.8 %

    d. 19 %

47. Which one of the following CPU scheduling algorithms provides the best results?

    a. round-robin

    b. priority based preemptive

    c. multi-level feedback queue

    d. shortest job first

48. Consider a demand-paged system where degree of multi-programming is fixed at 4. The current CPU utilization is 13 % and disk utilization is 97 %. What is happening in the system?

    a. low degree of multi-programming

    b. thrashing is occurring

    c. networking is high

    d. all of the above

49. Asymmetric multiprocessing is supported by

    a. Solaris

    b. Windows

c. Mac-OS

d. Linux

50. In order to take advantage of multiple processors in a computer system, which of the following methods should be supported by the operating system?

    a. user level threads

    b. kernel level threads

    c. a combination of user and kernel level threads

    d. only processes and no threads

51. An operating system has been designed in a manner such that a process can demand for more resources while holding one or more resources. Which of the following will be the correct for such a system?

    a. deadlock will always occur

    b. deadlock may or may not occur

    c. deadlock will not occur

    d. deadlock will occur but the system will recover

52. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are:

    a. Last fragment, 2400 and 2789
    b. First fragment, 2400 and 2759
    c. Last fragment, 2400 and 2759
    d. Middle fragment, 300 and 689

53. Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router's routing table has the following entries.

Prefix	Output Interface Identifier
131.16.0.0/12	3
131.28.0.0/14	5
131.19.0.0/16	2
131.22.0.0/15	1

The identifier of the output interface on which the packet will be forwarded is:

a. 1
b. 2
c. 3
d. 5

54. Assume the signal speed in the cable of an Ethernet LAN to be 2,00,000 km/s. What is the maximum length of the cable (in km) in the Ethernet LAN for transmitting data at the rate of 500 Mbps with frames of size 10,000 bits?

a. 1
b. 2
c. 3
d. 5

55. In a token ring network the transmission speed is 10^7 bps and the propagation speed is 200 metres/micro second. The 1-bit delay in this network is equivalent to:

a. 500 metres of cable.
b. 200 metres of cable.
c. 20 metres of cable.
d. 50 metres of cable.

56. In Ethernet when Differential Manchester encoding is used, the bit rate is:

a. half the baud rate.
b. twice the baud rate.
c. same as the baud rate.
d. none of the above

57. Consider the set of activities related to e-mail-

A : Send an e-mail from a mail client to mail server

B : Download e-mail headers from mail box and retrieve mails from server to a cache
C : Check e-mail through a web browser

The application level protocol used for each activity in the same sequence is:

a. SMTP, HTTPS, IMAP
b. SMTP, POP, IMAP
c. SMTP, IMAP, HTTPS
d. SMTP, IMAP, POP

58. Compression in PCM refers to the relative compression of which of the following?

a. higher signal amplitudes
b. lower signal amplitudes
c. lower signal frequencies
d. higher signal frequencies

59. Consider the following relation schema "Employee" along with five instances:

Name	Age	Salary	Designation
E1	32	25000	Clerk
E2	30	20000	Clerk
E3	25	15000	Peon
E4	40	45000	Sr. Clerk
E5	45	42000	Sr. Clerk

What are the *degree* and *cardinality* of Employee?

a. Degree: 4, Cardinality: 5

b. Degree: 5, Cardinality: 4

c. Degree: 5, Cardinality: 20

d. Degree: 20, Cardinality: 4

60. Consider the following relation schema "Employee" along with five instances:

Name	Age	Salary	Designation
E1	32	25000	Clerk
E2	30	20000	Clerk
E3	25	15000	Peon
E4	40	45000	Sr. Clerk
E5	45	42000	Sr. Clerk

What is the output of the following SQL query?

SELECT MAX(Salary) FROM Employee WHERE Salary < (SELECT MAX(Salary) FROM Employee);

a. 45000
b. 15000
c. 42000
d. 25000

61. Consider a relation schema R(A, B, C, D, E) and the set of functional dependencies F={A→BC, C→DE} defined over R. Which of the following can be a candidate key of R?

a. A
b. B
c. BC
d. BDE

62. Which of the following statements is/are FALSE?

(i) Each transaction in a database system must follow the ACID property.
(ii) Secondary index is a non-dense structure.
(iii) B^+ tree provides multi-level indexing.

a. Both (i) and (ii)
b. Both (ii) and (iii)
c. Only (iii)
d. Only (ii)

63. Consider the entities Employee and Project. If an employee can work on multiple projects and multiple employees can be associated with a single project, then what will be the cardinality of the "worksOn" relationship relating Employee and Project entities?

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

64. Which of the following options best describes the truthfulness of the following statements?

(i) The set of Armstrong's axioms related to functional dependencies is complete but not sound.

(ii) Both Union an Intersection operations of Relational Algebra require the argument relations to be union compatible.

a. (i) – TRUE, (ii) – FALSE
b. (i) – TRUE, (ii) – TRUE
c. (i) – FALSE, (ii) – TRUE
d. (i) – FALSE, (ii) –FALSE

65. In the instruction given below, 'bne' stands for which of the following?

```
bne  $s0, $s3, L1
```

a. branch if not equal

b. branch when not equal

c. branch on not equal

d. branch for not equal

66. Which of the following is false?

a. j 25000

b. jr $ra

c. j 2500

d. All of the above

67. Which one of the following commands is used for exception handling?

a. mflo

b. mfhi

c. mfco

d. none of the above

68. Which of the following is not true for a pipelined datapath?

a. It does not increase the execution time

b. It increases the throughput

c. It requires proper mechanism to address pipeline-hazards

d. It exploits parallelism in a non-sequential instruction steam

69. Identify the correct answer from the following:

a. $Memory\ Stall\ Clock\ Cycles = \frac{Memory\ Accesses}{Program} \times Miss\ Rate \times Miss\ Penalty$

b. $Memory\ Stall\ Clock\ Cycles = \frac{Instructions}{Program} \times \frac{Misses}{Instruction} \times Miss\ Penalty$

c. $CPU\ Time = (CPU\ Execution\ Clock\ Cycles + Memory\ Stall\ Clock\ Cycles) \times Clock\ Cycle\ Time$

d. All of the above

70. Which of the following is not applicable for $I-$ format of instructions?

a. Immediate addressing

b. Pseudo-direct addressing

c. Base addressing

d. $PC-$relative addressing